FINAL

ENVIRONMENTAL IMPACT STATEMENT
For the Rebuild by Design Meadowlands Flood Protection Project

October 2018



Boroughs of Little Ferry, Moonachie, Carlstadt, and Teterboro and the Township of South Hackensack, Bergen County, New Jersey

REBUILD BY DESIGN
MEADOWLANDS

Prepared by AECOM for the State of New Jersey Department of Environmental Protection

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Executive Summary

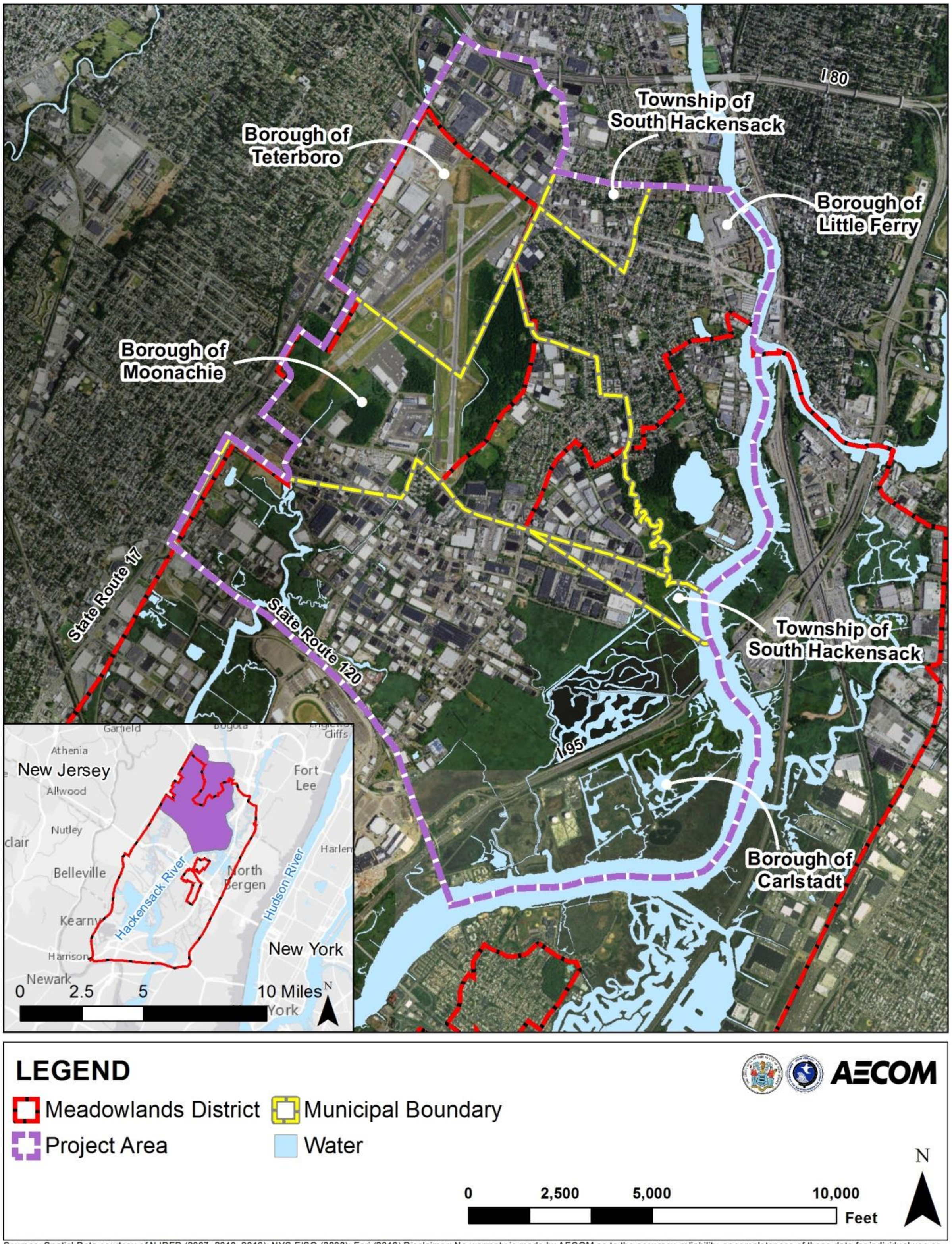
ES.1 Introduction

The State of New Jersey Department of Environmental Protection (NJDEP) has prepared this Environmental Impact Statement (EIS) for the Rebuild by Design (RBD) Meadowlands Flood Protection Project (the Proposed Project). On behalf of the State of New Jersey through its Department of Community Affairs (NJDCA), the recipient of United States (US) Department of Housing and Urban Development (HUD) grant funds, NJDEP is the "Responsible Entity," as defined by HUD regulations at 24 Code of Federal Regulations (CFR) § 58.2(a)(7)(i), for the Proposed Project. In accordance with criteria in 40 CFR § 1501.5(c), NJDCA has designated NJDEP as the Lead Agency to prepare this EIS for the Proposed Project in accordance with the National Environmental Policy Act (NEPA; 42 US Code [USC] §§ 4321 et seq.).

The Proposed Project is a comprehensive urban water management project designed to reduce the risk of coastal flooding from storm surges and/or systemic inland flooding from large rainfall events. HUD launched the RBD competition in the summer of 2013 (July 29, 2013, 78 Federal Register [FR] 45551) to develop ideas to improve physical, ecological, economic, and social resilience in regions affected by Hurricane Sandy. The competition sought to promote innovation by developing flexible solutions that would increase regional resilience. The Proposed Project was one of the competition's winning concepts; it was developed with the primary goal of reducing flood risk. HUD has allocated $150 million of Community Development Block Grant – Disaster Recovery (CDBG-DR) funding in response to Hurricane Sandy to the State of New Jersey for the planning, design, and implementation of this Proposed Project.

The Project Area, as defined in the award-winning RBD design, includes the Boroughs of Little Ferry, Moonachie, Carlstadt, and Teterboro, and the Township of South Hackensack, all in Bergen County, New Jersey. The Project Area has the following approximate boundaries: the Hackensack River to the east; Paterson Plank Road (State Route 120) and the southern boundary of the Borough of Carlstadt to the south; State Route 17 to the west; and Interstate 80 (I-80) and the northern boundary of the Borough of Little Ferry to the north. In total, the Project Area encompasses approximately 5,405 acres, and is mostly located within the Meadowlands District. **Figure ES-1** displays an aerial view of the Project Area.

The Project Area is vulnerable to both coastal flooding from storm surges and systemic inland flooding from large rainfall events. Coastal flooding results from high tides that are higher than normal high tides (such as storm surges), and can be worsened by onshore winds. Hurricane Sandy most recently exposed the vulnerability of the Project Area to coastal flooding after low-lying areas were inundated by coastal storm surges. However, within the Project Area, inland flooding is more common and happens more frequently than coastal flooding. Inland flooding occurs during high-intensity rainfall/runoff events. These events can include moderate precipitation accumulating over several days, heavy precipitation falling over a short period, or other circumstances in which ditches, creeks, or rivers overflow as a result of rainfall. Finally, the Project Area's existing vulnerabilities to flooding may become worse over time due to the effects of climate change and sea level change.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure ES-1: Rebuild by Design Meadowlands Flood Protection Project Area

In recognition of these vulnerabilities, the award-winning RBD concept used a multi-faceted approach to address flooding from major storm surges, high tides, and heavy rainfall events. The concept consisted of three integrated components: Protect, Connect, and Grow. Based on the amount of CDBG-DR funding awarded for this concept, the NJDEP determined that the Proposed Project would focus on the “Protect” component, defined as providing flood protection through a combination of infrastructure features that act as barriers during extreme high tide and/or storm surge events, and where flood control structures would be complemented with freshwater basins and expanded Meadowlands wetlands to increase flood storage capacity. Ancillary “Connect” and “Grow” components, while not precluded by the Proposed Project, are not considered reasonably foreseeable at this time and thus are not included in this environmental impact analysis. Should any projects associated with the “Connect” and “Grow” components of the winning concept be initiated in the future, they would be subject to an independent environmental review.

In accordance with the “Protect” function, the Proposed Project includes the construction of flood risk reduction measures designed to address the impacts of inland and/or coastal flooding on the quality of the human environment due to both storm hazards and sea level change within the Project Area. These measures include the construction of floodwalls, surge barriers, pump stations, channel dredging, new and improved open spaces, and green infrastructure systems. This EIS has been prepared to ensure a thorough analysis of the potential physical, cultural, environmental, and socioeconomic impacts of the Proposed Project. More specifically, this EIS describes the Proposed Project’s purpose and need; public involvement and agency consultation efforts; existing conditions of resources potentially affected by the Proposed Project; potential environmental impacts of the considered alternatives, including the No Action Alternative; and appropriate mitigation measures.

ES.2 Project Purpose, Need, and Objectives

The purpose of the Proposed Project is to reduce flood risk and increase the resiliency of the communities and ecosystems within the Project Area, thereby protecting critical infrastructure and facilities, residences, businesses, and ecological resources from frequent and intense flood events anticipated in the future. The ability to meet this purpose is measured in terms of the following goals and objectives of the Proposed Project:

- Contribute to Community Resiliency
- Reduce Risks to Public Health
- Contribute to On-going Community Efforts to Reduce Federal Emergency Management Agency (FEMA) Flood Insurance Rates
- Deliver Co-Benefits (e.g., active and passive recreational uses, multi-use facilities, etc.)
- Enhance and Improve Use of Public Space
- Consider Impacts from Sea Level Change
- Protect Ecological Resources
- Improve Water Quality

The interrelationship between coastal flooding and rainfall events contributes to the recurring flooding conditions throughout the Project Area. Each component represents challenges and needs to be addressed within the context of an overall flood reduction strategy for the Project Area.

As such, the Proposed Project is needed to address: (1) systemic inland flooding from high-intensity rainfall/runoff events; and/or (2) coastal flooding from storm surges. In addition to reducing flooding in the Project Area, the Proposed Project is needed to directly protect life, public health, and property in the Project Area. The Proposed Project seeks to reduce flood insurance claims from future events and maintain property values to the extent possible. The Proposed Project is further needed to increase community resiliency, including protecting accessibility to, and on-going operations of, critical health care services, emergency services, and transportation and utility infrastructure. In addition to reducing flood risk and improving community resiliency, the Proposed Project could provide ancillary benefits, such as protection of ecological resources (enhancement of water quality, regional biodiversity, and ecosystem resiliency) and improvement of civic, cultural, and recreational values in the Project Area.

Inland flooding is often the result of several types of rain events, including hurricanes moving up the coast, large frontal storms from the west and south (i.e., “nor’easters”), and local thunderstorms. The Meadowlands District, which includes the Project Area, is situated in a valley with high ridges on its sides that run parallel in a southwest to northeast direction. Comprised of mostly flat terrain, elevations within the Meadowlands District, including the Project Area, generally do not exceed 10 feet (North American Vertical Datum of 1988 [NAVD 88]), with most areas less than 6 to 7 feet (NAVD 88). Historically, the Meadowlands District contained a high concentration of wetlands, but these have largely been drained over the last two centuries. As a result, the Meadowlands District is now highly developed and is situated only several feet above sea level. The majority of the Project Area is encompassed by the FEMA 100-year floodplain, including 49 critical facilities and other infrastructure.

The lack of elevation difference in the Meadowlands District puts a strain on the ability of the communities to drain stormwater, as stormwater infrastructure is typically powered by gravity. Further, much of the Meadowlands District has become impervious due to the high degree of development, so much of the rainfall becomes runoff and is thrust immediately into the drainage infrastructure. Additionally, some of the existing drainage infrastructure is not adequately maintained, and can be overwhelmed by severe storms. As the frequency and intensity of stormwater-related flooding events are anticipated to increase in the future, the existing stormwater infrastructure may become increasingly insufficient to address the flooding challenges in the Project Area.

The impacts of inland flooding generally manifest in localized areas, such as individual roads or properties. Generally, flooding in these locations is characterized by several inches to over a foot of standing water encompassing an area of hundreds or thousands of square feet. Chronic localized flooding of roads and properties has severe impacts on local commerce, transportation, and residents by rendering roads impassable, disrupting normal activities, and causing significant commercial and residential property damage.

The other major source of flooding in the Project Area is coastal flooding from storm surges. Coastal flooding occurs less frequently than inland flooding, and often accompanies tropical storms. During these events, the tidally influenced Hackensack River surges over its banks and inundates the coastal floodplain.The communities in the Project Area contain a series of old berms that offer some protection against the Hackensack River. However, these berms are not entirely effective because they are neither continuous nor uniform in height. On average, they are overtopped approximately every 5 years. Due to the low elevation of the entire Project Area, this can lead to widespread damage.

The Project Area has been severely impacted by three major hurricanes since 1999: Hurricanes Floyd, Irene, and Sandy. The most recent of these, Hurricane Sandy, also most visibly revealed the vulnerability of the Project Area to coastal flooding. Though it was not a major rainfall event, the storm surge during Hurricane Sandy reached 9.5 feet (NAVD 88) in the Project Area, and virtually all of the Project Area was inundated. Following the storm, the floodwaters were slow to drain because they were being retained by the old berms surrounding the communities.

Hurricane Sandy had enormous health and safety, critical infrastructure, and financial impacts on the Project Area. Approximately 3,500 residents had to be evacuated. Following the storm, numerous fires and gas leaks were reported as the electricity returned to homes that were still flooded, and emergency and government services were hampered. In the Borough of Moonachie, the police station and municipal buildings sustained major damage, and were forced to relocate their operations. In the Borough of Little Ferry, schools were closed for two weeks, and only one school building was able to operate for the remainder of the year. Electric and natural gas service were unavailable for nearly a week following Hurricane Sandy. According to FEMA, there were nearly 1,700 homeowners who sustained damage from the storm, and the total assessed damage to homeowners in the five boroughs was over $21.4M. Most of this was concentrated in the Boroughs of Little Ferry and Moonachie. Further, when the aggregate effects of residential, commercial, and municipal damages were considered, the Borough of Moonachie was reported to be one of the two hardest hit towns in the State of New Jersey.

It is clear that the Project Area has a devastating history of inland and coastal storm surge flooding. With the anticipated effects of climate change and sea level change, flooding may become more common in the future. As such, the Proposed Project is needed to deliver a comprehensive flood reduction strategy that will protect life, public health, and property within the Project Area, as well as reduce flood insurance claims, maintain property values, and improve community resiliency.

ES.3 Agency Roles/Responsibilities and Decisions to be Made

HUD is the Federal agency funding the Proposed Project through a $150 million CDBG-DR grant, which was awarded to the State of New Jersey following the RBD competition. The NJDEP, on behalf of the NJDCA, is the Lead Agency and decision-maker concerning this Proposed Project in accordance with 42 USC 5304(g) and HUD regulations at 24 CFR Part 58. The NJDEP is also the Responsible Entity for completing the Environmental Review through a Memorandum of Understanding with the NJDCA. The NJDCA is the Certifying Officer for the Record of Decision (ROD) and HUD Release of Funds.

As the Lead Agency, the NJDEP is responsible for all decisions regarding the development and analysis of the Proposed Project. Through extensive alternatives development and screening processes and extensive public outreach, the NJDEP has determined which alternatives are analyzed in this EIS and which alternative is found to be preferred, and will determine which alternative is selected for implementation (as identified in the ROD) and which mitigation measures would be implemented. The NJDEP will codify their decision-making concerning the Proposed Project in the ROD, based on the analysis in this EIS.

The NJDEP is also working closely with a number of other Federal, State, and local agencies throughout the NEPA process. The following agencies have identified themselves as Cooperating Agencies and acknowledged the NJDEP as the Lead Agency for the Proposed Project:

- FEMA
- Federal Aviation Administration (FAA)
- Federal Transit Administration (FTA), Region 2
- National Railroad Passenger Corporation (Amtrak)

- Port Authority of New York and New Jersey
- US Army Corps of Engineers (USACE), New York District
- US Environmental Protection Agency (USEPA), Region 2

Based on consultation with the FAA, the proposed bioswale along the western side of Redneck Avenue, under Alternatives 2 and 3, is located on property dedicated to Teterboro Airport. Any land release or dedication of airport property to the Proposed Project would require approval by the FAA and would need to be reflected on the Airport Layout Plan. Further, this activity could trigger a Federal Action subject to NEPA for the FAA. Therefore, the FAA is serving as a Cooperating Agency to the Proposed Project, so that they may adopt this NEPA review. NJDEP will continue to coordinate with FAA throughout the design process to ensure compliance with NEPA, FAA Orders 1050.1F and 5050.4B, FAA Advisory Circular (AC) No. 150/5200-33B, and the Teterboro Airport Wildlife Hazard Management Plan. Wildlife hazards would be considered for the Proposed Project in its entirety and not only limited to Teterboro Airport property due to its proximity to the airport and the separation distances noted in FAA AC No.150/5200-33B.

Additionally, pursuant to Section 106 of the National Historic Preservation Act (NHPA) of 1966, NJDEP must consider the potential effects of this Proposed Project on any historic properties. As part of the Section 106 process, a Programmatic Agreement has been executed among the FEMA, HUD, New Jersey Historic Preservation Office (NJHPO), New Jersey Office of Emergency Management, and Advisory Council on Historic Preservation regarding administration of CDBG-DR funds. The NJDEP initiated the Section 106 consultation process with the NJHPO for the Proposed Project via a letter in July 2016. The NJDEP subsequently provided NJHPO with a draft Phase 1A Archaeological Survey Report and a draft Historic Structures Survey Report for review in January 2018. The NJHPO responded on March 19, 2018, by providing concurrence with the Area of Potential Effect (APE) for the Proposed Project and requesting additional information. These reports were revised and resubmitted in May 2018, and are included in **Appendix E**. The NJDEP received concurrence from the NJHPO on the Phase 1A Archaeological Survey Report and Historic Structures Survey Report on June 15 and 28, 2018, respectively. A copy of the concurrence letters is included in **Appendix A**.

As per the Section 106 Programmatic Agreement, and pursuant to 40 CFR § 1501.7(a)(1), the NHPA, and the Native American Graves Protection and Repatriation Act (NAGPRA), the NJDEP is consulting with federally recognized Native American Tribes potentially having ancestral ties to the Project Area. The NJDEP sent consultation letters to the following Native American tribes on October 5, 2016, December 12, 2017, and May 25, 2018:

- Absentee-Shawnee Tribe of Indians of Oklahoma
- Delaware Nation, Oklahoma
- Delaware Tribe of Indians
- Eastern Shawnee Tribe of Oklahoma
- Shawnee Tribe
- Stockbridge-Munsee Community Band of Mohicans

To date, the Stockbridge-Munsee Mohican Tribe, the Eastern Shawnee Tribe of Oklahoma, and the Shawnee Tribe have responded that they do not have concerns regarding the Proposed Project at this time.

The Delaware Nation has responded that it is primarily concerned with maintaining adequate buffers around known cultural sites, protecting/promoting indigenous plants, and being notified in the event of a discovery. Consultation with these tribes will remain ongoing throughout the NEPA and NHPA Section 106 processes.

ES.4 Overview of Proposed Project

The Project Area includes the Boroughs of Little Ferry, Moonachie, Carlstadt, and Teterboro, and the Township of South Hackensack, all in Bergen County, New Jersey (see **Figure ES-1**). Land use in the Project Area can be divided into four general regions. The northwest quadrant of the Project Area is dominated by the Teterboro Airport and some industrial areas, generally associated with airport operations; the northeast quadrant is comprised primarily of residential and commercial land use; the southeast quadrant consists of large wetland complexes; and the southwest quadrant consists mostly of industrial land use. The Proposed Project was designed to capitalize on, complement, and maximize the utility of each of these various existing land uses.

Because the Project Area is susceptible to chronic flooding due to the nature of the landscape, low elevation, and poor stormwater infrastructure, the Proposed Project focuses on implementing flood risk reduction measures that would reduce the flood risk within the Project Area attributable to both inland and coastal flooding. To address one or both of these flooding scenarios, the Proposed Project would implement a wide variety of infrastructure components as part of its flood risk reduction solution. Each component would be sited within the Project Area to address a current need and operate in an integrated manner with other proposed or existing flood reduction infrastructure. To achieve this goal, the NJDEP developed a variety of potential solutions and concepts that involved various infrastructure features aimed at maximizing the benefits to the Project Area while minimizing overall costs and adverse environmental effects. To this end, the NJDEP identified three Build Alternatives to be carried forward for analysis within this EIS:

- **Alternative 1:** Structural Flood Reduction
- **Alternative 2:** Stormwater Drainage Improvements
- **Alternative 3:** Hybrid of Alternative 1 and Alternative 2

Alternative 1 would implement a line of protection (LOP) around the Project Area that would guard against flooding from the Hackensack River and Berry's Creek during coastal storm surges. Public realm and ecological benefits would also be incorporated, as appropriate. Alternative 2 would reduce flooding in the Project Area that results from under-performing stormwater drainage infrastructure. This would be accomplished through new construction of both grey and green infrastructure in key locations throughout the Project Area to improve stormwater drainage. Alternative 3 would include both a LOP and stormwater drainage improvements to address both coastal flooding and inland flooding in the Project Area. Under the CDBG-DR funding requirements, the Proposed Project must be complete and operational by September 2022. Therefore, a 3-year construction phasing program is anticipated, with construction commencing in late 2019/early 2020 and reaching completion in the late summer of 2022.

The CDBG-DR funding further requires an Operations and Maintenance (O&M) Plan to be developed prior to completion of construction of the Proposed Project. The O&M Plan would describe the procedures and responsibilities for routine maintenance, communication, and timing of activation in the event of an impending storm, and would be developed by an O&M Subcommittee formed by the NJDEP with local and State partners. More information on the alternatives carried forward for further analysis in this EIS is found below.

ES.5 Alternatives Development Process

The NJDEP assembled numerous design concepts to identify the most effective and feasible solutions to coastal and inland flooding in the Project Area; these concepts were ultimately refined until the three final Build Alternatives were established. To inform the refinement of the various concepts, the NJDEP developed, with public input, a Concept Screening Criteria Matrix, which included a suite of criteria by which the various concepts could be measured and compared. Examples of screening criteria include, but are not limited to, performance criteria (i.e., flood risk reduction effectiveness), environmental constraints (i.e., cultural resources and environmental justice [EJ]), community interests (i.e., access to the Hackensack River), and feasibility factors (such as constructability and construction cost).

Using the Concept Screening Criteria Matrix, the NJDEP evaluated several preliminary concepts intended to address coastal storm surge and/or inland flooding. Preliminary concepts to address coastal storm surge flooding (i.e., structural flood reduction measures for Alternative 1) included a Hackensack River surge barrier and numerous potential alignments and heights for a LOP (i.e., floodwalls, levees, etc.) around the Project Area. It was determined that the available funding for the Proposed Project was not sufficient to construct a Hackensack River surge barrier or provide a FEMA-accredited level of protection against the 100-year flood (i.e., an LOP to a height of 12.6 feet [NAVD 88]). The NJDEP also considered LOPs that would provide a lower level of flood protection (i.e., higher than 7 feet but lower than 12.6 feet [NAVD 88]), but determined that these structures would have an unsafe threat of overtopping.

Preliminary concepts to address inland flooding (i.e., stormwater drainage improvements for Alternative 2) included a wide assortment of potential upgrades to existing stormwater drainage networks, including dredging channels, installing new pump stations, establishing and/or improving open spaces, etc. These concepts were refined or eliminated based on potentially significant impacts to the Project Area (i.e., impacts to large wetland complexes or contaminated sites) or their inability to meet the basic feasibility requirements (i.e., cost, schedule, or provision of enough benefits). Additionally, the NJDEP considered concepts such as conducting comprehensive maintenance of existing drainage infrastructure or conducting a reexamination of existing municipal stormwater policies. These two concepts were eliminated either because they were incompatible with the congressionally mandated schedule limitations (i.e., the Proposed Project must be complete by September 2022), or would not meet the purpose of and need for the Proposed Project.

Finally, the NJDEP evaluated several additional alternatives intended to reduce the impacts of flooding. These included dredging the Hackensack River, increasing the capacity of Oradell Dam, and relocating residents out of the highest risk portions of the Project Area. However, these solutions were eliminated because they would either cause significant adverse impacts, fail to provide sufficient benefits, and/or would not meet the purpose of and need for the Proposed Project.

ES.6 Alternatives Carried Forward for Evaluation

Through intensive screening and evaluation, detailed examination within the Feasibility Study Report, and public input, the NJDEP identified three Build Alternatives that meet the purpose of and need for the Proposed Project, including the majority of the Proposed Project's established goals and objectives. Additionally, while the No Action Alternative would not meet the purpose of and need for the Proposed Project, it is carried forward to provide a comparative baseline against which to analyze the effects of the Proposed Project, pursuant to NEPA and Council on Environmental Quality (CEQ) Regulations (40 CFR § 1502.14[d]). The NJDEP is recommending Alternative 3 as the Preferred Alternative for implementation.

No Action Alternative

With the selection of the No Action Alternative, the Proposed Project would not be implemented and current conditions and operations would generally continue in the Project Area. Flood protection measures in the Project Area under this alternative would generally be limited to the O&M of existing infrastructure. Under the No Action Alternative, projected future conditions without implementation of the Proposed Project include:

- Continued coastal flooding from tidal storm surges during severe coastal storm events;
- Continued inland flooding during heavy rainfall events due to local stormwater drainage issues; and
- Increased exposure to the effects of climate change and sea level change, including increased frequency of intense rainfall events and anticipated rise in regional sea level.

Worsening flooding conditions over time would produce commensurately increased adverse impacts to residents, property, and the quality of the human and natural environment of the Project Area. Failure to provide the Project Area with additional protection from coastal storm surges and/or inland flooding would likely lead to increased and more frequent damage to local infrastructure and property, direct harm to economic activity, and increased potential for human health effects, including loss of life.

Alternative 1: Structural Flood Reduction

Alternative 1 includes various infrastructure-based solutions intended to provide protection against coastal storm surges. This alternative would protect the Project Area from coastal flooding; however, chronic inland flooding from heavy or frequent precipitation events would continue to adversely affect the Project Area.

Under Alternative 1, a LOP would be constructed to connect high ground along the Hackensack River and Berry's Creek using a range of grey infrastructure, including floodwalls, levees/berms, a tide gate, closure gates, and a storm surge barrier and pump station (in Berry's Creek), designed to provide flood protection up to an elevation of 7 feet (NAVD 88). A LOP at this height would be sufficient to provide protection against approximately the present-day 50-year storm surge (i.e., there would be an approximately 2 percent chance each year that the LOP would be overtopped), and against approximately the 10-year storm surge (i.e., 10 percent annual chance of overtopping) in 50 years, based on sea level rise (SLR) projections. The LOP would likely operate (i.e., closure gates and surge barrier enabled) only during large flood events, such as when a Coastal Flood Warning is issued by the National Weather Service.

The LOP would extend from the Hackensack Riverwalk located at the Riverfront shopping center in the City of Hackensack south along the river and existing wetlands to high ground near the intersection of Commerce Boulevard and Washington Avenue in the Borough of Carlstadt. This high ground would extend to the Berry's Creek watershed, where a new surge barrier at the Paterson Plank Road Bridge and several other small LOP components would extend the LOP west to existing high ground near the Rutherford Commons shopping center in East Rutherford. Additionally, four new parks, a cantilever riverwalk, pathways, and various green infrastructure elements would be integrated into the proposed LOP. These features would provide various co-benefits to the Project Area, thereby meeting the Proposed Project's established goals and objectives, as discussed previously.

A 3-year construction phasing program is anticipated under Alternative 1, with construction peaking in 2021. In total, approximately 26.6 acres of permanent easements and 8.3 acres of temporary easements would be required, and approximately 69 parcels would be impacted. A total of approximately 20,000 man-days of labor would be anticipated.

Construction traffic in the Project Area would be concentrated along roads that provide access to the Hackensack River or Berry's Creek. Small portions of Paterson Plank Road and Murray Hill Parkway would also be raised as part of the LOP. Alternative 1 would likely require temporary lane realignments during construction, but Traffic Management Plans (TMP) would be developed and implemented to minimize potential impacts to traffic and circulation. Additionally, it is possible that some existing utility lines would require relocation if they conflict with the foundation of the LOP. These relocations would be coordinated with the utility providers to minimize these impacts.

Alternative 2: Stormwater Drainage Improvements

Alternative 2 would implement various grey and green infrastructure-based solutions, in conjunction with new parks and improved open spaces, to improve stormwater management in important locations throughout the Project Area. Specifically, stormwater management would be improved through the installation of 41 green infrastructure features along roads (i.e., bioswales, storage/tree trenches, and rain gardens), five new parks, improvements to five existing open spaces, three new pump stations, two new force mains, and dredging of the lower reach of East Riser Ditch. This alternative would reduce chronic inland flooding from heavy or frequent precipitation events; however coastal flooding would continue to adversely affect the Project Area.

Flood reduction under Alternative 2 would primarily be achieved through grey infrastructure improvements to improve channel conveyance. East Riser Ditch would be dredged between the existing tide gate and Moonachie Avenue, and a pump station would be installed at the tide gate. Losen Slote would be improved through the installation of two new pump stations, which would each use a force main to bypass the channel in developed areas. These improvements would reduce both the depths and extent of flooding in these channels for storms ranging in frequency from 2 years to 100 years.

In addition to the grey infrastructure improvements to flooding, the green infrastructure systems, new parks, and improved open spaces would provide minor localized flood reduction proximate to their locations. The green infrastructure systems would be designed to accommodate the NJDEP Water Quality Design Storm, and the parks and open spaces would be designed to store and treat stormwater through the use of additional green infrastructure, new or enhanced wetlands, native vegetation, and permeable pavement. Alternative 2 would also reduce impervious surfaces in the Project Area by approximately 3.4 acres partially as a result of the creation of new parks and open spaces, as well as enhancement of existing open spaces, for stormwater management. By implementing these features, Alternative 2 would increase the rate and capacity of stormwater infiltration and treatment in the Project Area, thereby potentially decreasing stormwater runoff and flooding in the vicinity of its footprint during low intensity rainfall events, while also improving water quality and providing new recreational opportunities for the local communities.

Construction of Alternative 2 would occur in three phases over the approximately 3-year construction period, with construction peaking in 2020. In total, approximately 41.1 acres of permanent easements and 4.1 acres of temporary easements would be required, and approximately 64 parcels would be impacted. Overall, Alternative 2 would likely require approximately 8,000 man-days of effort.

Whereas Alternative 1 would be concentrated along the Hackensack River and Berry's Creek, Alternative 2 is spread throughout the Project Area. Consequently, construction traffic would occur on more roads than under Alternative 1. Temporary lane realignments or closures would be required for construction of the force mains, East Riser Ditch improvements, some of the green infrastructure systems, and specific activities at the parks and open spaces. Similar to Alternative 1, a TMP would be implemented to minimize these impacts. Generally, Alternative 2 would be designed to avoid utility relocations, but this may be unavoidable for certain components, such as improvements to East Riser Ditch or installation of the force mains. Potential utility relocations and resultant temporary disruptions of service would be coordinated with the utility providers.

Alternative 3: Hybrid Alternative

Alternative 3 would consist of a hybrid of coastal flood protection and stormwater drainage improvements. To achieve this, the majority of both Alternatives 1 and 2 would be implemented. However, due to funding and construction constraints associated with a project of this magnitude, the Alternative 3 features would be separated into two stages: a *Build Plan*, which includes all features to be constructed as part of the Proposed Project, and a *Future Plan*, which includes the remaining features that could be constructed by others over time as funding sources become available and construction feasibility permits.

The Alternative 3 *Build Plan* would consist of all of the Alternative 2 components identified above, with the exception of two parks and one pump station/force main along Losen Slote, which would not be constructed. Additionally, one of the proposed open space improvements would be reconfigured from the Alternative 2 design (i.e., rearrangement of trails and landscape features). The Alternative 3 *Future Plan* would further include the entire LOP from Alternative 1, including three of the parks, the cantilever riverwalk, and other features; the second pump station/force main along Losen Slote from Alternative 2; and improvements (i.e., dredging and culvert replacements) to the remainder of East Riser Ditch from Moonachie Avenue north to Wesley Street.

The NJDEP is recommending Alternative 3 as the Preferred Alternative for implementation of the Proposed Project, as it would provide the most comprehensive flood reduction to the Project Area, including both storm surge protection and stormwater drainage improvements. In the short-term, the Alternative 3 *Build Plan* would reduce flooding in the East Riser Ditch and Losen Slote watersheds, and remain within both the budget and schedule associated with the RBD funding. Beyond 2022, as future funding becomes available, implementation of the *Future Plan* would incorporate additional inland flood reduction in the Losen Slote and East Riser Ditch watersheds, and coastal flood protection during storm surges.

A hybrid solution of both coastal and inland flooding reduction would constitute the most holistic flood reduction strategy for the Project Area; provide numerous co-benefits, including new recreational opportunities, water quality improvements, new and enhanced habitats, and aesthetic benefits; and adhere to the feasibility constraints of the Proposed Project. Although Alternative 3 is the Preferred Alternative, only the *Build Plan* is further described in this section and analyzed in detail in the EIS, while the *Future Plan* is described and analyzed as a reasonably foreseeable action in the cumulative impacts analysis.

Due to the similarity between Alternative 3 and Alternative 2, they would be constructed using the same phasing and timeframe (i.e., three phases over three years, peaking in 2020). However, construction of two of the parks and one of the pump stations/force mains would not be conducted, so only approximately 6,400 man-days of effort would be required. In total, approximately 27.8 acres of permanent easements and 4.1 acres of temporary easements would be required, and approximately 56 parcels would be impacts. Further, the traffic and utility components of construction anticipated under Alternative 3 would be similar to those anticipated under Alternative 2, but would be less due to the construction of fewer features (e.g., one of the force mains would not be constructed in a public right-of-way).

ES.7 Major Conclusions of the Environmental Analysis

Proposed Project Impacts

All three of the Build Alternatives considered would meet the purpose of and need for the Proposed Project. Per CEQ Regulations (40 CFR § 1502.16), this EIS analyzes in detail the potential environmental consequences of each Build Alternative and the No Action Alternative for the Proposed Project. These impacts, summarized below in **Table ES-1**, form the basis of the comparative analysis of the alternatives for the decision-maker and the public.

Each Build Alternative would have ***beneficial*** impacts on all technical resource areas except for *Noise and Vibration* and *Air Quality and Greenhouse Gas Emissions*. Additionally, with the exception of *Sustainability/Green Infrastructure* and *Agricultural Resources and Prime Farmlands*, all technical resource areas analyzed in this EIS would experience ***less-than-significant, adverse*** impacts from construction and/or operation of each Build Alternative.

The Proposed Project would have ***potentially significant, adverse*** impacts on multiple technical resource areas. Technical resource areas that could experience ***potentially significant, adverse*** impacts are listed by Build Alternative below:

Alternative 1

- Land Use and Land Use Planning
- Cultural and Historical Resources
- Noise and Vibration
- Biological Resources
- Water Resources, Water Quality, and Waters of the US (WOUS)
- Hydrology and Flooding
- Hazards and Hazardous Materials

Alternative 2 and Alternative 3 (*Build Plan*)

- Cultural and Historical Resources
- Noise and Vibration
- Water Resources, Water Quality, and WOUS
- Hazards and Hazardous Materials

Finally, the No Action Alternative would result in ***potentially significant, adverse*** impacts to all technical resource areas except for *Noise and Vibration* and *Air Quality and Greenhouse Gas Emissions* due to the anticipated continuation of coastal flooding during severe coastal storm events, inland flooding during heavy rainfall events, and increased exposure to the effects of climate change and sea level change.[1] The No Action Alternative would have ***less-than-significant, adverse*** impacts on *Noise and Vibration* and *Air Quality and Greenhouse Gas Emissions*.

[1] Potentially significant adverse impacts noted in the *Global Climate Change and Sea Level Change* technical resource area generally entail either the adverse impacts of climate change on the ability of the Proposed Project to reduce flooding, or the impacts of continued flooding on the Project Area that are not addressed by each alternative.

Table ES-1: Impact Summary and Comparison

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Land Use and Land Use Planning	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to existing land use (conflicts or restrictions on land use patterns or options) and zoning (zoning changes that could substantially decrease development intensity).	*Direct:* Long-term, ***potentially significant adverse*** impacts due to the displacement of 1 business; Short-term, less-than-significant adverse impacts to existing land uses during construction from temporary easements on 8.3 acres (63 parcels); Long-term, less-than-significant adverse impacts to existing land uses from permanent land easements (26.6 acres over 63 parcels, including 6 full parcel acquisitions) and potential zoning changes (12.2 acres); Long-term, beneficial impacts due to the improved utility of land use types. *Indirect:* Long-term, beneficial impacts to existing land uses from increased coastal flood protection.	*Direct:* Short-term, less-than-significant adverse impacts to existing land uses during construction from temporary easements on 5.6 acres (36 parcels); Long-term, less-than-significant adverse impacts to existing land uses from permanent land easements (45.2 acres over 61 parcels, including 3 full parcel acquisitions) and potential zoning changes (20.4 acres); Long-term, beneficial impacts due to the improved utility of land use types. *Indirect:* Long-term, beneficial impacts to existing land uses from increased inland flood protection. Additionally, short-term, less-than-significant adverse impacts to adjacent land uses (275 parcels) during construction in public rights-of-way; Long-term, less-than-significant adverse impacts on land use compatibility with Teterboro Airport and on aviation safety from increased wildlife hazards.	*Direct:* Same as Alternative 2, except there would be fewer temporary easement impacts (5.6 acres on 34 parcels), fewer permanent easement impacts (31.8 acres over 55 parcels, including 2 full parcel acquisitions), and fewer zoning changes (8.0 acres). *Indirect:* Beneficial impacts would be the same as Alternative 2, but adverse impacts would be slightly less than Alternative 2 due to fewer impacted adjacent land uses (242 parcels) and a decrease in proposed habitat improvements (i.e., fewer wildlife hazards).
Visual Quality / Aesthetics	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from degradation of, or loss of access to, a high-value visual resource due to future flooding.	*Direct:* Short-term, less-than-significant adverse impacts to the natural harmony, cultural order, and visual quality within Landscape Unit 4a (Commercial/Industrial Area) and Landscape Unit 5 (Hackensack River Waterfront Area) during construction; Long-term, less-than-significant adverse impacts to the natural harmony, cultural order, and visual quality of Landscape Unit 4a from proposed LOP elements; Long-term, beneficial impacts to the natural harmony, cultural order, and visual quality within Landscape Unit 5 from proposed waterfront improvements. *Indirect:* Long-term, beneficial impacts to the visual sensitivity of the viewing population to visual resources within Landscape Unit 4a and Landscape Unit 5, and to visual resources within all landscape units due to increased flood protection against coastal storm surges.	*Direct:* Short-term, less-than-significant adverse impacts to the natural harmony, cultural order, and visual quality within Landscape Unit 2 (Residential Area), Landscape Unit 4a, and Landscape Unit 5 during construction; Long-term, beneficial impacts to the natural harmony, cultural order, and visual quality within Landscape Unit 2, Landscape Unit 4a, and Landscape Unit 5 from proposed waterfront improvements. *Indirect:* Long-term, beneficial impacts to the visual sensitivity of the viewing population to visual resources within Landscape Unit 2, Landscape Unit 4a, and Landscape Unit 5, and to visual resources within all landscape units due to increased flood protection against inland flooding.	*Direct:* Impacts would be the same as Alternative 2 in Landscape Unit 4a, but adverse and beneficial impacts in Landscape Unit 2 and Landscape Unit 5 would be slightly less because Fluvial Park, DePeyster Creek Park, and Losen Slote pump station C and its force main would not be constructed. *Indirect:* Alternative 3 would not include Fluvial Park and DePeyster Park within Landscape Unit 5 and Losen Slote pump station C and its force main in Landscape Unit 2; therefore, the beneficial impacts to visual sensitivity and increased flood protection would be slightly less than Alternative 2.
Socioeconomics, Community / Populations, and Housing	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to public safety; business finances, employment, access, and services; demographic composition; and/or journey-to-work times.	*Direct:* Short-term and long-term, less-than-significant adverse impacts to businesses and residents in the Project Area from land acquisition, traffic/limited access, dust, noise, and vibration during construction; Long-term, less-than-significant adverse impacts to vacant buildings that would be demolished during construction; Short-term and-long term, beneficial impacts from created jobs during construction (990 job-years) and operation (20 annual jobs); Long-term, beneficial impacts on social amenities due to increased access to greenspace and the Hackensack River waterfront. *Indirect:* Long-term, beneficial effects to sense of safety, community infrastructure, property values, employment, and resident/visitor perceptions from increased coastal storm surge protection.	*Direct:* Short-term and long-term, less-than-significant adverse impacts to businesses, schools, municipal facilities, and residents in the Project Area from land acquisition, traffic/limited access, dust, noise, and vibration during construction; Short-term and long-term, beneficial impacts from created jobs during construction (1,000 job-years) and operation (22 annual jobs); Long-term beneficial effects on social amenities due to increased access to greenspace and the Hackensack River waterfront. *Indirect:* Long-term beneficial effects to community infrastructure, property values, and resident/visitor perception from increased protection against inland flooding.	*Direct:* Same as Alternative 2, except there would be approximately 640 job-years created during construction and 16 annual jobs during operation. *Indirect:* Slightly less beneficial effects than Alternative 2 since there would be fewer stormwater drainage improvements constructed, thereby providing less protection against inland flooding.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Environmental Justice	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to housing, public/community safety, long-term employment, short-term and/or long-term access to community facilities, and/or demographic composition.	*Direct:* Short-term, less-than-significant adverse impacts to EJ populations from dust, noise, vibration, traffic/access restrictions during construction (there are 13 residential units within 100 feet of the proposed LOP; all 13 units occur in areas where the percentage of EJ populations exceeds County thresholds); Short-term, beneficial impacts from created jobs during construction and operation. *Indirect:* Long-term, beneficial effects to EJ community infrastructure, sense of safety, housing and property values, and long-term employment from increased coastal flood protection.	*Direct:* Same as Alternative 1, except there are 385 residential units within 100 feet of the proposed footprint, and some of these units occur in areas where the percentage of EJ populations exceeds County thresholds: 219 units are in areas where the percentage of persons in poverty is higher; 287 units are in areas where the percentage of minority persons is higher, and 383 units are in areas where the percentage of low-and moderate-income (LMI) persons is higher. *Indirect:* Long-term, beneficial effects from reduced damages to EJ community infrastructure from reduced inland flooding.	*Direct:* Same as Alternatives 1 and 2, except there are 339 residential units within 100 feet of the proposed features in areas where the percentage of EJ populations exceeds County thresholds: 204 units are in areas where the percentage of persons in poverty is higher; 264 units are in areas where the percentage of minority persons is higher, and 337 units are in areas where the percentage of LMI persons is higher. *Indirect:* Slightly less beneficial effects than Alternative 2 since there would be fewer stormwater drainage improvements constructed, thereby providing less protection against inland flooding.
Cultural and Historical Resources	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to the character-defining features, viewshed, acoustic environment, or other environmental component of historic resources.	*Direct:* Long-term, ***potentially significant adverse*** impacts to known or unanticipated archaeological sites (5 high archaeological sensitivity areas), and to the US Route 46 Bascule Bridge; Short-term, less-than-significant adverse effects to the US Route 46 Bascule Bridge from dust, noise, and vibration during construction. *Indirect:* Long-term, ***potentially significant adverse*** impacts to the viewshed of the US Route 46 Bascule Bridge; Short-term, less-than-significant adverse effects to the physical and acoustic environment of the US Route 46 Bascule Bridge and 4 potentially National Register of Historic Places (NRHP)-eligible historic architectural resources within the indirect APE during construction; Long-term, less-than-significant adverse effects to the viewshed of 4 potentially NRHP-eligible historic architectural resources in the Project Area; Long-term beneficial effects to the protection of archaeological and historic architectural resources from increased coastal flood protection.	*Direct:* Same as Alternative 1, including the long-term, ***potentially significant adverse*** impacts, except there are only 3 high archaeological sensitivity areas associated with Alternative 2. *Indirect:* Same as Alternative 1, including the long-term, ***potentially significant adverse*** impacts, except there is only 1 potentially NRHP-eligible historic architectural resource (besides the US Route 46 Bascule Bridge) that would experience short-term, less-than-significant adverse effects to the physical and acoustic environment during construction and long-term, less-than-significant adverse effects to the viewshed. Additionally, beneficial effects would be associated with reduced inland flooding instead of reduced coastal flooding.	*Direct:* Slightly less long-term, ***potentially significant adverse*** impacts than Alternative 2 since there are only 2 high archaeological sensitivity areas associated with Alternative 3, and the US Route 46 Bascule Bridge would not be impacted. *Indirect:* Slightly less adverse impacts than Alternative 2 since there would be no indirect impacts to the US Route 46 Bascule Bridge (and therefore no potentially significant indirect impacts), and slightly less beneficial effects since there would be fewer stormwater drainage improvements constructed.
Transportation and Circulation	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to traffic, safety, available parking, pedestrian and bicycle facilities, transit demand, and/or freight operations.	*Direct:* Short-term, less-than-significant adverse impacts to traffic and circulation (87 additional vehicles projected in the AM peak hour in the peak month), on-street parking supply, and transit and freight services during construction; Long-term, less-than-significant adverse impacts to traffic (6 additional vehicle trips are projected in the weekday AM and PM peak hours) and the NJ Transit railroad track (suspended service during major flood events) during operation; Long-term, beneficial effects to pedestrian transportation and circulation from proposed paths, walkways, and boat dock/kayak launch. *Indirect:* Long-term, beneficial effects to the sustainability of existing transportation and circulation from increased coastal flood protection.	*Direct:* Generally the same as Alternative 1, except only 59 additional vehicles are projected in the AM peak hour in the peak month during construction, and only 5 additional vehicle trips are projected in the weekday AM and PM peak hours during operations. Additionally, there would be short-term, less-than-significant adverse impacts to the Seaman Lead due to the removal and replacement of a railroad bridge, and to pedestrian circulation due to sidewalk closures, during construction; however, there would be no impacts to the NJ Transit railroad track under this alternative. *Indirect:* Same as Alternative 1, except beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Slightly less than Alternative 2, as only 54 additional vehicles are projected in the AM peak hour in the peak month during construction, and only 3 additional vehicle trips are projected in the weekday AM and PM peak hours during operation; impacts to road/lane closures and parking during construction would be slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed, but impacts to transit and freight services and pedestrian circulation would be the same as Alternative 2. *Indirect:* Slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed, thereby providing less protection against inland flooding.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Noise and Vibration	*Direct:* No direct impacts. *Indirect:* Less-than-significant adverse impacts due to increased vibration and noise levels from traffic congestion and the diversion of vehicles in flooded areas.	*Direct:* Short-term, ***potentially significant adverse*** impacts to properties and buildings from noise and vibration due to construction activities; Short-term, less-than-significant adverse impacts to marine life from noise during construction, Long-term, less-than-significant adverse impacts to properties due to increased noise during operation from generators at one pump station. *Indirect:* No indirect impacts.	*Direct:* Impacts would be similar to, but slightly greater than, those under Alternative 1, including the short-term, ***potentially significant adverse*** impacts, since more properties and buildings have the potential to be impacted by noise and vibration during construction, and there would be generators at three pump stations during operations. *Indirect:* No indirect impacts (same as Alternative 1).	*Direct:* Impacts from noise and vibration during construction, including the short-term, ***potentially significant adverse*** impacts, would be slightly less than under Alternative 2, but greater than under Alternative 1, and there would be generators at two pump stations during operations. *Indirect:* No indirect impacts (same as Alternatives 1 and 2).
Air Quality and Greenhouse Gas Emissions	*Direct:* No direct impacts. *Indirect:* Less-than-significant adverse impacts on regional air quality due to traffic congestion and diversion of vehicles in flooded areas, fugitive dust from flooding carrying fine sediments into the Project Area, and to human health of sensitive populations due to negligible emissions of criteria pollutants and Hazardous Air Pollutants (HAPs) within an attainment area.	*Direct:* Short-term and long-term, less-than-significant adverse impacts to air quality and human health of sensitive populations in the Project Area due to criteria pollutant and HAP emissions; criteria pollutant emissions would not cause a National Ambient Air Quality Standards (NAAQS) exceedance, change the category of non-attainment status, or conflict with applicable air quality plans; HAP emissions would not would not exceed major source thresholds or health benchmarks, or conflict with applicable air quality plans. *Indirect:* Short-term, less-than-significant adverse impacts outside the Project Area due to criteria pollutant and HAP emissions; criteria pollutant emissions would not cause a NAAQS exceedance, change the category of non-attainment status, or conflict with applicable air quality plans; HAP emissions would not would not exceed major source thresholds or health benchmarks, or conflict with applicable air quality plans.	*Direct:* Impacts would be similar to Alternative 1, except criteria pollutant and greenhouse gas (GHG) emissions would be slightly less, and HAP emissions would be slightly greater. *Indirect:* Impacts would be similar to Alternative 1, except criteria pollutant and GHG emissions would be slightly less, and HAP emissions would be slightly greater.	*Direct:* Impacts would be similar to Alternatives 1 and 2, except criteria pollutant, HAP, and GHG emissions would be slightly less than both Alternatives 1 and 2. *Indirect:* Impacts would be similar to Alternatives 1 and 2, except criteria pollutant, HAP, and GHG emissions would be slightly less than both Alternatives 1 and 2.
Global Climate Change and Sea Level Change	***Potentially significant adverse*** impacts on the study area from future coastal and inland flooding, and because the effects of climate change and SLR would not be addressed.	***Potentially significant adverse*** impacts from climate change and SLR to the overall performance of Alternative 1 over time, and from future increased precipitation and inland flooding; Beneficial impacts through increased coastal flood protection.	***Potentially significant adverse*** impacts from future coastal flooding in the Project Area over time, and from climate change and SLR on the overall performance of Alternative 2 over time; Beneficial impacts to the Project Area through increased flood protection against inland flooding.	Same as Alternative 2, including the ***potentially significant adverse*** impacts, except benefits would be slightly less since Losen Slote pump station C and its force main would not be constructed, thereby providing less protection against inland flooding.
Recreation	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from damage, reduced visitation, and/or reduced accessibility to recreational resources due to future flooding.	*Direct*: Short-term, less-than-significant adverse impacts to the accessibility of recreational resources (i.e., public access to Riverside Boat Works and boat access at the Riverside Boat Works Marina and Little Ferry Marina) during construction; Long-term, beneficial effects due to the creation of new recreational resources (10.1 acres of new public recreational land) and improved accessibility (approximately 9,270 linear feet [LF] of new public paths and walkways, 0.2 acre of parking areas, and a new boat dock/kayak launch). *Indirect:* Long-term, beneficial effects to supply, capacity, and access to recreational resources from increased coastal flood protection.	*Direct:* Short-term, less-than-significant adverse impacts to the accessibility of recreational resources during construction due to lane closures and the establishment of staging areas in the parking lots and driveways of Little Ferry Public Schools, Robert Craig Elementary School, Joseph Street Park, and Willow Lake Park; Beneficial effects would be greater than under Alternative 1 since more land (20.0 acres) would be converted to accessible, public recreational land and there would be more accessibility improvements (9,900 LF of new trails and walkways, the conversion of existing private boat docks and a boat launch into public use, and a new kayak launch). *Indirect:* Same as Alternative 1, except beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Adverse impacts to accessibility would be the same as Alternative 2; Beneficial effects would be less than both Alternatives 1 and 2 since less land would be converted to accessible, public recreational land (7.6 acres) and there would be less accessibility improvements (6,400 LF of new trails and walkways and the conversion of existing private boat docks and a boat launch into public use). *Indirect:* Slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed, thereby providing less protection against inland flooding.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Utilities and Service Systems	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts on utility services by damaging infrastructure, increasing utility prices, and/or increasing service disruptions due to future flooding.	*Direct:* Short-term, less-than-significant adverse impacts to the supply, demand, capacity, and availability of utility services during construction; Long-term, less-than-significant adverse impacts to existing demand for electricity (from public lighting features and the Berry's Creek storm surge barrier), solid waste (from public parks and pathways), and telecommunication services (from a landline telephone at the Berry's Creek storm surge barrier). *Indirect:* Long-term, beneficial effects from increased coastal flood protection, which would reduce damages to utilities infrastructure and service disruptions, and decrease utility prices.	*Direct:* Same as Alternative 1, except electricity demands would be from public lighting features and the three proposed pump stations, and there would be no long-term demand for telecommunication services. Additionally, there would be long-term, beneficial impacts on stormwater drainage due to the proposed East Riser Ditch improvements and three new pump stations. *Indirect:* Same as Alternative 1, except beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Slightly less than Alternative 2 since fewer Proposed Project components would be constructed, thereby reducing potential construction impacts, operational utility demands, and beneficial impacts to stormwater drainage. *Indirect:* Slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed, thereby providing less protection against inland flooding.
Public Services	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts on public services by increasing service disruptions, response times, and/or demand, and from reducing access, supply, capacity, and/or reliability due to future flooding.	*Direct*: Short-term, less-than-significant adverse impacts to response times of public services due to road and/or lane closures during construction. *Indirect:* Short-term, less-than-significant adverse impacts to demand for public services during construction due to an influx of construction workers; Long-term, beneficial impacts to public service demand (fewer flood-related emergencies) and service reliability (fewer service interruptions and road closures) due to increased flood protection against coastal storm surges.	*Direct:* Impacts to response times would be slightly less than Alternative 1 because no road closures or realignments are proposed and lane closures under Alternative 2 are anticipated to be shorter in duration; however, Alternative 2 would have additional short-term, less-than-significant adverse impacts to access to public service facilities due to temporary lane closures and staging areas, and to disruption of public service facilities from increased noise during construction. *Indirect:* Generally the same as Alternative 1, but beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Slightly less than Alternative 2 since fewer Proposed Project components would be constructed, and therefore fewer impacts on response times, facility access, and disruptions from noise would be expected. *Indirect:* Adverse impacts would be slightly less than Alternative 2 due to fewer anticipated construction workers; beneficial effects would be slightly less since fewer stormwater drainage improvements would be constructed, thereby providing less protection against inland flooding.
Biological Resources	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from shoreline erosion, habitat alterations, reduction of ecological function, and/or increases in turbidity, sedimentation, or nutrient/contaminant inputs due to future flooding.	*Direct:* Long-term, ***potentially significant adverse*** impacts to aquatic habitats from dredge and fill activities; Short-term and long-term, less-than-significant adverse impacts to terrestrial habitats from vegetation removal; Short-term, less-than-significant impacts to terrestrial and aquatic habitats, wildlife (including threatened and endangered species), and Essential Fish Habitat (EFH) during construction (including increased turbidity, physical disturbance, and noise/vibration); Long-term, less-than-significant adverse impacts to aquatic habitats during operation from minor hydrology alterations, and to aquatic and terrestrial wildlife from limited loss of habitat; Long-term, beneficial impacts to terrestrial and aquatic habitats and wildlife from the removal of invasive species and proposed habitat enhancements. Under Alternative 1, about 6.3 acres of uplands would be impacted (4.0 acres permanently, 2.3 acres temporarily), and 7.4 acres of aquatic habitats would be impacted (5.9 acres permanently, 1.5 acres temporarily). Approximately 1.1 acres of vegetative habitat enhancements, and 1.1 acres of wetlands, would be created or enhanced. *Indirect:* Long-term, less-than-significant adverse impacts to terrestrial and aquatic wildlife (including threatened and endangered species) due to reductions in riparian habitat and increased human activity; Long-term beneficial effects to aquatic habitats and wildlife from the removal of invasive plants and improvements to wetlands, and to habitats from increased protection against coastal flooding and SLR, and decreasing turbidity, sedimentation, and nutrient/contaminant inputs.	*Direct:* Short-term, less-than-significant adverse impacts to terrestrial habitats from vegetation removal and disturbance during construction, and to terrestrial and aquatic habitats, wildlife (including threatened and endangered species), and EFH during construction (including increased turbidity, physical disturbance, and noise/vibration); Long-term, beneficial impacts to terrestrial and aquatic habitats and wildlife from proposed habitat and wetland enhancements. Under Alternative 2, approximately 20.3 acres of uplands would be impacted (0.6 acre permanently, 19.7 acres temporarily), and approximately 5.3 acres of aquatic habitats would be impacted (0.1 acre permanently, 5.2 acres temporarily). Additionally, approximately 11.9 acres of vegetative enhancements, and 7.2 acres of wetlands, would be created or enhanced. *Indirect:* Long-term, less-than-significant adverse impacts to terrestrial and aquatic wildlife, including threatened and endangered species, due to increased human activity; Long-term, beneficial effects to aquatic habitats and wildlife from anticipated reductions in sedimentation, turbidity, and nutrient/contaminant inputs in aquatic habitats.	*Direct:* Under Alternative 3, adverse impacts and beneficial effects would be slightly less than Alternative 2 due to fewer stormwater drainage improvements being constructed. Approximately 12.9 acres of uplands would be impacted (0.6 acre permanently, 12.3 acres temporarily), and approximately 4.0 acres of aquatic habitats would be impacted (0.1 acre permanently, 3.9 acres temporarily). Additionally, approximately 3.5 acres of wetlands would be created or enhanced. *Indirect:* Adverse and beneficial impacts would be slightly less than under Alternative 2 since Fluvial Park, DePeyster Creek Park, and the Losen Slote pump station C and its force main would not be constructed.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Geology and Soils	*Direct:* No direct impacts. *Indirect:* <u>***Potentially significant adverse***</u> impacts to soil resources through an increase in the potential for land subsidence within the Project Area and an increase in turbidity, sedimentation, nutrient input, and contaminant input due to soil erosion from future flooding.	*Direct:* Short-term, <u>less-than significant</u> adverse impacts to existing geologic and soil conditions in the Project Area during construction (approximately 39 acres of land disturbance and 84,900 cubic yards (CY) of soil removed); Long-term, <u>beneficial</u> impacts to soil resources due to a slight decrease in impervious surface area (approximately 0.8-acre decrease). *Indirect:* Short-term, <u>less-than-significant</u> adverse impacts on the exposure of people within the Project Area to radon; Long-term, <u>beneficial</u> effects from reduced hydrocompaction, soil erosion, turbidity, sedimentation, and nutrient/contaminant transport due to reduced coastal flooding.	*Direct:* Same as Alternative 1, except there would be approximately 51 acres of land disturbance and 32,300 CY of soils removed during construction and the long-term decrease in impervious area would be approximately 3.4 acres. *Indirect:* Same as Alternative 1, except there would be no reduction in hydrocompaction since Alternative 2 would not address coastal flooding.	*Direct:* Adverse impacts would be slightly less than Alternative 2 since there would be less ground-disturbing activities and 28,000 CY of potentially contaminated soil would be removed; <u>beneficial</u> effects would be slightly greater than Alternative 2 since the long-term decrease in impervious area would be approximately 3.7 acres. *Indirect:* Adverse impacts and <u>beneficial</u> effects would be slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed.
Water Resources, Water Quality, and Waters of the US	*Direct:* No direct impacts. *Indirect:* <u>***Potentially significant adverse***</u> impacts from future flooding to surface water quality and quantity (including scour and transport of sediment, nutrients, and pollutants); groundwater flow, quantity, and quality; and/or the hydrology of WOUS or State-regulated waterbodies or wetlands.	*Direct:* Long-term, <u>***potentially significant adverse***</u> impacts to surface water quantity, flow, and quality from construction in surface waters, and to wetlands, open waters, wetland functions and services, and riparian zones from construction in wetlands or open water; Short-term <u>less-than-significant</u> adverse impacts to localized surface water flow and quality, and to wetland areas, functions, and services, and riparian zones from construction activities; Short-term and long-term <u>less-than significant</u> adverse impacts to localized groundwater flow and quality during construction and operation; Long-term, <u>beneficial</u> effects to wetland functions and services where wetlands would be enhanced or created. Under Alternative 1, approximately 2.8 acres of wetlands would be impacted (1.2 acres permanently, 1.6 acres temporarily), 1.5 acres of open waters would be impacted (1.0 acre permanently, 0.5 acre temporarily), and 11.1 acres of riparian zones would be impacted (8.8 acres permanently, 2.3 acres temporarily). Approximately 1.1 acres of wetlands would be created or enhanced. *Indirect*: Short-term, <u>less-than-significant</u> adverse impacts to surface water from construction activities; Long-term, <u>less-than-significant</u> adverse impacts to wetland area, functions, and services upstream of the proposed tide gate on the unnamed tributary to the Hackensack River; Long-term, <u>beneficial</u> effects to surface water quantity, flow, quality, and sediment quality and transport by increasing coastal flood protection, to wetland functions and services by providing protection from SLR effects and increasing coastal flood protection, and to localized surface water quality from proposed parks and habitat enhancements.	*Direct:* Long-term, <u>***potentially significant adverse***</u> impacts to surface water quantity, flow, and quality from proposed construction over the Hackensack River, to localized sediment and contaminant transport in East Riser Ditch and Losen Slote, and to wetlands, open waters, wetland functions and services, and riparian zones from construction in wetlands or open waters; Short-term <u>less-than-significant</u> adverse impacts to localized surface water flow and quality, to groundwater flow and quality, and to wetland areas, functions, and services, and riparian zones from construction activities; Long-term <u>less-than-significant</u> adverse impacts to groundwater quality during operation of green infrastructure systems from the localized accumulation of contaminants; Long-term, <u>beneficial</u> effects to wetland functions and services were wetlands would be created or enhanced. Under Alternative 2, approximately 4.5 acres of wetlands would be impacted (0.3 acre permanently, 4.2 acres temporarily), 5.4 acres of open waters would be impacted (0.3 acre permanently, 5.1 acres temporarily), and 8.7 acres of riparian zones would be impacted (1.4 acres permanently, 7.3 acres temporarily). Approximately 7.2 acres of wetlands would be created or enhanced. *Indirect:* Short-term <u>less-than-significant</u> adverse impacts to surface water from vegetation removal and grading activities during construction; Long-term <u>less-than-significant</u> adverse impacts to surface water flow, water quality, and sediment and contaminant transport downstream of proposed Losen Slote force main discharges and in the upper reach of East Riser Ditch; Long-term <u>beneficial</u> effects to surface water quantity, flow, quality, and sediment and contaminant transport, and to off-site wetland functions and services from proposed improvements and enhancements.	*Direct:* Adverse impacts (including the long-term, <u>***potentially significant adverse***</u> impacts) and <u>beneficial</u> effects would be slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed. Under Alternative 3, approximately 3.4 acres of wetlands would be impacted (0.3 acre permanently, 3.1 acres temporarily), 3.8 acres of open waters would be impacted (0.3 acre permanently, 3.5 acres temporarily), and 4.9 acres of riparian zones would be impacted (0.8 acre permanently, 4.1 acres temporarily). Approximately 3.5 acres of wetlands would be created or enhanced. *Indirect:* Adverse impacts and <u>beneficial</u> effects would be slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Hydrology and Flooding	*Direct:* ***Potentially significant adverse*** impacts by permanently altering hydrology, flooding, or flood elevations; substantially and/or permanently disrupting the water table due to changes in surface water runoff; and substantially and/or permanently increasing normal water or flood levels. Over time, depending on SLR, an additional 11 to 26 percent of the Project Area could be at risk of coastal flooding during a 50-year storm surge. *Indirect:* No indirect impacts.	*Direct:* Short-term, less-than-significant adverse impacts to existing flood protection (berms) during construction; Long-term, less-than-significant adverse impacts to the normal water surface elevations of waterways in the Project Area due to disrupted groundwater movement from the LOP; Long-term, beneficial effects to the Project Area due to reduced coastal flooding, reduced impervious surfaces, and improved stormwater management in localized areas. During a 50-year storm surge, Alternative 1 would provide coastal flood protection to between 12 and 21 percent of the Project Area, as compared to the No Action Alternative, depending on SLR. *Indirect:* Long-term, ***potentially significant adverse*** impacts to developed areas outside the Project Area resulting from induced coastal flooding.	*Direct:* Long-term, less-than-significant adverse impacts to the groundwater table in localized areas; Long-term, beneficial effects to the Project Area due to reduced inland flooding from increased stormwater infiltration and conveyance capacity. Under Alternative 2, flood depths in the lower reach of East Riser Ditch would be reduced between 2.5 and 2.9 feet during a 2-year storm and between 1.6 and 2.2 feet during a 100-year storm, with residual flood reduction in the upper reach of East Riser Ditch. During a 100-year storm, approximately 182 buildings would receive inland flood protection against East Riser Ditch, totaling approximately $7.8M in avoided damages. For Losen Slote, flood depths would be reduced by up to 0.9 foot in the Main Reach between approximately Bertolotto Avenue and Niehaus Avenue, and by up to 0.6 foot in the Park Street Reach between its confluence with the Main Reach and approximately the south end of Teresa Court. Approximately 60 buildings would receive inland flood protection against Losen Slote during a 100-year storm, totaling approximately $1.1M in avoided damages. *Indirect:* No indirect impacts.	*Direct:* Generally the same as Alternative 2, except Alternative 3 would not provide flood reduction in the Park Street Reach of Losen Slote due to Losen Slote pump station C and its force main not being constructed. As such, only 44 buildings would receive inland flood protection against Losen Slote, totaling approximately $0.6M in avoided damages. *Indirect:* No indirect impacts (Same as Alternative 2).
Coastal Zone Management	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from increased long-term risks of coastal zone resources to identifiable hazards, reduced value of the coastal zone, alteration or diminishment of the coastal zones, and/or failure to achieve Coastal Zone Management compliance due to future flooding.	*Direct:* Short-term and long-term, less-than-significant adverse impacts to coastal zone-regulated areas and coastal resources in the Project Area during construction; Long-term, less-than-significant adverse impacts to existing marina access; Long-term, beneficial impacts to public open space, flood hazard areas, and public use due to increased public open spaces and recreational opportunities. *Indirect:* Long-term, beneficial effects to the coastal economy, human health, traffic, and human activities by increasing coastal flood protection.	*Direct:* Same as Alternative 1, except there would be no impacts to marina access, and beneficial effects due to increased public open spaces and recreational opportunities would extend to riparian zones and stormwater management/water quality. *Indirect:* Same as Alternative 1, except beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Adverse impacts and beneficial effects would be slightly less than Alternative 2 since fewer Proposed Project components would be constructed. *Indirect:* Slightly less than Alternative 2 since Losen Slote pump station C and its force main would not be constructed.
Sustainability / Green Infrastructure	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to drainage patterns that could increase the runoff rate to receiving waters without water quality treatment.	*Direct:* Long-term, beneficial impacts to hydrology due to a decrease in impervious surfaces (a net decrease of 0.8 acre), to communities through increased open space (four new parks and 10.1 acres of public open space, as well as 1.1 acres of created wetlands), to the quality of runoff due to decreased peak runoff rates from drainage enhancements, and to the coastal economy, human health, and human activities from reduced flooding and associated damages. *Indirect:* Long-term, beneficial effects by inducing activities that increase the future potential for green infrastructure construction through demonstrating the performance and community benefits of green infrastructure as part of open space improvements.	*Direct:* Slightly greater than Alternative 1 since there would be a net decrease of 3.4 acres of impervious surfaces, five new parks and 20.0 acres of public open space, 7.2 acres of wetland creation and/or enhancement, and improvements to the quantity, as well as quality, of runoff due to both decreased peak runoff rates and stormwater management through the installation of 41 green infrastructure systems. *Indirect:* Same as Alternative 1.	*Direct:* While there would be a net decrease of 3.7 acres of impervious surfaces under Alternative 3, beneficial impacts would overall be slightly less than Alternative 2 due to the exclusion of two new parks (only 7.6 acres of public open space), only 3.7 acres of wetland creation and/or enhancement, and some decreases in stormwater conveyance capacity since only one pump station and force main would be built for Losen Slote. *Indirect:* Slightly less than Alternative 2 since fewer Proposed Project components would be constructed.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Hazards and Hazardous Materials	*Direct:* No direct impacts. *Indirect:* ***<u>Potentially significant adverse</u>*** from future flooding to contaminated sites, the potential introduction or mobilization of contaminants, and/or conflicts with existing or planned remedial investigations.	*Direct:* Short-term, ***<u>potentially significant adverse</u>*** impacts from potentially triggering near-term remediation under the Industrial Site Recovery Act during construction; Long-term, ***<u>potentially significant adverse</u>*** impacts from the disruption or mobilization of previously known hazardous materials encountered during construction; Short-term, <u>less-than-significant</u> adverse impacts from subsurface disturbance of hazardous materials at known or suspected contaminated sites during construction, and to planned remedial activities that could be delayed temporarily; Short-term and long-term, <u>less-than-significant</u> adverse impacts from potential spills (e.g. gasoline and diesel) during construction and operational activities; Long-term <u>beneficial</u> impacts from the removal of potentially contaminated soils during construction (84,900 CY). Under Alternative 1, up to 13 contaminated sites could be directly impacted. *Indirect:* Long-term, ***<u>potentially significant adverse</u>*** impacts from potential creation of volatile organic compound/methane preferential pathways, mobilization of contaminant plumes in soil or groundwater, risk of thermal radiation or blast-overpressure damage from one aboveground storage tank (AST), and interference with future remedial investigations; Long-term, <u>beneficial</u> impacts from the protection of contaminated sites from the erosive effects of coastal flooding. Under Alternative 1, up to 11 contaminated sites could be indirectly impacted.	*Direct:* Same as Alternative 1, including the short- and long-term, ***<u>potentially significant adverse</u>*** impacts, except there are 20 contaminated sites that potentially could be impacted directly by Alternative 2, 32,300 CY of potentially contaminated soil would be exported, and long-term, <u>beneficial</u> impacts could also be realized from the capping of potentially contaminated soil by Alternative 2 components. *Indirect:* Same as Alternative 1, including the long-term, ***<u>potentially significant adverse</u>*** impacts, except there are 20 contaminated sites that potentially could be impacted indirectly by Alternative 2, and <u>beneficial</u> impacts would be realized from reduced erosive effects of inland flooding instead of coastal flooding. Additionally, there would be long-term, <u>less-than-significant</u> adverse impacts from localized increases in water velocity that could cause scour and mobilize contaminated sediments in East Riser Ditch and Losen Slote.	*Direct:* There are 19 contaminated sites that potentially could be impacted directly by Alternative 3, but adverse impacts (including the short- and long-term, ***<u>potentially significant adverse</u>*** impacts) and benefits would be slightly less than Alternative 2 since there would be less ground-disturbing activities, and only 28,000 CY of potentially contaminated soil would be exported. *Indirect:* There are 19 contaminated sites that potentially could be impacted indirectly by Alternative 3, but adverse impacts (including the long-term, ***<u>potentially significant adverse</u>*** impacts) and benefits would be slightly less than Alternative 2 since there would be less ground-disturbing activities (for example, a lower risk of scouring the Losen Slote channel because the Losen Slote C pump station and its force main would not be constructed).
Mineral and Energy Resources	*Direct:* No direct impacts. *Indirect:* ***<u>Potentially significant adverse</u>*** effects from future flooding to energy resources due to the increase of long-term risks to identifiable hazards, increases in consumer prices, a minimal diminishment of these resources in the Project Area, and/or short-term decreases in their supply, availability, or capacity.	*Direct:* Short-term, <u>less-than-significant</u> adverse impacts to the supply, availability, capacity, or costs of mineral and energy resources during construction. *Indirect:* Long-term, <u>beneficial</u> effects from increased coastal flood protection, which would reduce damages to energy resources; benefit their supply, availability, capacity, and cost; and commensurately reduce the need for reconstruction and rebuilding of facilities damaged by flood events, thereby reducing potential future need/use of mineral resources.	*Direct:* Slightly less than Alternative 1 since the amounts of mineral and energy resources required for construction are less for most materials. *Indirect:* Same as Alternative 1, except beneficial effects would stem from increased inland flood protection.	*Direct:* Slightly less than Alternative 2 since fewer Proposed Project components would be constructed, and fewer mineral and energy resources would be required. *Indirect:* Slightly less than Alternative 2 since the Losen Slote pump station C and its force main would not be constructed.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Agricultural Resources and Prime Farmland	*Direct:* No direct impacts. *Indirect:* Less-than-significant adverse impacts from the long-term risk of community and residential gardens to identifiable hazards and/or the prohibition of the use of and access to community and residential gardens for future agricultural use due to future flooding.	*Direct:* No direct impacts. *Indirect:* Long-term, beneficial effects on residential and community gardens due to increased coastal flood protection.	*Direct:* No direct impacts (Same as Alternative 1). *Indirect:* Same as Alternative 1, except beneficial effects would stem from increased inland flood protection and stormwater drainage improvements.	*Direct:* No direct impacts (Same as Alternatives 1 and 2). *Indirect:* Slightly less than Alternative 2 since there would be fewer stormwater drainage improvements.

Cumulative Impacts

Cumulative impacts are impacts that occur as a result of the Proposed Project in conjunction with impacts from other, unrelated projects that overlap a shared Region of Influence (ROI) in space or time. These other projects, herein referred to as reasonably foreseeable future (RFF) projects, are anticipated to occur within, or in the vicinity of, the Project Area, and could affect the same technical resource areas as the Proposed Project during construction and/or operational activities. The timeframe applied for this analysis extends through 2030, which includes both the construction and early operational phases of the Proposed Project. Additionally, the Project Area would continue to be impacted by the largely unabated future coastal and inland flooding conditions anticipated under the No Action Alternative. This future flooding would lead to significant, adverse, and cumulative flood damages to RFF projects and technical resource areas over time. The cumulative impacts anticipated under each Build Alternative of the Proposed Project are summarized below.

While the Proposed Project and RFF projects would cumulatively contribute to reduced flood risk from certain events and improved quality of life within the ROI, overall and perceptible increases in property values in the ROI would not be expected, as flood events would not be eliminated entirely under the Proposed Project. However, the Proposed Project and RFF projects may help to stabilize existing housing prices by decreasing the risk of fluctuations in housing and property values resulting from some future flood events. In addition, because the Proposed Project and RFF projects would be implemented on existing developed land and projects are generally in the form of enhancement or redevelopment projects, these projects would not be expected to cumulatively induce population growth or substantial land use changes within the ROI.

Alternative 1: RFF projects could contribute impacts to the same resource areas impacted by Alternative 1, although there would likely be fewer adverse impacts from RFF projects, as the majority of RFF projects are redevelopments or improvements planned on previously disturbed sites and existing developed land.

Adverse cumulative impacts to resources under Alternative 1, in combination with RFF projects, would mostly be less-than-significant, and would result from short-term, periodic construction activities. However, in conjunction with RFF projects, construction of Alternative 1 would also contribute ***potentially significant, adverse*** cumulative impacts to Transportation and Circulation due to traffic congestion and interference during construction; Noise and Vibration due to elevated levels of noise perceived by sensitive receptors during construction; Biological Resources, due to permanent loss of aquatic habitats; and Water Resources, Water Quality, and WOUS due to permanent loss of wetlands within the ROI. Potentially significant adverse impacts would be minimized to the extent practicable with the implementation of Proposed Project-specific mitigation measures, best management practices (BMPs), and recommended cumulative mitigation measures, such as: meetings and coordination with local planning boards, local municipalities, and service providers; open communication and cooperation with RFF project sponsors; and public outreach efforts.

In conjunction with RFF projects that would develop additional flood control measures, operation of Alternative 1 would provide ***long-term, beneficial*** cumulative impacts to almost all technical resource areas by reducing coastal flooding damages in the ROI and minimizing the effects of coastal storm surges.

Alternative 2: RFF projects could contribute impacts to the same resource areas impacted by Alternative 2, although there would likely be fewer adverse impacts from RFF projects, as the majority of RFF projects are redevelopments or improvements planned on previously disturbed sites and existing developed land.

Similar to Alternative 1, adverse cumulative impacts to resources under Alternative 2 in combination with RFF projects would mostly be less-than-significant, and would result from short-term, periodic construction activities. However, in conjunction with RFF projects, construction of Alternative 2 would also contribute ***potentially significant, adverse*** cumulative impacts to Transportation and Circulation due to traffic congestion and interference during construction; Noise and Vibration due to elevated levels of noise perceived by sensitive receptors during construction; and Water Resources, Water Quality, and WOUS due to permanent loss of wetlands within the ROI. Potentially significant adverse impacts would be minimized to the extent practicable with the implementation of measures as discussed under Alternative 1.

In conjunction with RFF projects that would install additional flood reduction and stormwater control measures, operation of Alternative 2 would result in ***long-term, beneficial*** cumulative impacts to most technical resource areas from collective stormwater drainage improvements. In addition, RFF projects incorporating new green space and open space development would contribute to the green infrastructure-based solutions (e.g., bioswales, storage/tree trenches, and rain gardens), new parks, and improved open spaces under Alternative 2, a cumulative long-term beneficial effect.

Alternative 3: Construction of Alternative 3 would result in the same cumulative impacts as Alternative 2 due to the similarity between these two Build Alternatives. Additionally, implementation of Alternative 3 would notably allow for development of the Alternative 3 *Future Plan,* which would provide coastal flood protection in addition to stormwater drainage improvements. While construction of the Alternative 3 *Future Plan* would further lead to the cumulative impacts identified under Alternative 1, it would also reduce adverse impacts to resources that would occur during coastal flooding events through structural flood protection, similar to the direct and indirect beneficial effects associated with Alternative 1. Therefore, operation of Alternative 3 and RFF projects (including the *Future Plan*) would collectively provide the most comprehensive strategy for mitigating inland and coastal flooding damages to technical resource areas, as compared to Alternatives 1 and 2, and would result in substantial ***long-term, beneficial*** cumulative impacts in the ROI.

The Alternative 3 *Future Plan* is contingent upon future funding availability. If funding for the *Future Plan* does not become available, it would not be implemented and cumulative impacts from construction and operation of Alternative 3 would be similar to those identified under Alternative 2.

ES.8 Summary of Mitigation Measures and Best Management Practices

As noted above, the Build Alternatives of the Proposed Project could have ***potentially, significant adverse*** impacts on multiple technical resource areas. Numerous mitigation measures and/or BMPs have been identified to reduce potentially significant adverse impacts that could result from the Proposed Project. These mitigation measures and BMPs are summarized in **Table ES-2**. Additional BMPs have been identified for technical resource areas that could experience ***less-than-significant, adverse*** impacts as a result of the Proposed Project. These are detailed within the EIS.

Table ES-2: Mitigation Measures/BMPs Identified to Reduce Potentially Significant Impacts Under Alternatives 1, 2, and 3

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	**Applicable to Alternative 1**	**Applicable to Alternative 2**	**Applicable to Alternative 3**
Land Use and Land Use Planning	**During Design/Coordination/Pre-Construction:** • The need for both temporary and permanent easements would be minimized to the extent possible. • Coordination with affected property owners and zoning districts would be conducted to obtain mutually agreeable settlements and to proactively prepare for required zoning changes. **During Construction:** • BMPs would be implemented, as necessary, based on adjacent land uses, to minimize transportation, noise and vibration, and air quality impacts to residences and businesses (see relevant resource areas below for more detail). **During Operations:** • Measures to minimize the potential for wildlife hazards to human health and safety from aircraft collisions would be implemented (e.g., use of approved plant species, coordination with FAA and Teterboro Airport, etc.).	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column. *Additionally:* **During Design/Coordination/Pre-Construction:** • Consultation with FAA would be conducted to ensure compliance with NEPA, FAA Orders 1050.1F and 5050.4B, FAA AC No. 150/5200-33B, and the Teterboro Airport Wildlife Hazard Management Plan. • Consultation with Teterboro Airport and other applicable cooperating agencies would be conducted to confirm that there are no plans to purchase the properties for a runway protection zone (RPZ) program within the 2,500-foot buffer zone; any required notices in compliance with 24 CFR Part 51, Subpart D would be implemented. **During Construction:** • Small construction equipment (i.e., less than 200 feet in height) would be utilized to avoid potential navigational airspace hazards associated with the use of tall equipment near Teterboro Airport in accordance with 14 CFR Part 77. • Construction near Teterboro Airport runways would occur during daylight hours to eliminate potential impacts from bright construction lighting.	Same as Alternative 2.
Visual Quality/Aesthetics	**During Design/Coordination/Pre-Construction:** • Consultation with the NJHPO would be conducted to ensure protection and management of cultural and aesthetic components within the viewshed. • Use of vegetated screening and/or material colors that blend into the existing environment and materials that are non-reflective would be incorporated into the design to promote natural harmony and project coherence and to reduce changes in viewer awareness to the Proposed Project elements, respectively. • Native vegetation would be used, whenever possible, when creating, enhancing, or restoring vegetated areas. **During Construction:** • Use of screening fences in a similar color to the natural environment to block the view of construction equipment and other materials. **During Operations:** • Sealants on concrete structures would be used and maintained that allow for the effective removal of graffiti.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	**Applicable to Alternative 1**	**Applicable to Alternative 2**	**Applicable to Alternative 3**
Socioeconomics, Community/Populations, and Housing	**During Design/Coordination/Pre-Construction:** • The need for both temporary and permanent easements would be minimized to the extent possible. • A Public Safety Plan would be developed in coordination with the local authorities to provide for safety of the public, including children, during construction activities. • Coordination with businesses would occur to address accessibility concerns during construction. • Coordination with local emergency services (including fire, police, and ambulance services) would occur to ensure that access to critical facilities is maintained. This would also require consideration for accessibility in the event a storm occurs while the Proposed Project is still under construction. **During Construction:** • The Public Safety Plan would be implemented. • Coordination with local emergency services (including fire, police, and ambulance services) would occur to maintain access to critical facilities. • Identified accessibility impacts on businesses would be minimized with signage and provision of temporary access ways.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.
Environmental Justice	**During Design/Coordination/Pre-Construction:** • A Public Safety Plan would be developed; it would establish a protocol for coordinating with representatives of EJ communities to ensure that construction activities occurring close to residences would have the least possible impact on pedestrian and vehicle traffic patterns, and that construction noise and dust would be reduced to the extent practicable. • The Proposed Project would comply with HUD Section 3 and NJDCA Section 3 requirements, and to the greatest extent possible, provide job training, employment, and contract opportunities for low-income and LMI residents. A HUD Section 3 Annual Summary Report (Form HUD-60002) would be submitted to the Office of Fair Housing and Equal Opportunity for all covered funding, as well as Quarterly Section 3 reports pursuant to NJDCA Policy 2.10.22 Section VIII. **During Construction:** • BMPs and standard measures would be implemented to maintain access and traffic, and control noise, vibration, and dust. • The Proposed Project would comply with HUD Section 3 and NJDCA Section 3 requirements. **During Operations:** • The Proposed Project would comply with HUD Section 3 and NJDCA Section 3 requirements.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	Applicable to Alternative 1	Applicable to Alternative 2	Applicable to Alternative 3
Cultural and Historical Resources	**During Design/Coordination/Pre-Construction:** Archaeological Resources • The NJDEP would consult with the NJHPO pursuant to 36 CFR § 800.5 of the NHPA to comply with Section 106 and minimize effects to NRHP-eligible archaeological resources. See **Section 4.6.4.2** for the sequential steps that would be undertaken. Historic Architectural Resources • The NJDEP would consult with the NJHPO pursuant to 36 CFR § 800.5 of the NHPA to comply with Section 106 and minimize effects to NRHP-eligible historic architectural resources. See **Section 4.6.4.2** for the sequential steps that would be undertaken. **During Construction:** Archaeological Resources • Archaeological monitoring may be necessary in locations of high sensitivity where Phase IB testing cannot be completed. Historic Architectural Resources • In consultation with the NJHPO, the NJDEP would mitigate identified adverse effects in accordance with the requirements of Section 106 of the NHPA. Short-term adverse effects to the US Route 46 Bascule Bridge may be mitigated by limiting the degree and magnitude of the construction activities as they encroach on the structure. Potential visual effects to historic architectural resources could be mitigated by selection of materials that are compatible with surroundings in terms of composition, color, texture, and overall appearance, in consultation with the NJHPO.	See "Applicable to All Alternatives" column.	See "Applicable to All Alternatives" column.	Same as "Applicable to All Alternatives," *except no mitigation would be required for the US Route 46 Bascule Bridge.*
Transportation and Circulation	**During Construction:** • Traffic Management Plans (TMPs) would be implemented in conjunction with the local municipalities and service providers to minimize impacts to these entities and provide the public with information on road closures and detours. This would allow pedestrians, bicyclists, freight facilities, transit facilities, and ancillary transportation facilities to plan their travel routes, minimize delays and disruptions, and ensure the safety of these routes. **During Operations:** • Maintenance activities would be performed during non-peak traffic hours to the extent practicable.	See "Applicable to All Alternatives" column. *Additionally:* **During Design/Coordination/Pre-Construction:** • Coordination with local municipalities and service providers (e.g., NJ Transit) would occur on potential monitoring needs, road/lane closures and realignments, and the proposed closure gate on the railroad track. **During Operations:** • Operation of the NJ Transit railroad line closure gate would be coordinated with NJ Transit prior to and during flooding events to minimize delays and disruptions to transit services. Gate closure would be conducted in accordance with NJ Transit procedures.	See "Applicable to All Alternatives" column. *Additionally:* **During Design/Coordination/Pre-Construction:** • Coordination with local municipalities and service providers (e.g., NJ Transit) would occur on potential monitoring needs and road, lane, and sidewalk closures. • Coordination with NJ Transit and local businesses in the Borough of Carlstadt regarding the closure of the railroad bridge over East Riser Ditch would occur prior to its removal and replacement.	Same as Alternative 2.

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	**Applicable to Alternative 1**	**Applicable to Alternative 2**	**Applicable to Alternative 3**
Noise and Vibration	**During Design/Coordination/Pre-Construction:** • Potential impacts from vibration would be reevaluated, as needed, based on the final pile driving locations to ensure they do not substantially differ from the anticipated impacts identified in this EIS. • If necessary during the permitting process, potential impacts from underwater noise would be reevaluated based on final pile driving locations to ensure they do not substantially differ from the anticipated impacts identified in this EIS. • Contractors and subcontractors would be trained to raise awareness of noise-specific issues and noise-sensitive areas. Noise complaint and response procedures would be established. • A construction schedule that is adjusted to comply with local regulations would be developed. • The construction schedule would be communicated to the public, including days of the week and hours of the day when work would occur. • An approved noise mitigation plan would be developed with the New Jersey Sports and Exposition Authority (NJSEA). See **Section 4.8.4.2** for additional details on the noise mitigation plan. Additionally, a vibration monitoring plan and compliance monitoring program would be developed. **During Construction:** • Noise reducing and/or the quietest practicable construction methods and equipment, such as the use of noise shrouds around pile driving rigs and equipment equipped with mufflers and noise attenuation devices, would be used. All equipment would be properly maintained. • Contractors would place noise barriers between work areas and noise-sensitive receptors. See **Section 4.8.4.2** for additional details on noise barriers. • Contractors would utilize specific vibration control measures that can be implemented for pile driving activities, including predrilling or augering and maximizing the use of vibratory rather than impact pile driving. Additionally, contractors should consider the use of drilled piles instead of impact or vibratory pile driving. • Construction vehicles would be routed away from residential streets, to the extent possible. • Vehicle idling would be limited in accordance with New Jersey Administrative Code (NJAC) 7:27-14 and NJAC 7:27-15. • Contractors would work with the local municipalities to address any scheduling concerns. Contractors should plan construction activities to occur during daytime hours to eliminate impacts during more sensitive nighttime hours. • Contractors would describe and commit to the developed mitigation and monitoring plans. **During Operations:** • Stationary equipment, such as generators and compressors, would be enclosed and would use acoustical louvers and/or sound attenuators in the exterior walls of these enclosures to reduce noise emissions through the air inlet and outlet louvers of the pump station(s).	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	**Applicable to Alternative 1**	**Applicable to Alternative 2**	**Applicable to Alternative 3**
Air Quality and Greenhouse Gas Emissions	**During Construction:** • Truck beds would be covered while in transit to limit fugitive emissions. • Water would be sprayed on any unpaved roads or stockpiles to limit fugitive emissions. • Construction staging areas and transport routes would be isolated from sensitive populations. • Control measures on heavy construction equipment and vehicles, such as minimizing operating and idling time, would be implemented to limit criteria pollutant emissions. • Clean diesel would be used in construction equipment and vehicles through the implementation of add-on control technologies such as diesel particulate filters and diesel oxidation catalysts, repowers, and/or newer and cleaner equipment. When feasible, auxiliary power units or electric-powered equipment would be used in lieu of diesel-powered equipment. **During Operations:** • Ultra-low sulfur diesel (ULSD) would be used in permanent, stationary sources to minimize oxides of sulfur emissions.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column. *Additionally:* **During Construction:** • Proposed construction at or near schools would be scheduled to occur when school is not in session. • Windows would be closed and indoor air would be circulated (i.e., air conditioning) in buildings where sensitive receptors are located to limit exposure to outdoor air quality.	See “Applicable to All Alternatives” column.
Global Climate Change and Sea Level Change	As the Proposed Project is itself intended to reduce the impacts of climate change and SLR, no specific mitigation measures or BMPs would be implemented.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.
Recreation	**During Design/Coordination/Pre-Construction:** • Consultation with recreational service providers regarding the proposed footprint would occur in order to minimize impacts to existing recreational areas and facilities. **During Construction:** • A TMP would be implemented to provide recreational services providers and the public with information on road closures and detours. This would allow users and proprietors of recreational facilities to plan their travel routes. Furthermore, road/lane closures would be planned to the extent possible to occur during periods of low recreational services demands.	See “Applicable to All Alternatives” column. *Additionally:* **During Design/Coordination/Pre-Construction:** • Coordination with the Little Ferry Marina and Riverside Boat Works would occur to develop a plan to reduce disruptions to these marinas, and to incorporate long-term access for these marinas into the design. **During Construction:** • Contractors would coordinate with the Little Ferry Marina and Riverside Boat Works to ensure access is maintained to and from the Hackensack River (i.e., through the use of boat cranes, temporary docks, or temporary boat ramps).	See “Applicable to All Alternatives” column. *Additionally:* **During Design/Coordination/Pre-Construction:** • Coordination with Riverside Boat Works would occur to develop a plan to reduce disruptions to this marina, and to incorporate long-term access for this marina into the design. **During Construction:** • Contractors would coordinate with Riverside Boat Works to ensure access is maintained to and from the Hackensack River (i.e., through the use of boat cranes, temporary docks, or temporary boat ramps).	Same as Alternative 2.

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	**Applicable to Alternative 1**	**Applicable to Alternative 2**	**Applicable to Alternative 3**
Utilities and Service Systems	**During Design/Coordination/Pre-Construction:** • Consultation with utility providers regarding the proposed footprints of the various components would occur in order to minimize impacts to existing utility services. • Utility providers would be consulted with to: (1) have all underground utility lines flagged in the field where they intersect with the temporary easements; and (2) identify proper measures to take while working near utilities (e.g., overhead power lines) to prevent damage to the utilities and ensure the safety of both construction personnel and the public. **During Construction:** • Contractors would coordinate with utility providers and property owners to facilitate the efficient relocation of all necessary utilities. Utility providers would provide advance notice to all affected users of the necessary temporary service disruptions. Furthermore, these disruptions would be planned to the extent possible to occur during periods of low utility demand.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.
Public Services	**During Design/Coordination/Pre-Construction:** • Consultation with public services providers regarding the proposed footprints of the various components would occur in order to minimize impacts to existing public services. • A Public Safety Plan would be developed. **During Construction:** • The Public Safety Plan and a TMP would be implemented to provide emergency service providers and the public with information on road closures and detours. This would allow first responders to plan their travel routes. Furthermore, road/lane closures or realignments would be planned to the extent possible to occur during periods of low public services demands. • Contractors would coordinate with public services providers to provide them with up-to-date information on the total numbers of workers within the Project Area during the work day, to ensure that public services could meet the demand of the increased population size. • Contractors would limit construction activities around noise-sensitive public facilities (i.e., libraries, schools, religious facilities), and implement the appropriate noise and air quality mitigation measures and BMPs.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	Applicable to Alternative 1	Applicable to Alternative 2	Applicable to Alternative 3
Biological Resources	**During Design/Coordination/Pre-Construction:** • Impacts to riparian zones, wetlands, and wetland buffers would be avoided and minimized to the extent practicable. As part of the permitting process, a compensatory mitigation plan would be developed to compensate for long-term unavoidable impacts to regulated wetlands and other WOUS associated with dredging, filling, or other permanent alteration. See **Section 4.14.4.2** for additional details on the mitigation plan. Wetland and waterbody impacts from construction dredge and fill activities would be coordinated with the NJDEP, USACE, National Marine Fisheries Service (NMFS), and other applicable regulatory agencies during project permitting. • A bird management plan would be developed to address Proposed Project construction timing and location to avoid or minimize effects to bird species, including special status species. This bird management plan would include pre-construction nest surveys that would identify timing restrictions for construction activities. See **Section 4.14.4.2** for additional details on the bird management plan. • To reduce the risk of erosion, sedimentation, and associated water quality impacts, a project-specific Stormwater Pollution Prevention Plan (SWPPP) would be prepared in accordance with NJ Stormwater Management Act NJAC 7:8. See **Section 4.14.4.2** for examples of the measures and BMPs that could be included in the SWPP. • The Bergen County Soil Conservation District would review and certify the Soil Erosion and Sediment (E&S) Control Plans as mandated by the Soil Erosion and Sediment Control Act, Chapter 251, Public Law 1975. • The EFH assessment would be revisited in consultation with NMFS to evaluate potential impacts to EFH that could result from construction work below mean high water.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	Applicable to Alternative 1	Applicable to Alternative 2	Applicable to Alternative 3
Biological Resources	**During Construction:** • Impacts to riparian zones, wetlands, and wetland buffers would be avoided and minimized to the extent practicable. Temporarily impacted wetlands and buffers would be restored immediately following construction. The developed compensatory mitigation plan would be implemented. • The bird management plan, SWPPP, and E&S Control Plans would be implemented. • To minimize the potential for introduction or proliferation of invasive species, construction BMPs that address activities such as soil disturbance, vegetation management and inspection, transport of materials, thoroughly cleaning construction equipment, and revegetation and restoration would implemented. • To reduce wildland fire risks and minimize the potential for ignition, construction BMPs that address activities such as equipment maintenance and cleaning and fire would be implemented. • In order to minimize the spatial extent and duration of construction impacts to aquatic habitat, EFH, and aquatic wildlife, BMPs such as silt curtains and turbidity barriers would be implemented, and construction would be conducted in accordance with Federal and State permits and any site-specific conditions specified therein. • To minimize potential for impacts to finfish during key migration periods, seasonal restrictions (i.e., between March 1 and June 30) would be applied to in-water work in accordance with permit conditions. • Noise reducing and/or the quietest practicable construction methods and equipment, such as the use of noise shrouds around pile-driving rigs and equipment with mufflers and noise-attenuation devices, would be used. All equipment would be properly maintained. • Contractors would utilize specific vibration control measures that can be implemented for pile-driving activities, including predrilling or augering and maximizing the use of vibratory rather than impact pile driving. Additionally, contractors should consider the use of drilled piles instead of impact or vibratory pile driving. **During Operations:** • Stationary equipment, such as generators and compressors, would be enclosed and would use acoustical louvers and/or sound attenuators in the exterior walls of these enclosures to reduce noise emissions through the air inlet and outlet louvers of the pump station(s). • To minimize potential for impacts to finfish during key migration periods, seasonal restrictions (i.e., between March 1 and June 30) would be applied to in-water work. • Activities that may introduce sediments into the water would not be conducted without appropriate sediment and erosion control measures in place.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	**Applicable to Alternative 1**	**Applicable to Alternative 2**	**Applicable to Alternative 3**
Geology and Soils	**During Design/Coordination/Pre-Construction:** • A detailed, site-specific E&S Control Plan would be prepared to address land-disturbance aspects of the Proposed Project and to minimize potential impacts to soil resources during construction. **During Construction:** • The prepared E&S Control Plan would be implemented. See **Section 4.15.4.2** for examples of the measures and BMPs that could be included in the E&S Control Plan. **During Operations:** • Activities that may cause soil erosion or compaction would not be conducted without appropriate sediment and erosion control measures in place.	See "Applicable to All Alternatives" column.	See "Applicable to All Alternatives" column.	See "Applicable to All Alternatives" column.
Water Resources, Water Quality, WOUS	**During Design/Coordination/Pre-Construction:** • Impacts to riparian zones, wetlands, and transition areas (i.e., wetland buffers) would be avoided and minimized to the extent practicable, and a compensatory mitigation plan would be developed, as described under Biological Resources. • Coordination with the NJDEP, USACE, US Coast Guard (USCG), NMFS, NJSEA, and other applicable regulatory agencies would be conducted, and all necessary permits obtained prior to construction. • Coordination with the USEPA and Berry's Creek Study Area (BCSA) Cooperating Potentially Responsible Parties (PRP) Group would be conducted during the final design process to ensure the Proposed Project does not adversely impact the ongoing BCSA PRP Group remediation project. • A project-specific SWPPP would be prepared, as described under Biological Resources. • The Bergen County Soil Conservation District would review and certify the Soil Erosion and Sediment Control Plans, as described under Biological Resources. **During Construction:** • Impacts to riparian zones, wetlands, and transition areas (i.e., wetland buffers) would be avoided and minimized to the extent practicable. Temporarily impacted wetlands and buffers would be restored immediately following construction. The developed compensatory mitigation plan would be implemented, as described under Biological Resources. • The prepared SWPPP would be implemented, as described under Biological Resources. • In order to minimize the spatial extent and duration of construction impacts to surface water flow, water quality, and sediment transport; wetland area, functions, and values; and groundwater flow and groundwater quality, BMPs (e.g., silt curtains, turbidity barriers, silt fencing, and hay bales) would be implemented, and construction would be conducted in accordance with Federal and State permits, and any conditions specified therein.	See "Applicable to All Alternatives" column.	See "Applicable to All Alternatives" column. *Additionally:* **During Design/Coordination/Pre-Construction:** • In order to minimize the spatial extent and duration of scour and sediment transport as a result of storm events, energy dissipation structures would be installed at the Losen Slote and East Riser Ditch pump station discharge locations.	Same as Alternative 2.

<table>
<tr><th rowspan="2">Technical Resource Area</th><th colspan="4">Mitigation Measures and BMPs</th></tr>
<tr><th>Applicable to All Alternatives</th><th>Applicable to Alternative 1</th><th>Applicable to Alternative 2</th><th>Applicable to Alternative 3</th></tr>
<tr><td>Hydrology and Flooding</td><td>During Design/Coordination/Pre-Construction:
• The mitigation measures set forth in Water Resources would be implemented.
During Construction:
• The mitigation measures set forth in Water Resources would be implemented.</td><td>See “Applicable to All Alternatives” column.
Additionally:
During Design/Coordination/Pre-Construction:
• The potential for induced flooding would be addressed during the final stages of the design and modeling processes in order to either eliminate them (i.e., through more refined modeling data) or reduce them to less-than-significant levels (i.e., induced flooding only in existing environmental areas in accordance with regulatory requirements).
During Construction:
• Adequate construction planning, including identification of potential emergency measures, would be implemented to avoid potential increased storm surge flooding in the Project Area while construction of the LOP is occurring along existing berms.</td><td>See “Applicable to All Alternatives” column.
Additionally:
During Design/Coordination/Pre-Construction:
• The mitigation measures set forth in Water Resources under Alternative 2 would be implemented.</td><td>Same as Alternative 2.</td></tr>
<tr><td>Coastal Zone Management</td><td>During Design/Coordination/Pre-Construction:
• The mitigation measures set forth in Biological Resources, Water Resources, and Cultural and Historical Resources would be implemented.
During Construction:
• Intertidal and subtidal impacts in the Hackensack River (below mean high water), wetland impacts, filling, and riparian and wetland buffers would be minimized to the extent possible, and coordination with the NJDEP, USACE, USCG, NMFS, NJSEA, and other applicable regulatory agencies would be conducted, as appropriate, to ensure proper mitigation and compliance with applicable regulations regarding in-water construction activities (e.g., 33 CFR 110.155).
• The mitigation measures set forth in Biological Resources would be implemented. Any sensitive habitats for endangered or threatened wildlife or plants that would be temporarily disturbed would be identified during the permitting process and appropriate mitigation measures, including timing restrictions and other measures as necessary, would be followed to protect sensitive populations and habitats.
• The mitigation measures set forth in Water Resources and Cultural and Historical Resources would be implemented.
During Operations:
• The mitigation measures set forth in Biological Resources, Water Resources, and Cultural and Historical Resources.</td><td>See “Applicable to All Alternatives” column.
Additionally:
During Design/Coordination/Pre-Construction:
• Coordination with the Little Ferry Marina and Riverside Boat Works would occur to develop a plan to reduce disruptions to these marinas, and to incorporate long-term access for these marinas into the design.</td><td>See “Applicable to All Alternatives” column.
Additionally:
During Design/Coordination/Pre-Construction:
• Coordination with Riverside Boat Works would occur to develop a plan to reduce disruptions to this marina, and to incorporate long-term access for this marina into the design.</td><td>Same as Alternative 2.</td></tr>
<tr><td>Sustainability/Green Infrastructure</td><td>Implementation of the mitigation measures identified in Recreation, Geology and Soils, Water Resources, Hydrology and Flooding, and Coastal Zone Management would further enhance the sustainability and green infrastructure benefits.</td><td>See “Applicable to All Alternatives” column.</td><td>See “Applicable to All Alternatives” column.</td><td>See “Applicable to All Alternatives” column.</td></tr>
</table>

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	Applicable to Alternative 1	Applicable to Alternative 2	Applicable to Alternative 3
Hazards and Hazardous Materials	**During Design/Coordination/Pre-Construction:** • HUD would be consulted to design proposed park/recreation features in compliance with HUD acceptable separation distance requirements. • A Materials Management Plan would be developed to address how any contaminated soil, sediment, surface water, groundwater, or waste materials would be handled for off-site disposal or on-site reuse (in the case of soil). • Coordination with the NJDEP Division of Solid and Hazardous Waste would be required for any actions that involve work within a landfill. A Landfill Disruption Permit would be required. • Parties responsible for completing remediation of properties adjacent to, or within 200 feet of, the Proposed Project footprint would be notified of the design and schedule. • Coordination with the USEPA and BCSA Cooperating PRP Group would be conducted during the final design process to ensure the Proposed Project does not adversely impact the ongoing BCSA PRP Group remediation project. **During Construction:** • Construction contractors would be required to use, store, and transport hazardous materials in compliance with Federal, State, and local regulations. • The Materials Management Plan would be implemented. • A New Jersey Licensed Site Remediation Professional would oversee those portions of the Proposed Project that would be considered a Linear Construction Project as defined by the NJDEP, and the Proposed Project would comply with these and other provisions of Chapter 16 of the NJDEP Administrative Requirements for the Remediation of Contaminated Sites (NJAC 7:26C) as necessary. This could occur with linear landscape features that cross more than one property. **During Operations:** • O&M activities would need to address NJ Site Remediation and Reform Act requirements for contaminated sites.	See "Applicable to All Alternatives" column. *Additionally:* **During Design/Coordination/Pre-Construction:** • The proposed construction near Deluxe International Trucks, Inc. includes a floodwall and excavation along the Hackensack River. These actions could require additional pre-construction review of site-specific records, sampling and analysis of materials to be disturbed, and precautionary planning to ensure mitigation, if not prevention, of the release and spread of contamination during construction, operation, use, and maintenance of features in these areas. • Construction of the Berry's Creek storm surge barrier and closure gate would require work within and in close proximity (i.e., parcels within 200 feet) to Universal Oil Products and other contaminated sites and waterways, including those within the Berry's Creek Study Area. Design and operation of these features would need to consider disturbance to ongoing and planned remedial investigation and action and potential downstream impacts should the surge barrier result in scour and the spread of known contaminants in soil and sediment. **During Construction:** • The proposed construction near Deluxe International Trucks, Inc. could require the implementation of BMPs to ensure mitigation, if not prevention, of the release and spread of contamination in these areas. • Precautions could be needed near historic fill and the Little Ferry Landfill to ensure that activity does not expose workers, local residents, or ecological receptors to contamination through the release and spread of hazardous materials.	See "Applicable to All Alternatives" column. *Additionally:* **During Design/Coordination/Pre-Construction:** • The proposed construction at Willow Lake Park includes various green infrastructure features. These actions could require additional pre-construction review of site-specific records, sampling and analysis of materials to be disturbed, and precautionary planning to ensure mitigation, if not prevention, of the release and spread of contamination during construction, operation, use, and maintenance of these features. • Dredging and construction at East Riser Ditch and Losen Slote would require work within and in close proximity (i.e., parcels within 200 feet) to contaminated sites and waterways. Design and operation of these features would need to consider downstream impacts and disturbance to ongoing and planned remedial investigation should proposed features, such as pump stations, result in scour and the spread of known contaminants in soil and sediment. **During Construction:** • The proposed construction at Willow Lake Park could require the implementation of BMPs to ensure mitigation, if not prevention, of the release and spread of contamination. • Precautions could be needed near historic fill and the Little Ferry Landfill and Morris Park Avenue Corporation landfill to ensure that activity does not expose workers, local residents, or ecological receptors to contamination through the release and spread of hazardous materials.	Same as Alternative 2.

Technical Resource Area	Mitigation Measures and BMPs			
	Applicable to All Alternatives	Applicable to Alternative 1	Applicable to Alternative 2	Applicable to Alternative 3
Mineral and Energy Resources	**During Design/Coordination/Pre-Construction:** • Construction managers would develop a construction energy conservation plan for energy use. See **Section 4.21.4.2** for examples of the mitigation measures and BMPs that could be included in the energy conservation plan. **During Construction:** • Demolition and debris cleared, as well as excavated soils, would be classified and sorted for beneficial re-use, either for Proposed Project construction or for other suitable uses. • Construction managers would implement the construction energy conservation plan for energy use.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.
Agricultural Resources and Prime Farmland	No adverse impacts to agricultural resources, prime farmlands, or residential and community gardens have been identified from the proposed construction or operation of the Proposed Project. Therefore, no BMPs or mitigation measures would be required.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.	See “Applicable to All Alternatives” column.

ES.9 Irreversible and Irretrievable Commitment of Resources and Energy Consumption

Implementation of Alternatives 1, 2, and 3 would result in the irreversible or irretrievable commitment of construction materials, land, energy, and existing habitats during the construction and operation of the Proposed Project. Fossil fuel energy, certain construction materials (e.g., concrete), and existing habitats would be irreversibly committed to the Proposed Project, as they would materially change during use. Other construction materials (e.g., metals or soils) and land area would be irretrievably committed to the Proposed Project, as they could be recycled or reused for other purposes only if the Proposed Project was dismantled. The use of these nonrenewable resources would be expected to account for only a small portion of the region's resources and would not affect the availability of these resources for other needs within the region. Long-term operation of Alternatives 1, 2, and 3 would not result in substantial long-term consumption of energy or natural resources.

ES.10 Known Areas of Controversy

Several areas of controversy regarding the Proposed Project were identified based on public comments received during the initial public scoping period and the public comment period of the DEIS. These generally included existing flooding concerns and flood protection methods, biological resources, wetlands, hazardous materials, O&M responsibilities, the Feasibility Study Report, and potential cumulative effects. These concerns were considered throughout the preparation of the EIS. Responses to comments received during the public scoping period are provided in the Final Public Scoping Document (available on the Proposed Project website), and responses to comments received during the DEIS public comment period are provided in the DEIS Public Comment Summary Report appended to this document (see **Appendix P**). A summary of substantive changes made to the FEIS in response to comments on the DEIS is provided in **Section 11.0**.

ES.11 Public Participation

The DEIS was been made available for public review and comment. Per 40 CFR § 1506.10, the public comment period was initiated with USEPA's publication of the Notice of Availability of the DEIS in the *Federal Register* on June 1, 2018, and concluded after 45 days on July 15, 2018. During this time, the DEIS was made available to the public in the following ways:

- The DEIS was posted on the Proposed Project website at www.rbd-meadowlands.nj.gov.
- It was made available in hard copy at the following locations:
  - Little Ferry Free Public Library, 239 Liberty Street, Little Ferry, NJ, 07643
  - Moonachie Municipal Office at Port Authority, 90 Moonachie Ave, Teterboro, NJ 07608
  - Carlstadt Public Library, 420 Hackensack St, Carlstadt, NJ 07072
  - Teterboro Municipal Building, 510 US Route 46, Teterboro, NJ 07608
  - South Hackensack Municipal Clerk, 227 Phillips Ave, South Hackensack, NJ 07606
- Electronic copies of the DEIS were mailed to Cooperating Agencies, and all members on the Listserv were notified.

Additionally, a Public Hearing was held on June 26, 2018, from 6:00 PM to 8:00 PM. Comments were accepted in the following ways: (1) either orally or in writing at the Public Hearing; (2) emailed to the Proposed Project email address at rbd-meadowlands@dep.nj.gov; or (3) mailed to NJDEP or NJDCA directly at:

NJDEP Bureau of Flood Resilience
Attn: Mr. Dennis Reinknecht
Manager
501 East State Street
Mail Code 501-01A, PO Box 420
Trenton, New Jersey 08625-0420

New Jersey Department of Community Affairs
Attn: Lisa Ryan
Assistant Commissioner, Sandy Recovery Division
101 South Broad Street
PO Box 800
Trenton, NJ 08625-0800

Comments postmarked by July 15, 2018 were considered. Following the public comment period, responses were prepared in the DEIS Public Comment Summary Report (see **Appendix P**), and changes were made in this Final EIS as appropriate.

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Acronyms and Abbreviations

°F	Degrees Fahrenheit
AADT	Average Annual Daily Traffic
AC	Advisory Circular
ACHP	Advisory Council on Historic Preservation
ADCIRC	Advanced Circulation
AF	Aviation Facilities
AM	Morning
ANSI	American National Standards Institute
APE	Area of Potential Effect
ASD	Acceptable Separation Distance
ASL	American Sign Language
AST	Above-ground Storage Tank
ASTM	American Society for Testing and Materials
ATR	Automatic Traffic Recorders
AUL	Activity and Use Limitation
BCR	Benefit-Cost Ratio
BCSA	Berry's Creek Study Area
BCUA	Bergen County Utilities Authority
BEA	Bureau of Economic Analysis
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practices
BP	Before Present
Btu	British Thermal Unit
CAA	Clean Air Act
CAG	Citizen Advisory Group
CDBG-DR	Community Development Block Grant - Disaster Recovery
CDC	Centers for Disease Control and Prevention
CEA	Classification exception area
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CKE	Currently Known Extent
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_{2e}	Carbon Dioxide Equivalent
COP	Citizen Outreach Plan
COPC	Chemicals of Potential Concern
CP	Commercial Park
CREC	Controlled Recognized Environmental Condition
CSA	Carlstadt Sewerage Authority
CWA	Clean Water Act
CY	Cubic Yard

CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	Decibel scale
dBA	A-weighted Decibel Scale
DDT	Dichloro-diphenyl-trichloroethane
DEIS	Draft Environmental Impact Statement
DPW	Department of Public Works
E&S	Erosion and Sediment
EC	Environmental Conservation
EDR	Environmental Data Resources
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EJ	Environmental Justice
EMS	Emergency Medical Services
EO	Executive Order
EPCRA	Emergency Planning and Community Right-to-Know Act
EPW	Evaluation for Planned Wetlands
ESA	Endangered Species Act
ESC	Executive Steering Committee
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHACA	Flood Hazard Area Control Act
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Maps
FPPA	Farmland Protection Policy Act
FR	Federal Register
FTA	Federal Transit Administration
GACT	Generally Available Control Technology
GHG	Greenhouse gas
GIS	Geographic Information System
GPI	Guidance for Public Involvement
GWRA	Global Warming Response Act
HAP	Hazardous Air Pollutant
HCM	Highway Capacity Manual
HEC	Hydrologic Engineering Center
HMDC	Hackensack Meadowlands Development Commission
HMS	Hydrologic Modeling System
HREC	Historical Recognized Environmental Condition
HUD	Department of Housing and Urban Development
Hz	Hertz
I-80	Interstate 80
I-95	Interstate 95

I-280	Interstate 280
IEC	International Electrotechnical Commission
IPaC	Information for Planning and Conservation
ISO	International Organization for Standardization
ISRA	Industrial Site Recovery Act
ITE	Institute of Traffic Engineers
KCS	Known Contaminated Site
kW	Kilowatt
L_{dn}	Day-night Average Sound Level
LDR	Low Density Residential
LEED	Leadership in Energy and Environmental Design
L_{eq}	Equivalent Sound Level
LF	Linear Feet
LI-A	Light Industrial A
LI-B	Light Industrial B
LID	Low Impact Development
LiDAR	Light detection and ranging
LMI	Low- and moderate-income
LNG	Liquid natural gas
LOP	Line of Protection
LOS	Level of Service
LSRP	Licensed Site Remediation Professional
MACT	Maximum Achievable Control Technology
MASSTR	Meadowlands Adaptive Signal System for Traffic Reduction
MD	Midday
MERI	Meadowlands Environmental Research Institute
MHW	Mean high water
mgd	Million gallons per day
MIMAC	Meadowlands Interagency Mitigation Advisory Committee
MLUL	Municipal Land Use Law
MOA	Memorandum of Agreement
MRI	Marsh Resources Inc.
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MUTCD	Manual on Uniform Traffic Control Devices
N/A	Not applicable
NAAQS	National Ambient Air Quality Standards
NACCS	North Atlantic Coast Comprehensive Study
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAVD 88	North American Vertical Datum of 1988
NC	Neighborhood Commercial
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutant
NFA	No Further Action

NFIP	National Flood Insurance Program
NGVD 29	National Geodetic Vertical Datum of 1929
NH_3	Ammonia
NHPA	National Historic Preservation Act
NJ	New Jersey
NJAC	New Jersey Administrative Code
NJCMP	New Jersey Coastal Management Program
NJDCA	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NJHPO	New Jersey Historic Preservation Office
NJMC	New Jersey Meadowlands Commission
NJPDES	New Jersey Pollutant Discharge Elimination System
NJSA	New Jersey Statutes Annotated
NJSEA	New Jersey Sports and Exposition Authority
NJSM	New Jersey State Museum
NMFS	National Marine Fisheries Service
NO	Nitrogen monoxide
NO_2	Nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_x	Nitrogen oxides
NPCC	New York Panel on Climate Change
NPL	National Priorities List
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NWI	National Wetlands Inventory
NWS	National Weather Service
O&M	Operations and Maintenance
O_3	Ozone
OU	Operable Unit
PA	Parks and Recreation
PAH	Polycyclic aromatic hydrocarbon
PANYNJ	Port Authority of New York and New Jersey
Pb	Lead
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dibenzo-p-dioxin
PCDF	Polychlorinated dibenzofuran
pCi/L	Pico-Curies per liter
PI	Program Interest
PL	Public Law

PM	Evening
PM_{10}	Particulate matter 10 micrometers or less in diameter
$PM_{2.5}$	Particulate matter 2.5 micrometers or less in diameter
ppb	parts per billion
ppm	parts per million
PR	Planned Residential
PRP	Potentially Responsible Parties
PSE&G	Public Service Electric and Gas
PU	Public Utility
RA	Redevelopment areas
RAO	Response Action Outcomes
RAS	River Analysis System
RBD	Rebuild by Design
RBDM	Rebuild by Design Meadowlands
RCRA	Resource Conservation and Recovery Act
REC	Recognized Environmental Condition
RFF	Reasonably Foreseeable Future
RIMS II	Regional Input-Output Modeling System
ROD	Record of Decision
ROI	Region of Influence
ROSI	Recreational and Open Space Inventory
RPZ	Runway Protection Zone
SARA	Superfund Amendments and Reauthorization Act
SCP	Scientific chemical processing
SF	Square Feet
SHPO	State Historic Preservation Office
SLR	Sea Level Rise
SO_2	Sulfur dioxide
SPL	Sound Pressure Level
SVAP	Stream Visual Assessment Protocol
SVOC	Semivolatile Organic Compound
SWAN	Simulating Waves Nearshore
SWQC	Surface Water Quality Criteria
SWPPP	Stormwater Pollution Prevention Plan
TCDD	Tetrachlorodibenzo-p-dioxin
TCT	Technical Coordination Team
TMC	Turning movement counts
TMP	Traffic Management Plan
TNM	Traffic Noise Model
TRB	Transportation Research Board
TrkAv	Westbrook, Ipswich, Sandy hook soils, very frequently flooded soil unit
TSCA	Toxic Substances Control Act
TSS	Total suspended solids
UdoB	Udorthents, organic substratum soil unit

UdouB	Udorthents, organic substratum-Urban Complex soil unit
UdwB	Udorthents, wet substratum soil unit
ULSD	Ultra-low sulfur diesel
UOP	Universal Oil Products
UR	Urban Land
US	United States
USACE	US Army Corps of Engineers
USC	United States Code
USCG	US Coast Guard
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
USGS	US Geologic Survey
UST	Underground storage tank
VdB	Vibration decibel scale
VOC	Volatile Organic Compound
WMA	Watershed Management Area
WOUS	Waters of the United States
WR	Waterfront Recreation

1.0 Introduction and Statement of Purpose and Need

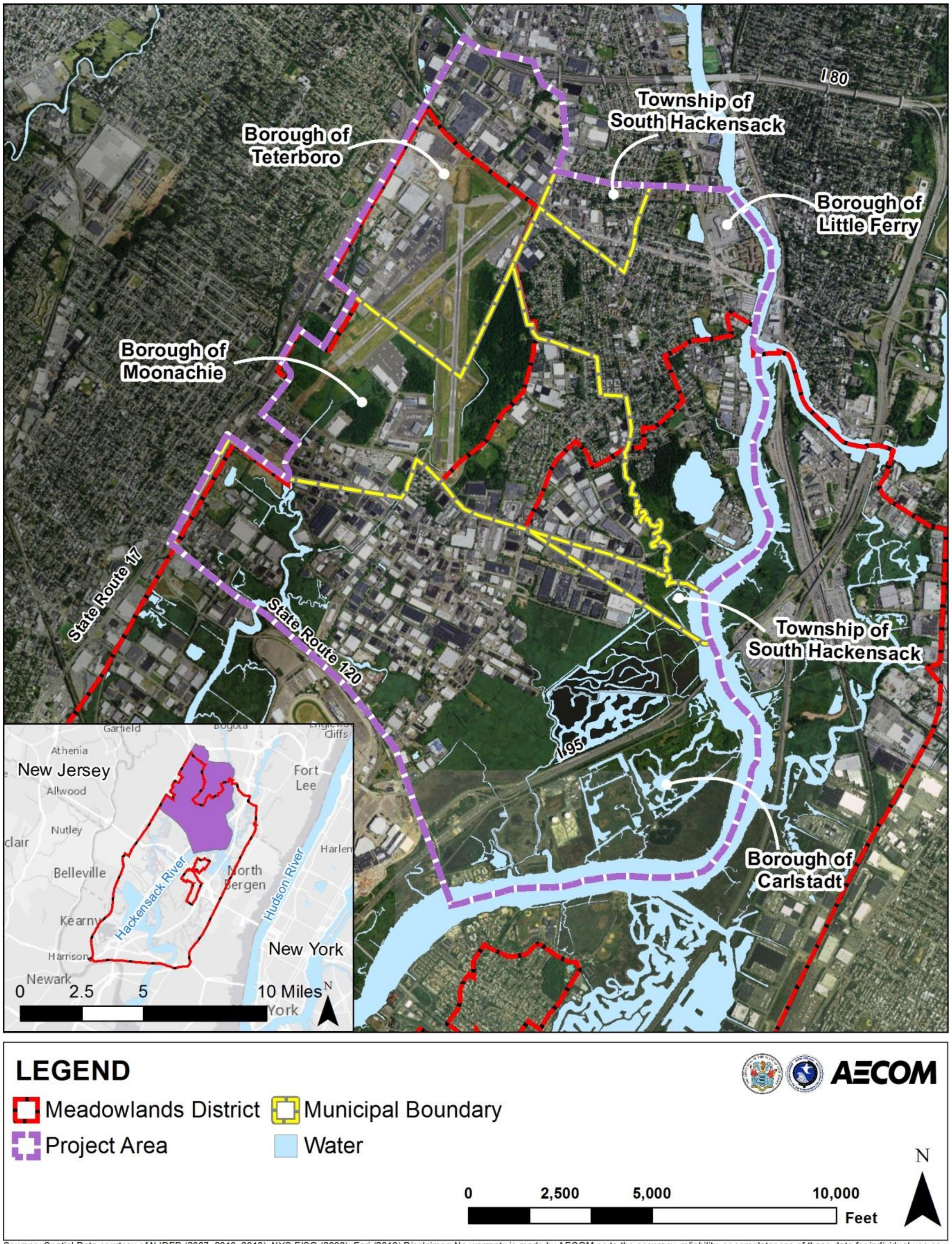
1.1 Introduction

The State of New Jersey Department of Environmental Protection (NJDEP) has prepared this Environmental Impact Statement (EIS) for the Rebuild by Design (RBD) Meadowlands Flood Protection Project (the Proposed Project). On behalf of the State of New Jersey through its Department of Community Affairs (NJDCA), the recipient of United States (US) Department of Housing and Urban Development (HUD) grant funds, NJDEP is the "Responsible Entity," as defined by HUD regulations at 24 Code of Federal Regulations (CFR) § 58.2(a)(7)(i), for the Proposed Project.

In accordance with criteria in 40 CFR § 1501.5(c), NJDCA has designated NJDEP as the Lead Agency to prepare this EIS for the Proposed Project in accordance with the National Environmental Policy Act (NEPA; 42 US Code [USC] §§ 4321 *et seq.*). This EIS, as required by NEPA, 24 CFR Part 58, and the President's Council on Environmental Quality (CEQ) *Regulations Implementing the Procedural Provisions of NEPA* (40 CFR Parts 1500-1508), analyzes the potential physical, cultural, environmental, and socioeconomic impacts of various alternatives to implement flood risk reduction (protection) measures designed to address the impacts of flooding in the Project Area.

The Project Area, as defined in the award-winning RBD design, includes the Boroughs of Little Ferry, Moonachie, Carlstadt, and Teterboro, and the Township of South Hackensack, all in Bergen County, New Jersey. The Project Area has the following approximate boundaries: the Hackensack River to the east; Paterson Plank Road (State Route 120) and the southern boundary of Borough of Carlstadt to the south; State Route 17 to the west; and Interstate 80 (I-80) and the northern boundary of the Borough of Little Ferry to the north. **Figure 1.1-1** displays an aerial view of the Project Area.

The "Phase 1 Pilot Area" was specifically identified and selected by HUD through the RBD competition. The Phase 1 Pilot Area is now referred to as the RBD Meadowlands Flood Protection Project Area (see **Section 1.3**). HUD launched the RBD competition in the summer of 2013 (July 29, 2013, 78 *Federal Register* [FR] 45551) to develop ideas to improve physical, ecological, economic, and social resilience in regions affected by Hurricane Sandy. The competition sought to promote innovation by developing flexible solutions that would increase regional resilience. The Proposed Project was one of the competition's winning concepts; it was developed with the primary goal of reducing flood risk in the Project Area. HUD has allocated $150 million of Community Development Block Grant – Disaster Recovery (CDBG-DR) funding to the State of New Jersey to plan, design, and implement this Proposed Project by September 2022.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 1.1-1: Rebuild by Design Meadowlands Flood Protection Project Area

The Project Area is vulnerable to both inland flooding[2] and coastal flooding[3]. Hurricane Sandy exposed the vulnerabilities within the Project Area after low-lying areas were inundated by coastal storm surges. Within the Project Area, rainfall-induced flooding is more common and happens more frequently than coastal storm surge flooding. However, during Hurricane Sandy the impacts of rainfall flooding were considerably less than those from coastal storm surge flooding. The Project Area's past history of flooding during heavy rainfall events indicates that if Hurricane Sandy had been a substantial rainfall event as well as a storm surge event, the storm could have resulted in increased flood levels and property damages.

Hurricane Sandy significantly impacted the Project Area, highlighting existing deficiencies in the Project Area's resiliency and showcasing its inability to adequately protect vulnerable populations and critical infrastructure and facilities[4] from flooding during major storm events. These impacts included extensive flooding due to major tidal surges, with significant damage to residential and commercial properties; impacts to critical health care facilities; and the failure of critical power, transportation, and water and sewer infrastructure.

Approximately 2,200 residences and 1,900 businesses within the Project Area were damaged by Hurricane Sandy. Loss of income, loss of property taxes, and other Sandy-related property damage were estimated to be in excess of $40 million within the Project Area, including over $20 million in property damages alone. The average amount of property damage to each structure in the Project Area ranged from approximately $1,000 to $12,000. Nearly 30 percent of the structures damaged within the Project Area were renter-occupied; finding affordable replacement housing for renters within the Project Area was one of the immediate challenges following the hurricane. Please see **Section 1.4.2** for more information.

The Proposed Project includes the construction of flood risk reduction measures designed to address the impacts of inland and coastal flooding on the quality of the human environment due to both storm hazards and sea level change within the Project Area. The purpose of the Proposed Project is to reduce flood risk in the Project Area, thereby protecting critical infrastructure and facilities, residences, and businesses from the more frequent and intense flood events anticipated in the future. The Proposed Project is needed to address: (1) systemic inland flooding from high-intensity rainfall/runoff events; and/or (2) coastal flooding from storm surges. In addition to reducing flooding in the Project Area, the Proposed Project is needed to directly protect life, public health, and property in the Project Area, reduce flood insurance claims from future events, and maintain property values to the extent possible with the available funding.

1.2 Project Area and Vicinity

The Project Area, as shown in **Figure 1.1-1**, includes approximately 5,405 acres to the west of the Hackensack River. Major roads within and near the Project Area include Paterson Plank Road (State Route 120), State Route 17, I-80, Washington Avenue, Moonachie Avenue, and US Route 46. The

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[2] **Inland flooding** occurs during high-intensity rainfall/runoff events. These events can include moderate precipitation accumulating over several days, heavy precipitation falling over a short period, or other circumstances in which ditches, creeks, or rivers overflow as a result of rainfall (fluvial flooding) (NSSL 2017).

[3] **Coastal flooding** results from high tides that are higher than normal high tides, and can be worsened by onshore winds (NSSL 2017).

[4] Structures, services, and facilities that are particularly vulnerable to flooding due to their potential to cause harm, damage, or disruption to community persons, properties, or activities if they are destroyed or impaired are known as “critical infrastructure” or “critical facilities” (FEMA n.d.). Critical facility determinations in this document are in accordance with those in the Bergen County Multi-Jurisdictional All-Hazards Mitigation Plan, which was approved by FEMA on April 13, 2015.

Project Area is composed of both relatively dense suburban development and large natural areas. The approximate percentages for broad land use categories in the Project Area are presented in **Table 1.2-1**.

Residential areas are clustered mostly in the northeastern portion of the Project Area in the Borough of Little Ferry, eastern Borough of Moonachie, and the Township of South Hackensack. Approximately 22,400 people reside in the five municipalities that comprise the Project Area (US Census Bureau 2014); the largest economic sector employing these residents includes educational services, health care, and social assistance services[5]. The population of the Project Area is generally in the middle class, and has employment rates resembling those of Bergen County and New Jersey. For more information regarding socioeconomics and populations, please refer to **Section 3.4**.

Industrial and commercial land uses are concentrated primarily in the southern portion of the Project Area in the Boroughs of Carlstadt, Moonachie, and the Township of South Hackensack. Teterboro Airport and additional, primarily airport-related, industrial and commercial areas encompass much of the northwestern portion of the Project Area. Due to its proximity to New York City, the Project Area hosts a variety of businesses and warehouses that support the supply chain to New York City, located approximately 10 miles to the east. The Project Area is part of the New York metropolitan area.

Table 1.2-1: Distribution of Land Use in the Project Area

Land Use	Percentage of Project Area
Residential	11%
Industrial and Commercial	30%
Teterboro Airport	9%
Wetlands and Waterways	35%
Other[1]	15%
Total	**100%**

1. Other land use types include, but are not limited to, cemeteries, major roadways, and railroads.

The southern and eastern portions of the Project Area, including portions of the Borough of Carlstadt, the Township of South Hackensack, and the Borough of Little Ferry, are largely dominated by wetlands associated with the Hackensack River, including the Marsh Resources, Inc. (MRI) Wetland Mitigation Bank and the Richard P. Kane Natural Areas and Wetland Mitigation Bank. These wetland-dominated areas include approximately 1,200 acres (approximately 20 percent) of the Project Area.

The Project Area is situated at a very low elevation, which ranges mostly below 10 feet (North American Vertical Datum of 1988 [NAVD 88]) (MERI 2014). Wetlands and waterways comprise approximately 35 percent of the Project Area, and historically were even more prominent. However, as a result of draining and filling, many of the historic wetland areas have been converted to development. The overall Meadowlands District area is estimated to have once had approximately 17,000 acres of wetlands and waterways, but less than half of those (approximately 8,400 acres) remain today. This land conversion

[5] Services that provide assistance, usually financial, to a person(s) who does not have the benefits or income to support their basic needs.

has disrupted the natural hydrology of the area and, in conjunction with the low elevation of the Project Area, has led to recurring flooding problems, as discussed in **Section 1.4.2**.

1.3 Proposed Project Overview

The Proposed Project is located within the New Jersey Meadowlands District (see **Figure 1.1-1**). The Meadowlands District is an essential component of the New York/New Jersey Harbor Estuary and part of the largest wetland ecosystem in northern New Jersey (USFWS 1997). The Meadowlands District is located in a valley between the Palisades to the east and a parallel western ridge, both of which run in a southwest to northeast direction (NJSEA 2004). Elevations of the Meadowlands range from 0 to 10 feet (NAVD 88) (MERI 2014). The area is prone to chronic flooding due to the nature of the landscape, low elevation, complexity of tidal influence, and inadequate stormwater management systems (NJSEA 2004).

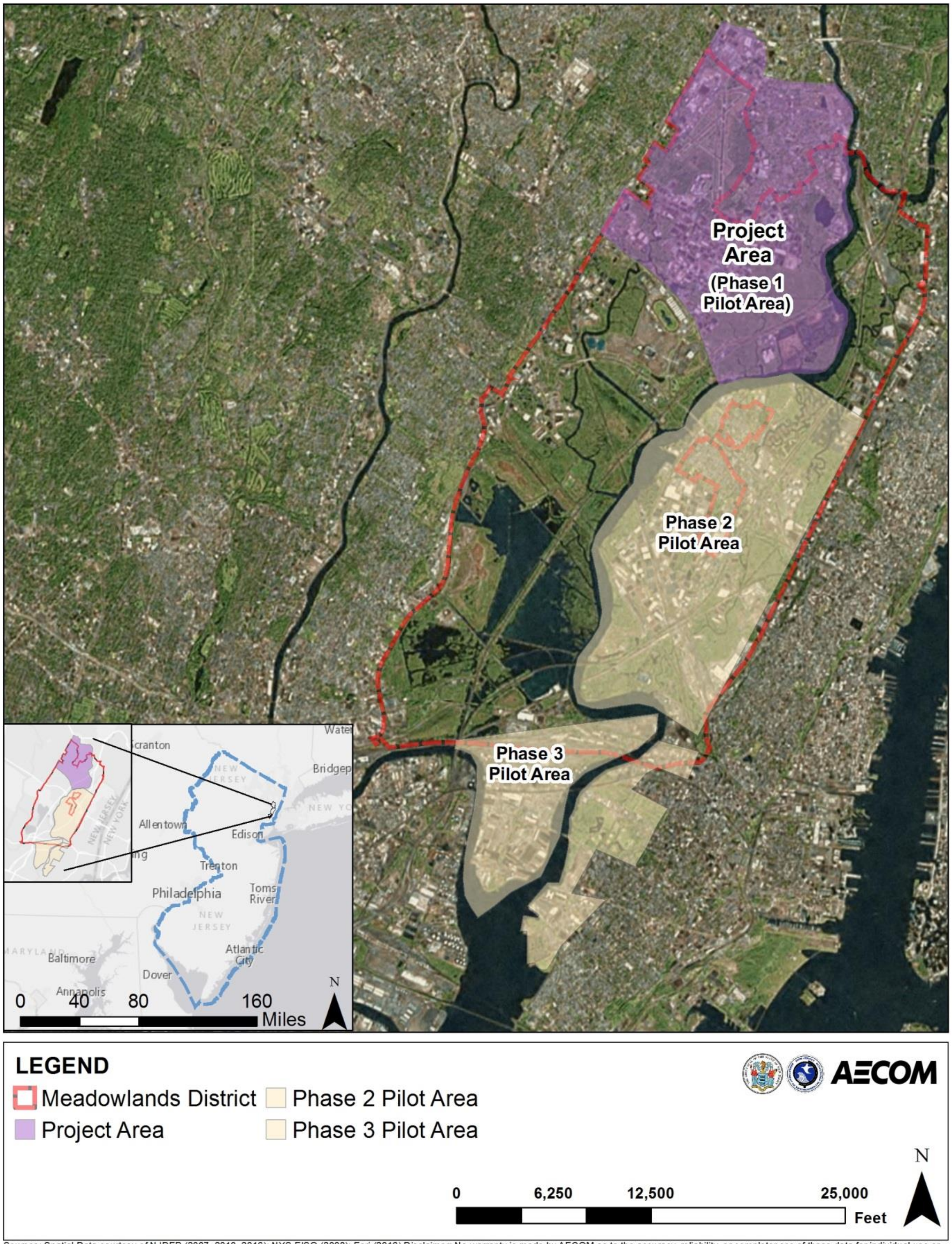
As noted above, the Meadowlands District area historically contained approximately 17,000 acres of waters and pristine wetlands featuring wetland cover types such as tidal marsh, hardwood forest, and Atlantic white cedar (*Chamaecyparis thyoides*) swamp (NJSEA 2004). Only an estimated 8,400 acres of wetlands and waterways remain in the Meadowlands District as a result of decades of extensive destruction and disturbance from activities including development, dredging, draining, and landfilling (USFWS 1997, NJSEA 2004). In addition, historic construction of dikes and tide gates, in an attempt to control and reduce flooding events, has impacted the integrity and spatial configuration of the Meadowlands District and altered its biodiversity (NJSEA 2004). Despite its developed nature, the Meadowlands District provides an oasis of diverse habitats for plants and wildlife in the urban New York/New Jersey metropolitan region (USFWS 1997, NJSEA 2004).

Approximately 8,600 acres of the original 17,000 acres of wetlands have been developed and altered by human activity, including extensive land use and land cover changes, and the creation of large areas of impervious surfaces. As a result of these man-made changes throughout the Meadowlands District, development within the Project Area is vulnerable to both inland and coastal flooding.

1.3.1 Proposed Project Background

Hurricane Sandy significantly impacted the Project Area, highlighting existing deficiencies in the Project Area's resiliency and showcasing its inability to adequately protect vulnerable populations and critical infrastructure and facilities from flooding during major storm events. The Proposed Project was developed and selected as a winning concept through HUD’s and the Hurricane Sandy Rebuilding Task Force’s RBD competition. The RBD competition promoted the development of innovative resilience projects in the region affected by Hurricane Sandy. The Proposed Project is a component of a regional concept proposal for the New Jersey Meadowlands District (the Meadowlands Program Area; see **Figure 1.3-1**) that aims to reduce flooding risks and potentially provide ancillary benefits.

As originally proposed during the RBD competition, the concept envisioned creating a system of natural areas, berms, and additional wetlands to reduce flooding risks. The original concept also articulated an integrated vision for protecting, connecting, and growing the Meadowlands District, as a critical asset, to both the rest of New Jersey and the metropolitan area of New York. By integrating transportation, ecology, and development, the awarded concept sought to transform the Meadowlands basin to address a wide spectrum of risks, while providing potential civic amenities and creating opportunities for new redevelopment.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 1.3-1: Meadowlands Program Area

As described in **Section 1.1**, HUD awarded $150 million in CDBG-DR funds to the State of New Jersey for the Proposed Project, specifically for the "Phase 1 Pilot Area." The Phase 1 Pilot Area is now referred to as the RBD Meadowlands Flood Protection Project Area, as shown in **Figure 1.3-1.** While additional project phases were identified for the overall Meadowlands Program Area during the RBD competition, no plan currently exists to fund the Phase 2 and Phase 3 Pilot Areas at this time.

The RBD award-winning concept took a multi-faceted approach intended to address flooding from both major storm surges and high tides, as well as from heavy rainfall events, with several potential ancillary benefits. The concept's comprehensive approach to resilience consisted of three integrated components: Protect, Connect, and Grow.

- **Protect:** Provide flood protection through a combination of hard infrastructure (such as bulkheads or floodwalls) and soft infrastructure (such as berms and/or levees) that act as barriers during exceptionally high tide and/or storm surge events. Flood control structures would be complemented with freshwater basins and expanded Meadowlands wetlands to increase flood storage capacity. A proposed Meadowpark, envisioned as a natural reserve and expansion of the existing marsh, would offer additional flood protection and connection of surrounding developments to the Meadowlands through its views and recreational offerings.
- **Connect:** Increase connectivity among Meadowlands District towns with a "Meadowband" (multi-use levee) that would include a new local street, recreational facilities and access, and a Bus Rapid Transit line that would provide improved connectivity and access within the Project Area, much in the same way 5th Avenue and 8th Avenue frame Central Park in New York City.
- **Grow:** Through improved flood control, an ancillary benefit of re-zoning and up-zoning newly protected areas could become a reality. Through re-zoning, the local development pattern could transform from lower density, suburban-type development to a denser, better planned, multi-functional, and multi-level mixed use of offices, warehousing, retail, and residential development.

1.3.2 Proposed Project Evolution

Based on the amount of CDBG-DR funding (i.e., $150M) provided by HUD for the "Phase 1 Pilot Area," now referred to as the Project Area, the NJDEP has determined that the Proposed Project, in application, will focus primarily on reducing flood risk within the Project Area (i.e., the "Protect" component of the "Protect, Connect, Grow" concept). Ancillary "Connect" and "Grow" components of the winning concept, while not precluded by the Proposed Project, are not reasonably foreseeable at this time and thus are not included in this environmental impact analysis. Should any projects associated with the "Connect" and "Grow" components of the winning concept be initiated in the future, they would be subject to an independent environmental review.

1.3.3 Proposed Project Summary

The Proposed Project focuses on implementing flood risk reduction measures that would reduce the flood risk within the Project Area attributable to both inland and coastal flooding. To achieve this goal, the NJDEP developed a variety of potential solutions and concepts that involved various infrastructure features aimed at maximizing the benefits to the Project Area while minimizing overall costs and adverse environmental effects. The process undertaken by the NJDEP to develop and screen the various concepts considered is presented in **Section 2.4**.

1.4 Project Purpose, Need, and Objectives

1.4.1 Purpose

The purpose of the Proposed Project is to reduce flood risk and increase the resiliency of the communities and ecosystems within the Project Area, thereby protecting critical infrastructure and facilities, residences, businesses, and ecological resources from frequent and intense flood events anticipated in the future. The ability to meet this purpose is measured in terms of the following goals and objectives of the Proposed Project:

- ***Contribute to Community Resiliency*.** The Proposed Project would integrate a flood hazard risk reduction strategy with existing and proposed land uses and assets. The Proposed Project would reduce flood risks within the Project Area, leading to improved resiliency and the protection of accessibility and on-going operations of services (including protecting critical infrastructure and facilities such as hospitals, fire stations, and police department buildings; and roadways and transit resources). This would allow these key assets to support emergency preparedness and community resiliency during and after flood events.
- ***Reduce Risks to Public Health*.** In addition to providing protection to critical healthcare infrastructure (such as local hospitals and emergency services), the flood risk reduction strategy would reduce the adverse health impacts associated with these types of flood events, such as the spread of infectious diseases, compromised personal hygiene, and contaminated water sources.
- ***Contribute to On-going Community Efforts to Reduce Federal Emergency Management Agency (FEMA) Flood Insurance Rates*.** The National Flood Insurance Program's (NFIP) Community Rating System allows municipalities to reduce their flood insurance rates through implementation of comprehensive floodplain management. The Proposed Project would include concepts and alternatives that are consistent with the local municipalities' overall effort to reduce FEMA flood insurance rates.
- ***Deliver Co-Benefits*.** Where possible, the Proposed Project would integrate the flood hazard risk reduction strategy with civic, cultural, ecological, economic, and recreational values. The Proposed Project would strive to incorporate active and passive recreational uses, multi-use facilities, and other design elements that integrate the Proposed Project into the fabric of the community. In this way, the Proposed Project would be independent of but complement local strategies for future growth to the extent possible.
- ***Enhance and Improve Use of Public Space*.** The Proposed Project would strive to include flood reduction design elements that improve public and recreational spaces, thereby enhancing quality of life for the community.
- ***Consider Impacts from Sea Level Change*.** The Proposed Project would consider the projected impacts from sea level change and its impacts on the frequency and degree of flooding.
- ***Protect Ecological Resources*.** The Proposed Project would strive to protect and enhance ecological resources by protecting wetlands and other habitats that contribute to local and regional biodiversity and ecosystem resiliency.
- ***Improve Water Quality*.** The Proposed Project may incorporate green infrastructure solutions into the design and construction of proposed flood risk reduction measures to manage stormwater runoff, reduce stormwater pollution, and improve water quality.

1.4.2 Need

The interrelationship between coastal flooding and rainfall events contributes to the recurring flooding conditions throughout the Project Area. Each component represents challenges and needs to be addressed within the context of an overall flood reduction strategy for the Project Area.

As such, the Proposed Project is needed to address: (1) systemic inland flooding from high-intensity rainfall/runoff events; and/or (2) coastal flooding from storm surges. In addition to reducing flooding in the Project Area, the Proposed Project is needed to directly protect life, public health, and property in the Project Area. The Proposed Project seeks to reduce flood insurance claims from future events and maintain property values to the extent possible. The Proposed Project is further needed to increase community resiliency, including protecting accessibility to, and on-going operations of, critical health care services, emergency services, and transportation and utility infrastructure. In addition to reducing flood risk and improving community resiliency, the Proposed Project could provide ancillary benefits, such as protection of ecological resources (enhancement of water quality, regional biodiversity, and ecosystem resiliency) and improvement of civic, cultural, and recreational values in the Project Area.

The Meadowlands District is situated in a valley with ridges on its sides that run parallel in a southwest to northeast direction. In some locations, these ridges are over 100 feet (NAVD 88). Comprised of mostly flat terrain, elevations within the Meadowlands District, including the Project Area, generally do not exceed 10 feet (NAVD 88), with most areas less than 6 to 7 feet (NAVD 88) (MERI 2014). Historically, the Meadowlands District contained a high concentration of wetlands, but these have largely been drained over the last two centuries (Rutgers University 2007a). As a result, the present day Meadowlands District is highly developed and is situated only several feet above sea level. For comparison, the Hackensack River and Berry’s Creek, which are tidal, have mean high water spring elevations of 2.7 feet and 3.0 feet (NAVD 88), respectively (NJSEA 2005), thus further decreasing the relative elevation of the Meadowlands District, and the Project Area specifically, above these tidal waterbodies. A spring high tide occurs during full and new moons, and represents the highest tide in the lunar cycle. The 100-year floodplain, shown in **Figure 1.4-1**, encompasses the majority of the Project Area, including 49 critical facilities and other infrastructure (Bergen County Office of Emergency Management 2015).

The lack of elevation difference in the Meadowlands District puts a strain on the ability of the communities to drain stormwater, as stormwater infrastructure is typically powered by gravity (Guo, et al. 2014). Further, much of the Meadowlands District has become impervious due to the high degree of development. This, in conjunction with the significant changes made to the natural hydrology of the Project Area, has severely limited the ability of the land to absorb and store stormwater and discharge it over time. Consequently, much of the rainfall becomes runoff and immediately enters the stormwater drainage infrastructure (Rutgers University 2007a). As described in **Section 3.12.3.6**, some of the existing drainage infrastructure is not adequately maintained, and can be overburdened by stormwater during and after severe storms. With the potential increase in frequency and intensity of stormwater-related flooding events over time, the existing stormwater infrastructure may become increasingly insufficient to address the flooding challenges in the Project Area.

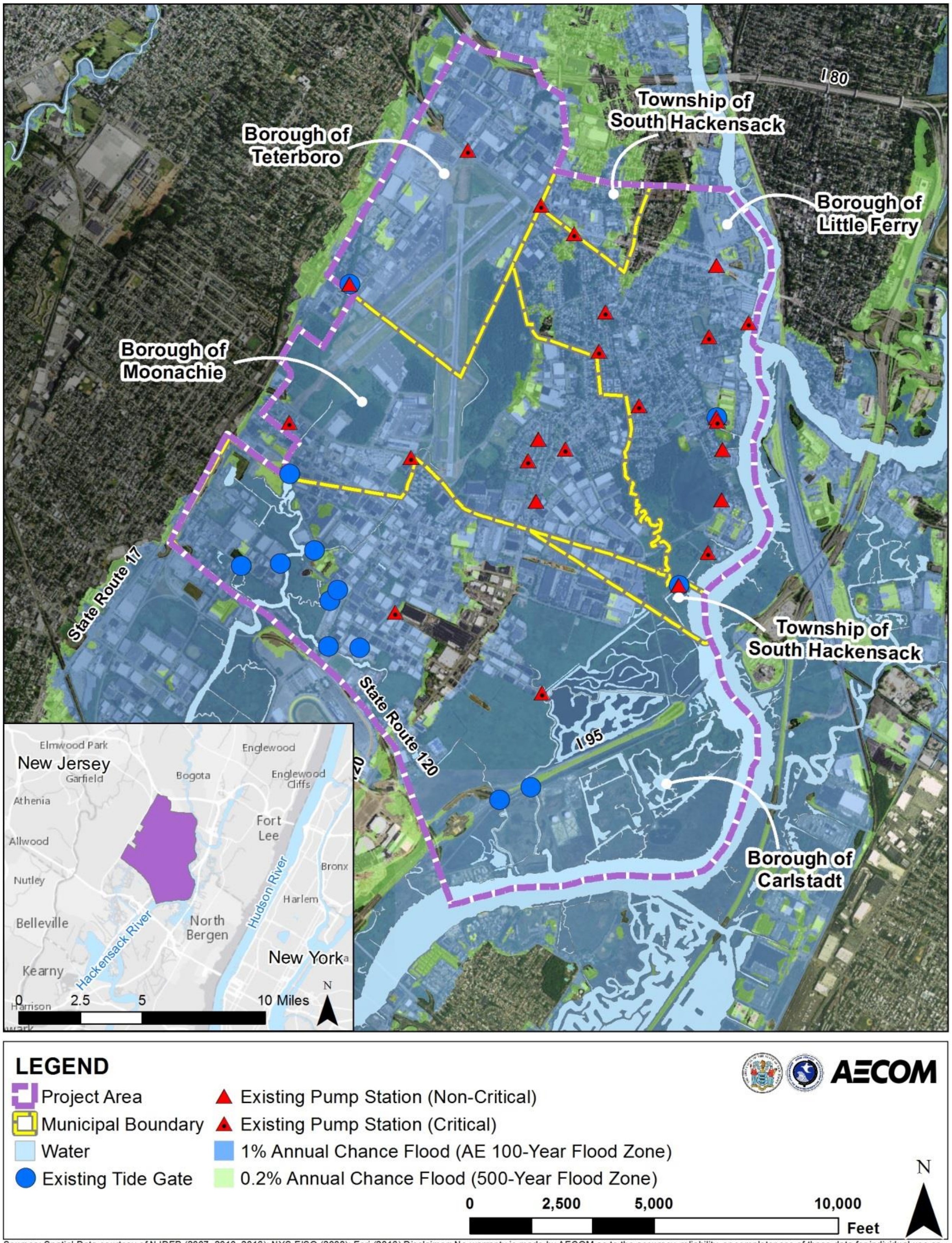


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Figure 1.4-1: FEMA's Digital Flood Insurance Rate Mapping Within the Project Area

In the Project Area, the 1-year storm is classified as 2.7 inches of rainfall in a 24-hour period (NWS 2014). In the Boroughs of Little Ferry and Moonachie, nearly 75 percent of that amount becomes runoff (Guo, et al. 2014). Flooding is further compounded when the river experiences a spring high tide, as the river is the ultimate destination for stormwater discharge. If the river is not at a lower elevation than the stormwater outfalls, they will back up until the tide recedes, unless the infrastructure has been specifically designed to mitigate this situation. A number of tide gates, pumps, and other water control structures have been installed in the Project Area to assist in the drainage process (Rutgers University 2007a).

Inland flooding is often the result of several types of rain events, including hurricanes moving up the coast, large frontal storms from the west and south (i.e., “nor’easters”), and local thunderstorms. According to the National Climatic Data Center’s storm events database, 97 heavy rain and flood events were reported in Bergen County between 1995 and 2015 (NOAA 2016). The State of New Jersey further reports that there have been 16 nor’easters (or similar storms) statewide since 1991, including nine such storms between 2007 and 2013. FEMA disasters were declared in Bergen County for three of these nor’easters (in 1992, 2007, and 2011), as well as for six other flooding events during the same time frame (New Jersey Office of Emergency Management 2014).

The impacts of inland flooding generally manifest in localized areas, such as individual roads or properties. In 2005, the New Jersey Meadowlands Commission (NJMC; which has since become the New Jersey Sports and Exposition Authority [NJSEA]) produced the Hackensack Meadowlands Floodplain Management Plan. Alhough the details of the information may be dated, the plan provides insight into the nature of the local flooding challenges. In the plan, the NJSEA highlighted 16 flood hazard areas in the Meadowlands District, eight of which are located in the Project Area. Generally, flooding in these locations was characterized by several inches to over a foot of standing water encompassing an area of hundreds or thousands of square feet (SF) (NJSEA 2005). Chronic localized flooding of roads and properties has severe impacts on local commerce, transportation, and residents by rendering roads impassable, disrupting normal activities, and causing significant commercial and residential property damage (Guo, et al. 2014, Rutgers University 2007a).

The other major source of flooding in the Project Area is coastal flooding from storm surges. Coastal flooding occurs less frequently than inland flooding, and often accompanies tropical storms. During these events, the tidally influenced Hackensack River surges over its banks and inundates the coastal floodplain. A series of old berms along the Hackensack River offers some protection against coastal inundation. However, these berms are not entirely effective because they are neither continuous nor uniform in height (US Department of Homeland Security 2014). One recent study reported that they are breached approximately every 5 years. Due to the low elevation of the entire Project Area, these breaches can lead to widespread damage (NJIT 2014). Storm surges can be particularly severe if they occur in tandem with spring high tides, since they can be substantially higher than normal high tides (Rutgers University 2007a, NJSEA 2005).

The Project Area has been severely impacted by three major hurricanes since 1999: Hurricanes Floyd, Irene, and Sandy. The most recent of these, Hurricane Sandy, also most visibly revealed the vulnerability of the Project Area to coastal flooding. Although it was not a major rainfall event, its storm surge reached 9.5 feet (NAVD 88) in the Project Area (NJIT 2014). This massive surge is estimated to have been 20 percent larger as a result of the full moon amplifying the high tide (US Department of Homeland Security 2014). Gauges in the Project Area recorded the surge to be 7 feet (NAVD 88) or higher for a duration of 6 hours (NJIT 2014). This elevation and duration were sufficient for the

Hackensack River to inundate nearly the entire Project Area. Reports suggest that the Borough of Moonachie was completely inundated and the Borough of Little Ferry was approximately 80 percent flooded (NJIT 2014, Petrecca 2012). Following the storm, the floodwaters were slow to drain because they were being retained by the old berms surrounding the communities (Borough of Little Ferry 2014).

Hurricane Sandy had enormous health and safety, critical infrastructure, and financial impacts on the Project Area. This massive, rapid inundation was unexpected, and no mandatory evacuation order was given prior to the storm. The National Guard, along with local and regional rescue teams, evacuated approximately 3,500 residents after the storm had passed (Akin and O'Brien 2012, Makely 2012). The storm also caused minor injuries to residents of the Project Area, and one man from the Township of South Hackensack was killed in the City of Hackensack, just north of the Project Area, as a result of the flooding (Keller 2012). Numerous fires and gas leaks were reported as the electricity returned to homes that were still flooded and emergency and government services were hampered. In the Borough of Moonachie, the police station and municipal buildings sustained major damage, and were forced to relocate their operations first to a county shelter in the Borough of Teterboro, and later to temporary trailers in the Borough of Moonachie (Akin and O'Brien 2012). According to a FEMA news report released one year after Hurricane Sandy in October 2013, 60 percent of the State’s schools were still closed a week later due to lack of power and heat and other safety issues. In the Project Area, students from the Borough of Moonachie spent the remainder of the school year at schools in the Borough of Wood-Ridge, and students from the Borough of Little Ferry were relocated to the Township of Lyndhurst. Schools were closed for two weeks in the Borough of Little Ferry (FEMA 2013).

Electric and natural gas service were unavailable for nearly a week following Hurricane Sandy. The lack of electricity further prolonged the flooding event, as the pump stations needed to drain the communities all lost power. As a result, some neighborhoods were flooded with 5 to 6 feet of water for up to 5 days or more following the storm (NJIT 2014). Over 1,100 residents reported having at least 1 foot of water in the first floor of their home, and several hundred reported over 4 feet of water (HUD n.d.).

The financial impact of Hurricane Sandy on the Project Area was also devastating. According to FEMA, approximately 1,700 homeowners sustained damage from the storm. The total assessed value of damage to homeowners in the five boroughs was over $21.4M. Most of this damage was concentrated in the Boroughs of Little Ferry and Moonachie, where the average damage per homeowner was approximately $12,000 (FEMA 2015a). FEMA delivered over $15.5M in assistance to homeowners and renters in the area following Hurricane Sandy (FEMA 2015b). Property values were affected as well. Between 2012 and 2013, the Borough of Little Ferry experienced a decrease in value of 1.8 percent, according to the assessed value in land. This was approximately three times the rate of depreciation the borough had been experiencing in years prior to Hurricane Sandy (Borough of Little Ferry 2014).

Although little data are available detailing the damages and costs to businesses on a municipal level, it is estimated that over 1,700 businesses in the Project Area were impacted by Hurricane Sandy from physical damage and operational losses (State of New Jersey n.d., NJIT 2014). Over 4,000 commercial private insurance claims were filed in Bergen County, which was the most out of any county in New Jersey (State of New Jersey n.d., Halpin 2013). The Borough of Moonachie was awarded the highest average commercial claim per parcel at over $20,000. Furthermore, upon review of the aggregate effects of residential, commercial, and municipal damages, as well as other factors, one study determined that the Borough of Moonachie was one of the two towns hit hardest in the State (Halpin 2013).

Evidence of the flooding problems in the Project Area can also be found in the NFIP data. As of February 2016, the average annual premium for an NFIP policy was $1,935 in the Borough of Little Ferry, $2,342 in the Borough of Moonachie, $4,323 in the Borough of Carlstadt, $2,710 in the Borough of Teterboro, and $2,270 in the Township of South Hackensack. There are a total of 1,440 NFIP policies in force in these five municipalities, which combine for $3M in written premiums and $350M of insurance (FEMA 2016a). Additionally, there have been 1,761 recorded losses in these municipalities, totaling nearly $60M in NFIP payouts (FEMA 2016b). A large portion of those losses has been the nearly 300 repetitive loss and severe repetitive loss properties, of which 255 are located in the Borough of Little Ferry, and which have combined for over 750 losses and $30.8M in payouts (Bergen County Office of Emergency Management 2015). The NJSEA is registered as an NFIP community as well, and overlaps the Project Area in part. It is unclear if any residents of the Project Area have insurance through the NJSEA NFIP community.

It is clear that the Project Area has a devastating history of inland and coastal storm surge flooding. With the anticipated effects of climate change and sea level change, flooding may become more common in the future (see **Section 3.10**). As such, the Proposed Project is needed to deliver a comprehensive flood reduction strategy that will protect life, public health, and property within the Project Area, as well as reduce flood insurance claims, maintain property values, and improve community resiliency.

1.5 National Environmental Policy Act Review Process

Because a Federal agency is funding the Proposed Project, it must comply with NEPA, and because the Proposed Project is a "major Federal action significantly affecting the quality of the human environment," an EIS must be prepared.

HUD funding requires compliance with NEPA as stated in HUD's regulations outlined in 24 CFR Part 58, *Environmental Review Procedures for Entities Assuming HUD Environmental Responsibilities*. The Proposed Project is also subject to the CEQ's *Regulations Implementing the Procedural Provisions of NEPA* at 40 CFR Parts 1500-1508. HUD has further outlined the Proposed Project's environmental review requirements in a *Federal Register* notice published on October 16, 2014 (79 FR 62182).

In accordance with 42 USC 5304(g) and HUD's regulations at 24 CFR § 58.4, HUD has provided for assumption of its NEPA authority by the State of New Jersey through the NJDCA, with NJDCA delegating NEPA Lead Agency responsibility to NJDEP for the administration of the Proposed Project, including its environmental review and preparation of the EIS. With NJDEP serving as the Lead Agency, this EIS has been prepared in accordance with NEPA, CEQ regulations (40 CFR Parts 1500-1508), and HUD regulations (24 CFR Parts 51, 55, and 58).

An EIS is a public disclosure document that provides full and open disclosure of the potential environmental impacts of a proposed Federal action, prior to making any decision to implement the action. The EIS takes an interdisciplinary approach to project evaluation; documents an objective consideration of all reasonable alternatives; identifies mitigation measures[6] to avoid or reduce adverse environmental impacts; and provides an avenue for public and agency participation in the decision-making process (40 CFR § 1502.1).

[6] NEPA defines mitigation as avoiding, minimizing, rectifying, reducing, or compensating for significant effects of a proposed action (40 CFR § 1508.20).

Following the publication of the Notice of Intent (NOI) to prepare an EIS in the *Federal Register* and local media outlets, and the conduct of a subsequent 30-day public scoping period (see **Section 1.9.2**), the Draft EIS (DEIS) is the first formal step in documenting the environmental analysis of the Proposed Project. The DEIS describes the Proposed Project's purpose and need; discusses the alternatives development process and the public involvement process; describes the alternatives to be considered in depth within the EIS, including the No Action Alternative (per 40 CFR § 1502.14(d)); identifies the regulatory requirements applicable to the Proposed Project; describes the affected natural and built environments; analyzes the potential impacts; and identifies potential mitigation measures that could be implemented to avoid, reduce, or compensate for anticipated adverse impacts.

The DEIS is published via a Notice of Availability (NOA) in the *Federal Register* and local media outlets in accordance with HUD and CEQ regulations. Following the publication of the NOA, there is a 45-day public review and comment period, during which the DEIS is made available to the general public for comment (including at a formal public hearing), and circulated to stakeholders, groups, and government agencies that have been identified as having particular interest in, or jurisdiction over, the Proposed Project.

At the conclusion of the 45-day comment period for the DEIS, NJDEP incorporates substantive public comments into the document and compiles the Final EIS (FEIS). The FEIS is circulated in the same manner as the DEIS (including the publication of a NOA in the *Federal Register* and local media outlets) and has a review/comment period of 30 days. At that time, NJDEP determines whether a public hearing on the FEIS is appropriate.

Following completion of the FEIS comment period, NJDEP prepares a Record of Decision (ROD) and Statement of Findings. The ROD summarizes the Government's decision, identifies the Environmentally Preferable Alternative, selects the alternative that will be implemented, and identifies the potential environmental impacts of that alternative, as well as the mitigation measures that the Government will implement. If additional substantive comments are received during the FEIS comment period, NJDEP addresses these comments in the ROD. An overview of the EIS process is provided in **Figure 1.5-1**.

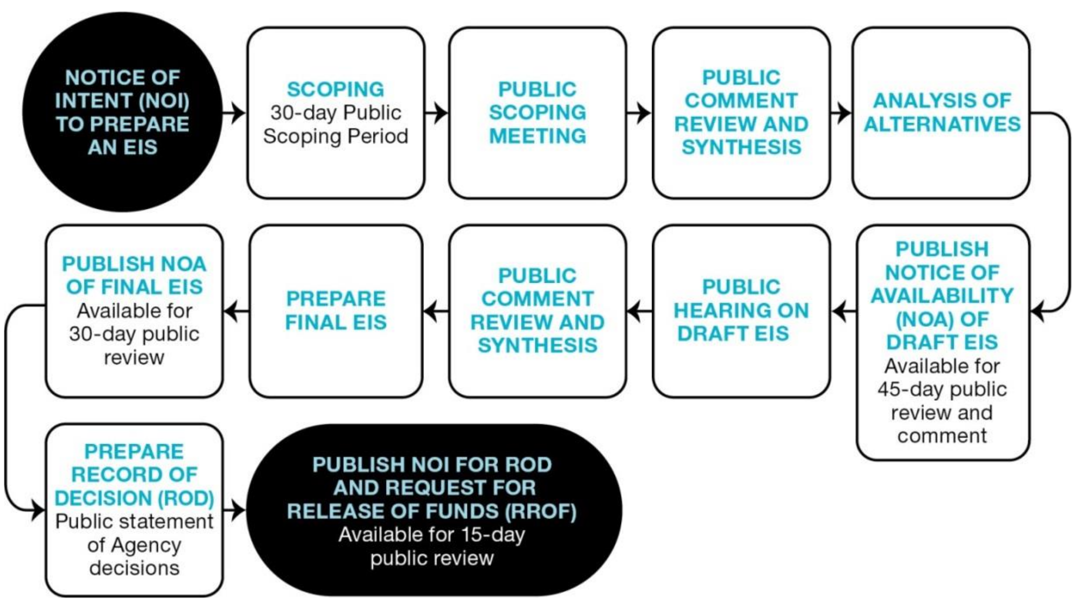


Figure 1.5-1: Overview of the EIS Process

1.6 Scope of the Environmental Impact Statement

As described in **Section 1.1**, the geographic scope of this analysis is limited to the Project Area by the RBD award. The Project Area includes the Boroughs of Little Ferry, Moonachie, Carlstadt, and Teterboro, and the Township of South Hackensack, as shown in **Figure 1.1-1**.

In accordance with NEPA and CEQ regulations, the EIS focuses on technical resource areas within the Project Area potentially subject to significant effects. Based on the results of internal and external scoping conducted as part of this NEPA process, and as codified in the Final Public Scoping Document (NJDEP 2016f), the following 21 technical resource areas are evaluated in this EIS: land use and land use planning; visual quality/aesthetics; socioeconomics, community/populations, and housing; environmental justice (EJ); cultural and historical resources; transportation and circulation; noise and vibration; air quality and greenhouse gas (GHG) emissions; global climate change and sea level change; recreation; utilities and service systems; public services; biological resources, including protected species; geology and soils; water resources, water quality, and waters of the United States (WOUS); hydrology and flooding; coastal zone management (CZM); sustainability/green infrastructure; hazards and hazardous materials; mineral and energy resources; and agricultural resources and prime farmlands.

Further, this EIS addresses the direct, indirect, and cumulative effects of the Proposed Project and alternatives on each of these technical resource areas. **Section 3.0** of the EIS presents information on the existing condition of each technical resource area within the Project Area, while **Section 4.0** provides the environmental effects analysis. Cumulative effects are described in **Section 5.0**.

1.7 Agency Roles & Responsibilities and Decisions to be Made

The NJDEP, on behalf of the NJDCA, is the Lead Agency and decision-maker concerning this Proposed Project in accordance with 42 USC 5304(g) and HUD regulations at 24 CFR Part 58*.* The NJDEP is the Responsible Entity for completing the Environmental Review through a Memorandum of Agreement (MOA) with the NJDCA. The NJDCA is the Certifying Officer for the ROD and HUD Release of Funds. States are recipients for purposes of directly undertaking a State project and must assume the environmental review responsibilities for the State's activities and those of any non-governmental entity that may participate in the project" (24 CFR §§ 58.4(a) and (b)).

The NJDEP is responsible for all decisions regarding the development and analysis of the Proposed Project, including which alternatives are analyzed in this EIS, which alternative is found to be the Environmentally Preferable Alternative, which alternative is selected for implementation (as identified in the ROD), and which mitigation measures would be implemented. The NJDEP will codify their decision-making concerning the Proposed Project in the ROD, based on the analysis in this EIS.

The NJDEP is also working closely with a number of other Federal, State, and local agencies throughout this NEPA process. During the public scoping period, the NJDEP invited numerous Federal and State agencies with jurisdiction by law or special expertise (42 USC §§ 4331(a) and 42 USC §§ 4332(2)) to participate in the NEPA process as Cooperating Agencies. The following agencies responded to the invitations by identifying themselves as Cooperating Agencies and acknowledging the NJDEP as the Lead Agency for the Proposed Project:

- FEMA
- Federal Aviation Administration (FAA)

- Federal Transit Administration (FTA), Region 2
- National Railroad Passenger Corporation (Amtrak)
- Port Authority of New York and New Jersey (PANYNJ)
- US Army Corps of Engineers (USACE), New York District
- US Environmental Protection Agency (USEPA), Region 2

Based on consultation with the FAA, the proposed bioswale along the western side of Redneck Avenue, under Alternatives 2 and 3, is located on property dedicated to Teterboro Airport. Any land release or dedication of airport property to the Proposed Project would require approval by the FAA and would need to be reflected on the Airport Layout Plan. Further, this activity could trigger a Federal Action subject to NEPA for the FAA. Therefore, the FAA is serving as a Cooperating Agency to the Proposed Project, so that they may adopt this NEPA review. NJDEP will continue to coordinate with FAA throughout the design process to ensure compliance with NEPA, FAA Orders 1050.1F and 5050.4B, FAA Advisory Circular (AC) No. 150/5200-33B, and the Teterboro Airport Wildlife Hazard Management Plan. Wildlife hazards would be considered for the Proposed Project in its entirety and not only limited to Teterboro Airport property due to its proximity to the airport and the separation distances noted in FAA AC No.150/5200-33B.

The NJDEP is also working closely with the Meadowlands Interagency Mitigation Advisory Committee (MIMAC), which is an interagency review team for mitigation banks and other mitigation projects in the Meadowlands District. The MIMAC consists of representatives from the National Marine Fisheries Service (NMFS), US Fish and Wildlife Service (USFWS), USACE, USEPA, NJSEA, and NJDEP Mitigation Unit. Additionally, the Technical Coordination Team (TCT), which is also composed of regulatory agencies having potential purview over the Proposed Project, was created by HUD to establish clear communication channels with affected Federal, State, and local agencies. These efforts support the integration of potential regulatory considerations into the early planning stages of the Proposed Project, and provide for a more efficient and streamlined review and implementation process.

Additionally, pursuant to Section 106 of the National Historic Preservation Act (NHPA) of 1966, NJDEP must consider the potential effects of this Proposed Project on any historic properties. As part of the Section 106 process, a Programmatic Agreement has been executed among the FEMA, HUD, New Jersey Historic Preservation Office (NJHPO), New Jersey Office of Emergency Management, and Advisory Council on Historic Preservation (ACHP) regarding administration of CDBG-DR funds. The NJDEP initiated the Section 106 consultation process with the NJHPO via a letter in August 2016. The NJDEP subsequently provided NJHPO with a draft Phase 1A Archaeological Survey Report and a draft Historic Structures Survey Report for review in January 2018. The NJHPO responded on March 19, 2018, by providing concurrence with the Area of Potential Effect (APE) for the Proposed Project and requesting additional information. These reports were revised and resubmitted in May 2018, and included in **Appendix E**. The NJDEP received concurrence from the NJHPO on the Phase 1A Archaeological Survey Report and Historic Structures Survey Report on June 15 and 28, 2018, respectively. A copy of the concurrence letters is included in **Appendix A**.

Copies of the letters sent to each agency invited to participate as a Cooperating Agency and those responding with their interest in serving in this capacity are included in **Appendix A**.

1.8 Consultation with Native American Tribes

As per the Section 106 Programmatic Agreement, and pursuant to 40 CFR § 1501.7(a)(1), the NHPA, and the Native American Graves Protection and Repatriation Act (NAGPRA), NJDEP is consulting with federally recognized Native American Tribes potentially having ancestral ties to the Project Area. Tribes were invited to participate in the NEPA and NHPA Section 106 processes as Sovereign Nations per Executive Order (EO) 13175 (*Consultation and Coordination with Indian Tribal Governments*).

The NJDEP sent consultation letters to the following Native American tribes on October 5, 2016, December 12, 2017, and May 25, 2018:

- Absentee-Shawnee Tribe of Indians of Oklahoma
- Delaware Nation, Oklahoma
- Delaware Tribe of Indians
- Eastern Shawnee Tribe of Oklahoma
- Shawnee Tribe
- Stockbridge-Munsee Community Band of Mohicans

In an email on October 27, 2016, the Stockbridge-Munsee Mohican Tribe declined to participate in the Proposed Project because it is outside of their cultural area of interest. On December 15, 2017, the Eastern Shawnee Tribe of Oklahoma responded that the Proposed Project was outside the known historical regional areas of their tribe, but that they should be notified if any archaeological sites or objects are discovered. On January 3, 2018, the Shawnee Tribe responded that they had no concerns regarding the Proposed Project at that time, but that they should be notified if any archaeological materials are encountered. Finally, on January 29, 2018, the Delaware Nation responded that it is primarily concerned with maintaining adequate buffers around known cultural sites, protecting/promoting indigenous plants, and being notified in the event of a discovery. Copies of the consultation letters sent to these tribes and the responses received are included in **Appendix A**. No other responses have been received to date. Consultation will be ongoing with these tribes throughout the NEPA and NHPA Section 106 processes.

1.9 Public Participation

It is vital that those who are interested in, potentially affected by, and/or have regulatory jurisdiction over the Proposed Project have an opportunity to share their concerns and provide input into the EIS and the overall NEPA process. As such, and pursuant to 40 CFR § 1506.6, NJDEP has worked diligently to involve and inform the public about the Proposed Project and the ongoing NEPA process.

1.9.1 Ongoing Public Participation Efforts

Early in the Proposed Project's planning process and prior to publication of the NOI, the NJDEP authored two public outreach documents: the Citizen Outreach Plan (COP) and the Guidance for Public Involvement (GPI); both documents are available for review at www.rbd-meadowlands.nj.gov. These documents established the following framework of public involvement and outreach strategies, designed to facilitate collaboration with the general public, including vulnerable and underserved populations, in the Proposed Project's planning, design, and implementation process, so that the public could provide relevant and timely input throughout all phases of the Proposed Project. **Figure 1.9-1** summarizes the NEPA public outreach and engagement organization for this NEPA process.

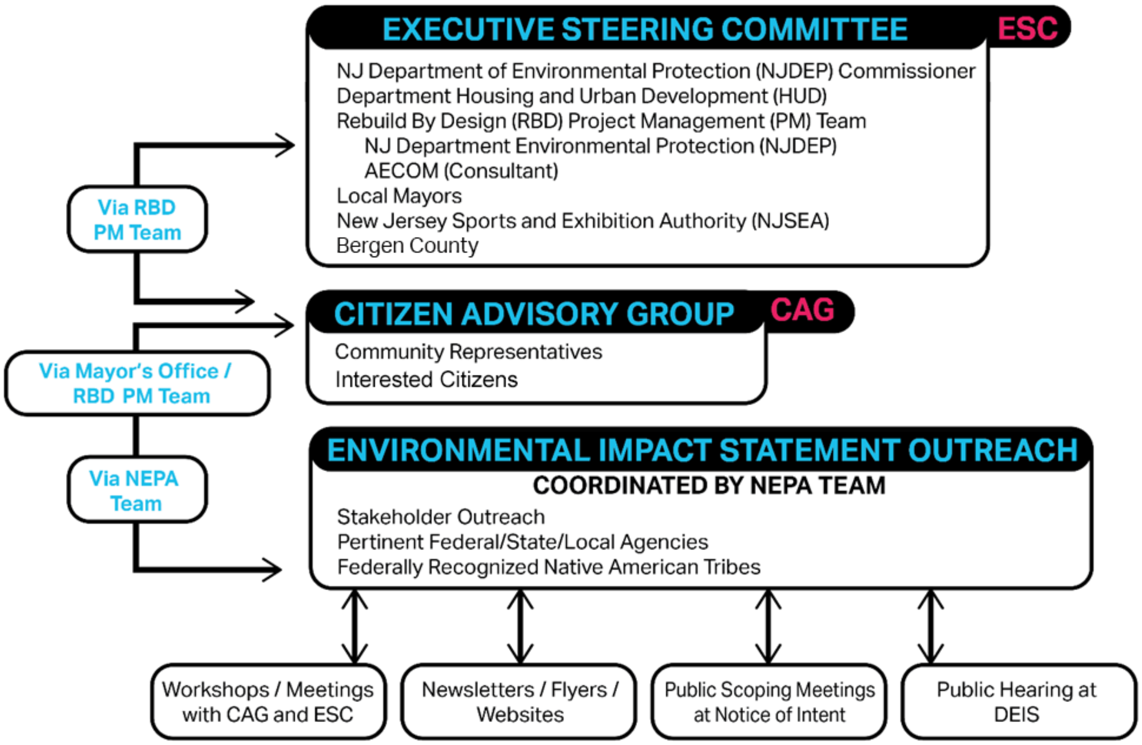


Figure 1.9-1: NEPA Public Outreach and Engagement Organization

Committee Outreach. In order to make public outreach efforts most efficient, several committees were created early in the planning process. The Executive Steering Committee (ESC), which serves as an information exchange forum for leaders of the Proposed Project, reserves seats for the mayors (or their designees) of the five affected municipalities, thereby encouraging the participation of local elected leadership in critical decisions. This committee was tasked with identifying stakeholders that represent vulnerable and underserved populations in the Project Area and developing a comprehensive communication plan for engaging stakeholders in the development of the Proposed Project. The stakeholders identified by the ESC were invited to the Citizen Advisory Group (CAG), along with stakeholders identified by the NJDEP.

Citizen Advisory Group. The CAG was created to facilitate a two-way exchange of information between NJDEP and the Project Area community. The CAG consists of citizens' representative of the community who are best positioned to network with local constituents. CAG members include local officials, representatives of non-profit organizations, business owners, and interested citizens. NJDEP has met with the CAG on a regular basis throughout the NEPA process to provide an open forum for discussion and to encourage interaction among key stakeholders. These meetings provide opportunities to keep the CAG informed of the latest Proposed Project-related developments and solicit their input on upcoming steps. CAG members have been provided an opportunity to review and provide comments on several documents (i.e., the Public Scoping Document and Concept Screening Criteria) before these data were made available to the general public, thereby influencing the direction of the Proposed Project during the planning stages. CAG meeting topics, materials, and minutes are maintained on the Proposed Project website described below.

Website and Listserv/Email. NJDEP established a website dedicated to the Proposed Project, which is available at www.rbd-meadowlands.nj.gov. This website is used to post all public documents related to the Proposed Project, including the NOI, COP, GPI, Public Scoping Document, Public Scoping Summary Report, agency and tribal consultation correspondence, and materials from public and CAG meetings. Additionally, NJDEP created a Listserv mailing list. This mailing list can be joined by any interested party, and is used to announce updates regarding the Proposed Project or the Proposed Project website. Finally, NJDEP established an email address by which interested parties can contact NJDEP directly with comments, questions, and concerns specific to the Proposed Project. This email address is rbd-meadowlands@dep.nj.gov.

Newsletter Updates. Newsletters have been published on a regular basis since the beginning of the NEPA process, and will continue until the ROD is signed. These newsletters relay the latest updates on the NEPA analysis and announce public participation opportunities. Newsletters are emailed to the Listserv mailing list, and are posted on the Proposed Project website.

1.9.2 NOI Publication and Public Scoping Period

The NEPA process formally began with HUD's publication of the NOI in the *Federal Register* on June 20, 2016. The NOI described the RBD competition, the purpose and need for the Proposed Project and the project alternative concepts as known at that time. The NOI also announced the Public Scoping Meeting and the availability of the Draft Public Scoping Document for comment. To increase local awareness, NJDEP also published the NOI, in its entirety, in local English, Spanish, and Korean newspapers. These newspapers included *The Record*, *El Diario*, and *Korea Central Daily News*. The publication of the NOI initiated the 30-day public scoping period, as outlined in 40 CFR § 1501.07, which extended through July 21, 2016. A copy of the NOI is available on the Proposed Project's website at www.rbd-meadowlands.nj.gov.

Draft Public Scoping Document and Public Scoping Meeting. The NJDEP encouraged Federal agencies and the public to participate in the public scoping process by submitting comments on the Draft Public Scoping Document. The Draft Public Scoping Document outlined the Proposed Project's purpose and need, initial range of alternatives, technical resource areas to be addressed in the EIS, proposed analytical methodologies, and other elements associated with the Proposed Project and NEPA process. The NJDEP accepted comments on the Draft Public Scoping Document by mail and email, and at the Public Scoping Meeting. The Final Public Scoping Document, along with responses to substantive comments received, is available on the Proposed Project website at www.rbd-meadowlands.nj.gov.

The Public Scoping Meeting was advertised extensively in the weeks preceding it. It was announced via municipal websites, the Proposed Project website, the Listserv mailing list, NOI publications, social media, outreach efforts of the CAG, and distribution of thousands of flyers throughout the Project Area. The Public Scoping Meeting was hosted by NJDEP on July 6, 2016 between 6:00 and 8:00 PM EDT at the Robert L. Craig School in Moonachie, New Jersey. The purpose of the meeting was to share information and obtain public input on the Proposed Project early in the NEPA process. The meeting was attended by more than 80 people, including mayors and other government officials from the five affected municipalities, HUD and NJDEP representatives, special interest groups, and residents of the Project Area.

The NJDEP provided each meeting participant with a meeting packet that included several handouts describing the Proposed Project, NEPA process, and how to submit comments. NJDEP also delivered a formal slide presentation, provided an open comment period, and conducted an open workshop session during which participants were encouraged to visit several stations relating to areas of particular concern associated with the Proposed Project.

All meeting packets and poster boards were made available in English, Spanish, and Korean. In addition, NJDEP provided translation and interpreter services at the Public Scoping Meeting, including Spanish, Korean, and American Sign Language (ASL). A court stenographer was in attendance for the full 2-hour meeting. The stenographer documented the formal slide presentation and oral comment period, and was available to document public comments during the workshop session. Additionally, for those who were unable to attend the meeting in person, a full video was recorded of the formal slide presentation and oral comment period. Copies of the meeting handouts, presentation slides, poster boards, stenographer transcript, and video recording were all made available on the Proposed Project website. For the full Public Scoping Summary Report, please refer to the Proposed Project website at www.rbd-meadowlands.nj.gov.

1.9.3 Public Review and Comment of the Draft EIS

The DEIS was made available for public review and comment. Per 40 CFR § 1506.10, the public comment period was initiated with USEPA's publication of the NOA of the DEIS in the *Federal Register* on June 1, 2018, and concluded after 45 days on July 15, 2018. During this time, the DEIS was made available to the public in multiple ways:

- The DEIS was posted on the Proposed Project website at www.rbd-meadowlands.nj.gov.
- It was available in hard copy at the following locations:
  - Little Ferry Free Public Library: 239 Liberty Street, Little Ferry, NJ, 07643
  - Moonachie Municipal Office at Port Authority, 90 Moonachie Ave, Teterboro, NJ 07608
  - Carlstadt Public Library, 420 Hackensack St, Carlstadt, NJ 07072
  - Teterboro Municipal Building, 510 US Route 46, Teterboro, NJ 07608
  - South Hackensack Municipal Clerk, 227 Phillips Ave, South Hackensack, NJ 07606
- Electronic copies of the DEIS were mailed to Cooperating Agencies, and all members on the Listserv were notified.

Additionally, a Public Hearing was held on June 26, 2018, from 6:00 PM to 8:00 PM. Comments were accepted in any of the following ways: (1) either orally or in writing at the Public Hearing; (2) emailed to the Proposed Project email address at rbd-meadowlands@dep.nj.gov; or (3) mailed to NJDEP or NJDCA directly at:

NJDEP Bureau of Flood Resilience
Attn: Mr. Dennis Reinknecht
Manager
501 East State Street
Mail Code 501-01A, PO Box 420
Trenton, New Jersey 08625-0420

New Jersey Department of Community Affairs
Attn: Lisa Ryan
Assistant Commissioner, Sandy Recovery Division
101 South Broad Street
PO Box 800
Trenton, NJ 08625-0800

Comments had to have been postmarked by July 15, 2018 in order to be considered. Following the public comment period, responses were prepared in the DEIS Public Comment Summary Report (**Appendix P**), and changes were made to this FEIS as appropriate.

1.10 Organization of this Environmental Impact Statement

This EIS describes the Proposed Project's purpose and need, the Proposed Project, the alternatives' development and analysis process, public involvement efforts, the affected environment, potential environmental impacts (including direct, indirect, and cumulative impacts) of the considered alternatives, and appropriate mitigation measures. The structure and content of this document have been developed in accordance with NEPA requirements. The main organization of this document is as follows:

Section 1.0, "Introduction and Statement of Purpose and Need," describes the Proposed Project's background and evolution; the Project Area; the purpose, need, and objectives of the Proposed Project; the NEPA process and regulatory framework; the scope of the EIS; the roles and responsibilities of agencies and tribes in the NEPA process; public participation efforts conducted; and the organization of the EIS.

Section 2.0, "Proposed Project and Alternatives," presents a detailed description of the Proposed Project and Build Alternatives, and uses a comparison table to preview the analysis presented in **Section 4.0**. **Section 2.0** also describes the alternatives development and screening process, as well as alternatives that were dismissed from further consideration in accordance with 40 CFR § 1502.14.

Section 3.0, "Affected Environment," is organized by the 21 technical resource areas that are analyzed for potential impacts in this EIS. Each discussion outlines the approach taken to analyze the technical resource area, discusses the regulatory context of the Proposed Project as it relates to the technical resource area specifically, and describes the existing conditions of the technical resource area that provide a baseline for analysis of potential impacts.

Section 4.0, "Environmental Consequences," is organized in the same manner as **Section 3.0** and describes in detail the potential physical, cultural, environmental, and socioeconomic impacts (direct and indirect) of each considered alternative of the Proposed Project, including the No Action Alternative. This section also identifies potential mitigation measures that could be implemented to avoid or reduce adverse impacts.

Section 5.0, "Cumulative Impacts," discusses the potential of each considered alternative, including the No Action Alternative, to contribute to cumulative impacts when analyzed in conjunction with other past, present, or reasonably foreseeable future (RFF) actions being taken within the same geographic and temporal scope as the Proposed Project, and identifies any potential mitigation actions that could be taken.

Section 6.0, "Other Required Disclosures," discusses the relationship between short-term uses of the environment and potential long-term productivity of the Proposed Project; the irreversible and irretrievable commitments of resources associated with implementation of the Proposed Project; and the significant and non-significant potential impacts of the Proposed Project.

Section 7.0, "List of Preparers," lists all individuals involved in the preparation of this EIS.

Section 8.0, "References," provides a bibliography of all sources cited in this EIS.

Section 9.0, "Glossary," contains an index of all major topics for easy reference.

Section 10.0, "List of Stakeholders," lists all agencies, officials, and Native American tribes that have been consulted throughout the NEPA process.

Section 11.0, "Comments and Responses to Comments on DEIS," will be presented in the FEIS, and will contain a matrix of comments received on the DEIS during the public comment period, NJDEP's response to each comment, and a description of any changes made to the FEIS as a result of each comment.

2.0 Proposed Project and Alternatives

2.1 Introduction

The Proposed Project, as outlined in the NOI and Public Scoping Document (see **Section 1.9.2**), is an urban water management project designed to reduce the risk of flooding from coastal storm surges and/or systemic inland flooding from large rainfall events within the Project Area, thereby protecting public health, public safety, and property. The Project Area for the Proposed Project includes a portion of the New Jersey Meadowlands District, which was heavily affected by Hurricane Sandy in 2012, and is known to have recurring flooding problems from more typical storms (see **Section 1.4.2**).

The NJDEP has identified three Build Alternatives to be carried forward for analysis within this EIS:

- **Alternative 1:** Structural Flood Reduction
- **Alternative 2:** Stormwater Drainage Improvements
- **Alternative 3:** Hybrid of Alternative 1 and Alternative 2

After an extensive alternatives development and evaluation process, these three Build Alternatives were determined to be the only feasible alternatives that would meet the purpose and need for the Proposed Project, as described in **Section 1.4**. These alternatives were evaluated through application of the publicly reviewed Concept Screening Criteria Matrix, described in **Section 2.3**.

In developing these three Build Alternatives, a wide range of other alternatives were initially considered, but ultimately eliminated from consideration during the planning stages of the Proposed Project. Those alternatives, and the rationales for their elimination, are outlined in **Section 2.4**. In addition to the three Build Alternatives identified above, and in accordance with 40 CFR § 1502.14(d), the NJDEP also fully analyzed the No Action Alternative as documented in this EIS. A full description of each Build Alternative and the No Action Alternative is provided in **Section 2.5**. The NJDEP has identified Alternative 3 as the Preferred Alternative for implementation.

2.2 Description of Proposed Project

2.2.1 Project Location

The Project Area consists of portions of the following five municipalities: Borough of Little Ferry, Borough of Moonachie, Borough of Carlstadt, Borough of Teterboro, and the Township of South Hackensack.

As discussed in **Section 1.2**, land use in the Project Area can be divided into four general regions. The northwest quadrant of the Project Area is dominated by the Teterboro Airport and some industrial areas, generally associated with airport operations; the northeast quadrant is comprised primarily of residential and commercial land use; the southeast quadrant consists of large wetland complexes; and the southwest quadrant consists mostly of industrial land use (see **Figure 3.2-1**). The Build Alternatives of the Proposed Project were designed to capitalize on, complement, and maximize the utility of each of these various existing land uses.

The Project Area has an extensive history of both coastal surge and systemic inland flooding. As such, numerous tide gates, pump stations, berms, levees, and ditches have been constructed within and surrounding the Project Area over time in an attempt to alleviate flooding (see **Section 3.17**). Therefore, in addition to the installation of new infrastructure, the Proposed Project seeks to integrate targeted improvements to the existing infrastructure, thereby resulting in a cohesive and efficient flood reduction solution for the Project Area.

The Proposed Project further seeks to account for projected sea level rise (SLR) in its design. As described in **Section 3.10**, coastal hydrodynamic models were used to analyze potential flooding for the Proposed Project under two SLR scenarios, which included the National Oceanic and Atmospheric Administration (NOAA) Intermediate-Low scenario, which projects 1.2 feet of SLR by 2075, and the NOAA Intermediate-High scenario, which projects 2.4 feet of SLR by 2075.

In accordance with 40 CFR §1501.2, the Proposed Project's design and NEPA processes were initiated concurrently, such that existing environmental resources could be considered and integrated into the alternatives development, screening, and design processes, including the Feasibility Study Report.[7] When evaluating locations for implementation of the individual components for the Proposed Project (e.g., the alignment for Alternative 1), the NJDEP further analyzed and integrated environmental data collected as part of this NEPA process, including information concerning hazards and hazardous materials sites, wetlands and waterways, utilities infrastructure, and other environmental values and amenities, as discussed in **Section 3.0**.

This integration of environmental data into the alternatives development process enabled the Proposed Project to be designed in a manner that would simultaneously: (1) minimize adverse physical, environmental, cultural, and socioeconomic impacts; (2) maximize potential beneficial environmental impacts; and (3) optimize flood risk reduction within the existing funding and congressionally mandated schedule limitations.

2.2.2 Project Characteristics

The Proposed Project is needed to reduce the risk of floods from coastal storm surges and/or systemic inland flooding from large rainfall events within the Project Area. To address one or both of these flooding scenarios, the Proposed Project would implement a wide variety of infrastructure components as part of its flood risk reduction solution. Each component would be sited within the Project Area to address a current need and operate in an integrated manner with other proposed or existing flood reduction infrastructure. These components are described in the following sections according to the flooding scenario they are most commonly used to address.

2.2.2.1 Coastal Storm Surge Flood Reduction Components

Alternatives 1 and 3 would implement a line of protection (LOP) around the Project Area that would guard against flooding from the Hackensack River and Berry's Creek during coastal storm surges.[8] This LOP would provide protection to an elevation of 7 feet (NAVD 88), and would consist of both compacted earthen structures (e.g., berms and levees) and engineered structures (e.g., floodwalls).

Public realm and ecological benefits would also be incorporated, as appropriate. Minor public realm components, such as planters, benches, and viewing platforms, would be integrated into the alignment where site constraints drive the need for a smaller footprint. In other locations, there may be room to

[7] The Feasibility Study Report was conducted to analyze the social, economic, environmental, and resiliency benefits and costs associated with implementation of each Build Alternative and the No Action Alternative based on existing conditions.

[8] As an essential requirement of the Proposed Project as directed by HUD, coastal storm surge flood protection measures must not induce flooding elsewhere.

create larger public realm opportunities, such as parks and walkways. Coastal storm surge flood reduction structures include the following, and are shown in **Figure 2.2-1**:

- **Berms and Levees** – Berms and levees consist of compacted earth. The core of these structures, generally composed of clay, is impermeable so as to prevent seepage and structural weakening (FEMA 2007). The outer layer is vegetated in order to prevent erosion. Generally, levees are larger than berms, and are constructed along large waterways (i.e., rivers) to contain flood events (FEMA 2007, FEMA n.d.). Berms, which are similar in construction to levees, can be implemented in a wider array of circumstances due to their smaller sizes. For example, berms are often constructed along individual properties to prevent flooding or along ditches or channels in order to prevent overflow during storms. Because berms and levees consist of mounds of compacted earth, their width must be greater than their height in order to maintain structural integrity. As such, they require correspondingly large footprints of property in order to be constructed (FEMA 2007). Depending on size and location, berms and levees can sometimes be fitted with pathways for pedestrian and bicycle transportation. The type of vegetation used for stabilization can also be chosen and maintained in a manner that creates specific ecological habitats and improvements, such as use of native vegetation. Further, berms can be incorporated into public open space to enhance community recreation areas.
- **Floodwalls** – Floodwalls are engineered walls usually made from concrete or steel (FEMA n.d.). Floodwalls are often more expensive than earthen structures due to the greater efforts required for construction and installation. However, they generally provide greater flexibility for design and implementation. For example, unlike earthen structures, floodwalls can be constructed at varying heights independent of their width because their foundation extends vertically into the ground beneath them. This relatively small geographic footprint often makes them the preferred flood control structure in areas where space is limited, such as in developed areas. They also have a wider array of potential co-utilities. Whereas berms and levees must be maintained as vegetated mounds of earth, floodwalls have greater design flexibility to complement the existing landscape and/or land use (FEMA 2007).

  Floodwalls can also be designed with a number of social amenities.[9] For the Proposed Project, floodwalls could include raised walkways into their design in some locations. These features would provide added value to the community by creating new gathering areas along the Hackensack River. This type of feature would be integrated into the LOP in residential and commercial portions of the Project Area, where they would most effectively serve the public. However, in areas where public use or aesthetic appearance is less important, floodwalls would be designed as, for example, simple sheet pile walls, which are just as effective at a lower cost. Finally, in some circumstances, floodwall alignments are required to traverse areas that normally must remain open, such as roadways. In these locations, portions of the floodwall (i.e., closure gates) can be deployed, as needed, when flooding is imminent.
- **Tide Gates** – Tide gates are barriers designed to allow one-way directional flow of water from a drainage structure (i.e., a ditch or culvert) to a tidal waterbody. This occurs during low tide, when the tide is lower than the drainage structure. During high tide, when the tide is higher than the drainage structure, the tide gate closes to prevent the tidewater from flowing back through the drainage structure due to gravity (Giannico and Souder 2005). Surge barriers are similar to tide

[9] Social amenities are characteristics that benefit the general public, such as seating or congregation areas, vegetation, or aesthetically pleasing features.

gates, but are only closed during flood events in order to prevent tidal storm surges from inundating a water channel and proximate, lower elevation areas upstream.

- **Pump Stations** – Pump stations are constructed to move water from one location to another, and vary substantially in terms of the volume of water they are capable of moving reliably. Pump stations may be installed in locations that regularly require water to be pumped, such as flat areas where drainage is naturally difficult, or in locations that accumulate large amounts of water during floods and need to be pumped on occasion. In the Project Area, pump stations are often located behind tide gates or along ditches, so that they can keep water flowing in locations where drainage is either naturally difficult or impeded by a closed tide gate.

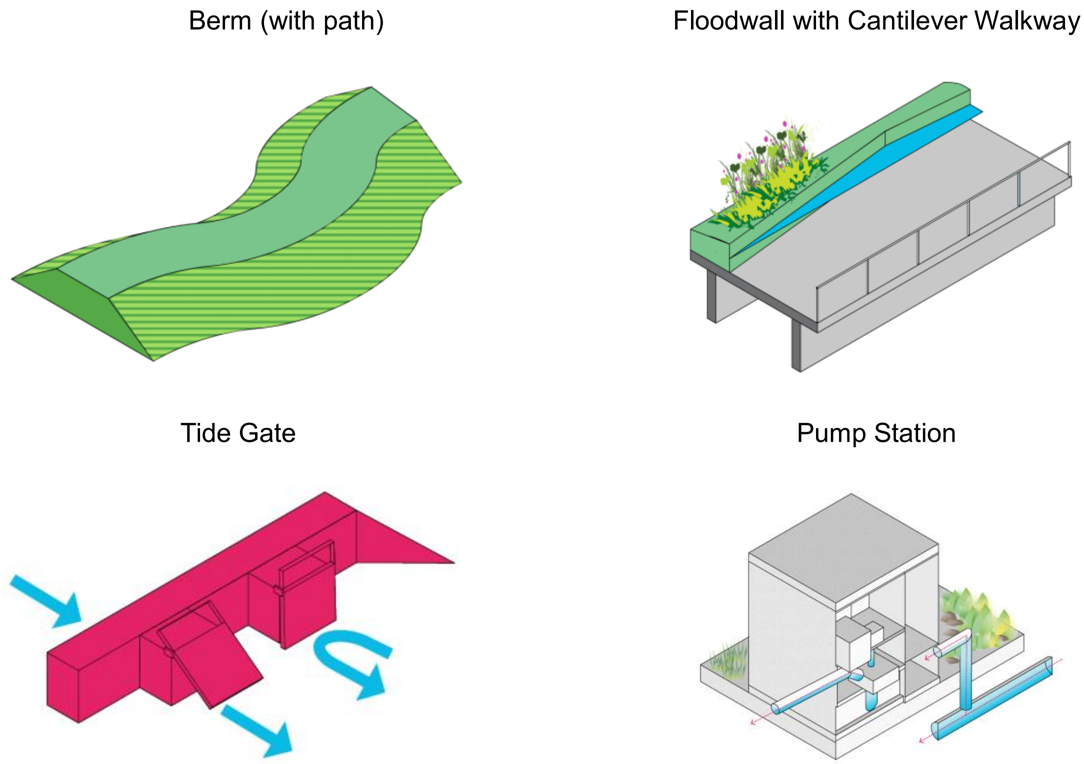


Figure 2.2-1: Coastal Storm Surge Flood Reduction Components

2.2.2.2 Inland Flood Reduction Components

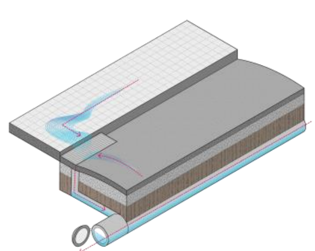
Alternatives 2 and 3 would reduce flooding in the Project Area that results from under-performing stormwater drainage infrastructure. This would be accomplished through new construction of both grey and green infrastructure in key locations throughout the Project Area. For the purposes of this document, grey infrastructure typically refers to built infrastructure, such as stormwater sewers or pumping stations. Green infrastructure, such as rain gardens, bioswales, landscaped open space, and pervious pavement, refers to environmental solutions designed to reduce flow volumes and peaks (through infiltration and storage) and treat stormwater pollutants (through vegetation) at its source, while also providing potential social, environmental, or economic benefits (USEPA 2016q).

Grey and green infrastructure are not mutually exclusive; often a combination of both is used to achieve the best results in terms of flood reduction and water quality performance, cost effectiveness, and additional benefits. Grey and green infrastructure can also be integrated within a single flood reduction feature. For example, green infrastructure components of the Proposed Project would be designed to capture and treat runoff from the NJDEP Water Quality Design Storm, which is 1.25 inches of rainfall within a 2-hour span (NJDEP 2004a). For major flooding events that exceed the capacity of green infrastructure, grey infrastructure elements could be installed to address the excess stormwater. Grey infrastructure can also reduce potential damage to green infrastructure during more intense events. The various grey and green infrastructure elements incorporated into this alternative are described below.

Grey Infrastructure: Grey infrastructure elements included in the Proposed Project consist of the following components, which are illustrated in **Figure 2.2-2**:

- **Force Mains** – A force main is a pressurized pipe. Stormwater pipes most often operate using the force of gravity to keep the stormwater flowing. However, in some cases, pipes must be installed where gravity is not sufficient to keep stormwater flowing, such as when the pipe must be installed at a nearly flat angle, or when the pipe must go uphill. In these situations, pumps or compressors are used to pressurize the pipes to keep the stormwater flowing.
- **Backflow Preventers** – Backflow preventers are flapgates, valves, or other devices used to prevent water from flowing backwards through the stormwater drainage infrastructure. For example, it is possible that a spring high tide or storm surge in the Project Area could increase the elevation of the Hackensack River above the elevation of some stormwater drainage outfalls. Without backflow preventers, this could result in river water traveling backwards through the stormwater drainage pipes and into the streets of the Project Area.
- **Channel Improvements** – Channel improvements can take several different forms depending on local conditions. Channels can be widened or deepened to increase stormwater capacity. They can also be relocated or reshaped (e.g., straightened) to improve conveyance. Finally, channels can be improved to prevent erosion and/or enhance ecological conditions and values, which benefit both water quality and biological resources.
- **Berms** – Berms may be installed along ditches or ponds in order to improve their stormwater storage and conveyance capacities. Berms were previously described in **Section 2.2.2.1**.
- **Pump Stations** – Pump stations may be installed in areas that are naturally slow to drain (see **Section 2.2.2.1**).

Force Main with Backflow Prevention



Channel Improvements

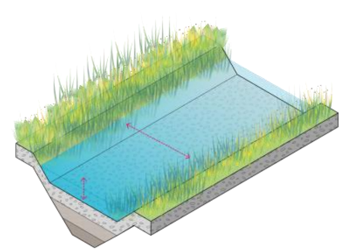


Figure 2.2-2: Inland Flood Reduction Components – Grey Infrastructure

Green Infrastructure: Green infrastructure elements included in the Proposed Project consist of the following components, which are illustrated in **Figure 2.2-3**:

- **Rain Gardens** – Rain gardens are landscaped stormwater collection basins that are designed, based on the soil and vegetative composition, to absorb and filter stormwater. Rain gardens are often located such that they can collect stormwater from roofs, streets, and other impervious areas. They allow collected stormwater to infiltrate the ground or be absorbed by vegetation, thereby reducing stormwater flow that could cause flooding and relieving stress on the overall stormwater drainage infrastructure. Additionally, rain gardens help to improve water quality. As stormwater travels through these systems, soil, pollutants, sediment, and excess nutrients settle out. Stormwater runoff is a major source of pollution for surface waterbodies, such as streams and rivers. By directing stormwater into the soil or vegetation, rain gardens help to filter out these pollutants before they reach a receiving waterbody (USEPA 2017).
- **Bioswales** – Bioswales are essentially rain gardens in the form of a channel. Often found along streets or parking lots, bioswales collect stormwater and convey it toward an outlet. During this process, the stormwater has the opportunity to infiltrate the ground or be taken up by vegetation, thus decreasing the amount of stormwater that reaches the outlet. Like rain gardens, bioswales also help to filter out pollutants before stormwater reaches a receiving waterbody (USEPA 2016q). Depending on location, bioswales can be 4 to 8 feet wide and up to 40 feet long.
- **Storage Trenches/Tree Trenches** – Storage trenches are non-vegetated subsurface basins typically used where the ground surface needs to be repaved or reestablished as lawn due to the existing site use. Street runoff is diverted to storage trenches by stormwater inlets, where it either infiltrates to native soil, or, where infiltration is not feasible, the system underdrains back into the existing stormwater sewer system. A typical storage trench consists of up to 4-feet of stone aggregate wrapped in geotextile fabric and an underdrain that reconnects to the existing stormwater system. Where existing site conditions allow for small unpaved areas like tree pits, trees may be added to a storage trench to enhance street landscapes, and these systems are typically referred to as **Tree Trenches**. Tree trenches do not capture runoff or provide surface runoff treatment like bioswales, but do allow for stormwater uptake through the tree root systems, which reduces the volume of runoff reaching the existing storm sewer system.
- **Permeable Pavement** – Impervious surfaces are a leading cause of stormwater drainage challenges in developed areas. Impervious surfaces prevent infiltration and convey all rainfall into the stormwater drainage infrastructure, whereas in undeveloped areas the stormwater is naturally absorbed, to a large degree, by the land. Permeable pavement provides a surface that is mostly paved, but that permits some infiltration of rainfall into the ground, thereby decreasing the amount of stormwater carried offsite by the drainage infrastructure. Permeable pavement can be created with a variety of materials, such as porous asphalt or spaced paver stones (USEPA 2016q).
- **Wetland Improvements** – Wetlands provide similar functions as rain gardens. However, wetlands remain saturated on a seasonal or year-round basis, while rain gardens are normally dry, except after storm events. Wetlands capture and store stormwater, and remove pollutants, sediment, and nutrients. Additionally, wetlands provide valuable habitat for a wide variety of plant and animal species (ASLA 2017).
- **Parks/Open Spaces** – New or improved parks or open spaces provide additional opportunities for water to be collected and absorbed by the land. These areas also provide additional recreational opportunities, such as playing fields. Within the Project Area, such areas would provide public access to the Hackensack River, as well as include targeted habitat improvements.

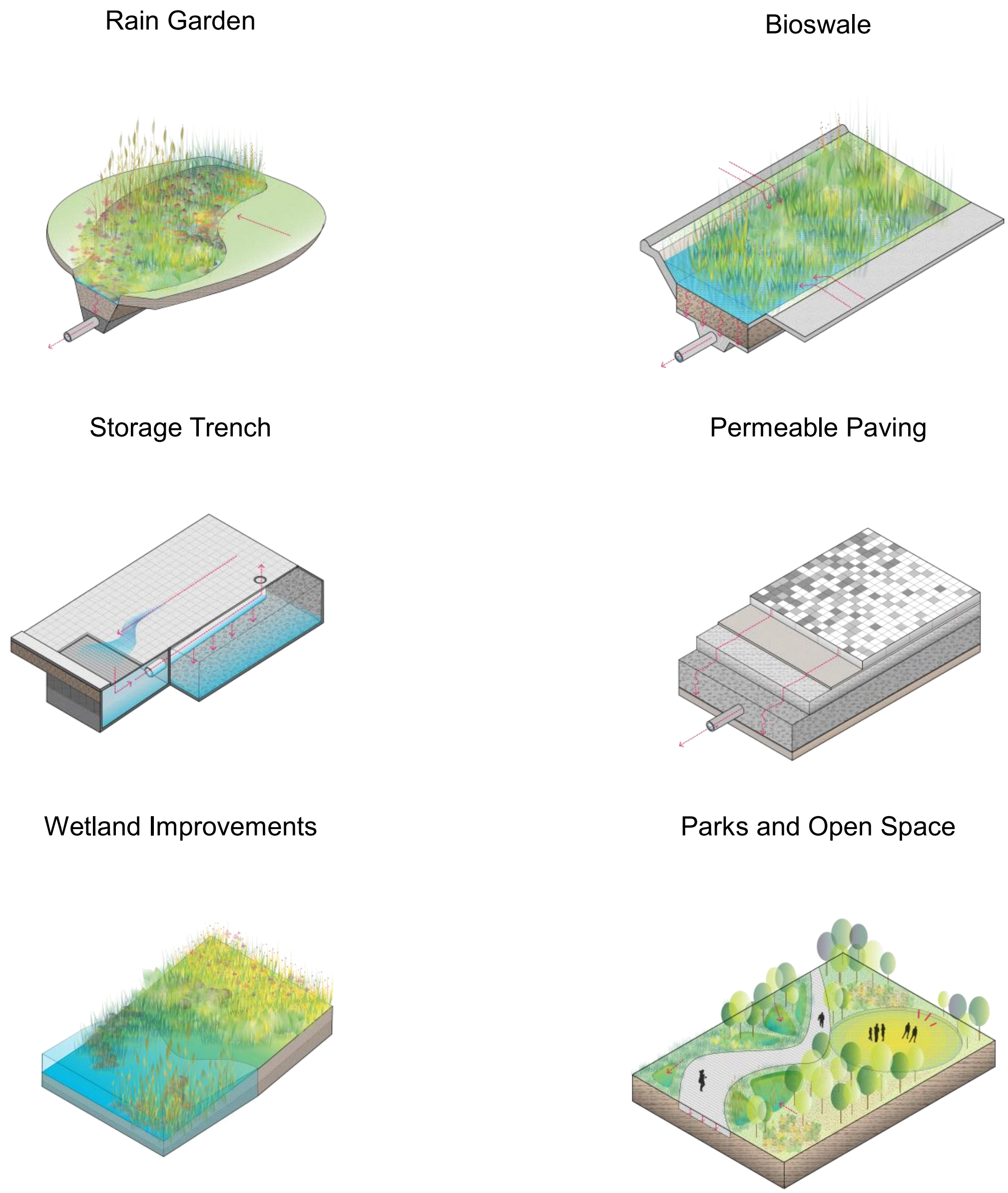


Figure 2.2-3: Inland Flood Reduction Components – Green Infrastructure

2.3 Alternatives Screening Criteria and Process

Using the features described in **Section 2.2.2**, the NJDEP assembled numerous design concepts to identify the most effective and feasible solutions to coastal and inland flooding in the Project Area. Throughout the alternatives development process, these concepts were refined iteratively until the three final Build Alternatives were established (see **Section 2.5**). To inform the refinement of the various alternatives considered, the NJDEP developed a Concept Screening Criteria Matrix, which is shown in **Table 2.3-1**. This Concept Screening Criteria Matrix was presented to and reviewed by the ESC and CAG, and was subsequently revised to incorporate comments from these groups.

The Concept Screening Criteria Matrix included an array of criteria by which the various concepts could be measured and compared. Individual screening criteria in the matrix were established based on the

Proposed Project's purpose and need (see **Section 1.4**), including its goals and objectives; potential impacts to the natural environment and the community; and the Proposed Project's overall feasibility.

Examples of screening criteria included were: performance criteria (such as flood risk reduction effectiveness); environmental constraints (including but not limited to cultural resources, hazardous waste, and EJ); community interests (such as access to the Hackensack River); and feasibility factors (such as constructability and construction cost). The matrix identified initial, broad relative levels of potential impact for each criterion by applying a Good-Fair-Poor-Fatal Flaw ranking and using both quantitative and qualitative metrics, as appropriate.

As the alternatives development process progressed, the Concept Screening Criteria Matrix was used to identify which structural flood reduction and/or stormwater drainage improvement concepts met the purpose of and need for the Proposed Project. These concepts were advanced as the Proposed Project's Build Alternatives. These Build Alternatives are subjected to full analysis within this EIS (see **Section 4.0**) and the associated Rebuild by Design Meadowlands (RBDM) Feasibility Study Report (NJDEP 2018). The RBDM Feasibility Study Report provides a more detailed summary of the alternatives development and screening process.

Table 2.3-1: Concept Screening Criteria Matrix

	Screening Criteria	Comparative Concept Screening Metrics[10]			
		Good	Fair	Poor	Fatal Flaw
FLOOD RISK REDUCTION	Reduces Flood Risk from Coastal Storm Surge	Provides the greatest relative reduction in future flood risk, as measured by annual flood damage reduction, from coastal storm surge risk.	Provides a moderate relative reduction in future flood risk, as measured by annual flood damage reduction, from coastal storm surge risk.	Provides the least relative reduction in future flood risk, as measured by annual flood damage reduction, from coastal storm surge risk.	Plan induces increased flooding from coastal storm surge in the Project Area or elsewhere.
FLOOD RISK REDUCTION	Reduces Flood Risk from Rainfall /Interior Drainage Challenges	Provides improved discharge corridors and/or natural stormwater storage for most high priority inflow locations/localized flooding areas in the Project Area.	Provides improved discharge corridors and/or natural stormwater storage for some high priority inflow locations/localized flooding areas in the Project Area.	Provides improved discharge corridors and/or natural stormwater storage for few to none high priority inflow locations/localized flooding areas in the Project Area.	Plan may induce increased flooding from interior rainfall in the Project Area or elsewhere.
FLOOD RISK REDUCTION	Provides Protection to Vulnerable and Underserved Populations	Protects the greatest relative number of vulnerable and underserved populations as compared to other concepts.	Protects a moderate relative number of vulnerable and underserved populations as compared to other concepts.	Protects least relative number of vulnerable and underserved populations as compared to other concepts.	Plan provides no improved protection to vulnerable or underserved populations or increases the risk to these populations.
FLOOD RISK REDUCTION	Provides Protection to Critical Infrastructure (emergency services, hospitals, transit facilities)	Protects the greatest relative amount of critical infrastructure as compared to other concepts.	Protects a moderate relative amount of critical infrastructure as compared to other concepts.	Protects the least relative amount of critical infrastructure as compared to other concepts.	N/A

[10] Use of the terms “relative” or “relatively” indicates that concepts are compared to each other.

Screening Criteria		Comparative Concept Screening Metrics[10]			
		Good	Fair	Poor	Fatal Flaw
BUILT ENVIRONMENT/HUMAN ENVIRONMENT	**Effects to Existing Utilities & Utility Infrastructure**	Requires no or only limited relocations of existing utility infrastructure.	Requires a moderate amount of relocations of existing utility infrastructure.	Requires a large amount of relocations of existing utility infrastructure. However, these impacts could be mitigated in concert with Proposed Project implementation.	N/A
	Effects to Existing Transportation Network, Local Traffic, and Connectivity	Includes features to improve connectivity (vehicles, bike, pedestrians) of the street system that would improve connections and traffic circulation. Would result in long-term benefits to transportation infrastructure, with no adverse impacts to transportation infrastructure.	Does not include features to improve connectivity (vehicles, bike, pedestrians) of the street system that would improve connections and traffic circulation. However, the concept would not adversely affect existing or future-planned connectivity. Would not result in any long-term transportation improvements. May result in neutral or minor adverse impacts to transportation infrastructure.	May decrease connectivity or traffic circulation at some locations and/or conflict with future opportunities to improve connectivity (vehicles, bike, pedestrians). Would not result in any long-term transportation improvements. Would result in mitigatable adverse impacts to transportation infrastructure during construction or operation.	Would result in significant adverse impacts to transportation infrastructure in the Project Area
	Effects on Land Acquisition / Housing Displacements	May result in land use improvements over the long term. Would not require land acquisitions / easements, housing demolition, or permanent relocations.	Would not result in land use improvements over the long term. Would require minimal land acquisitions / easements. No housing demolition or permanent relocations would be required.	Would not result in land use improvements over the long term. Would require numerous land acquisitions / easements, and minimal housing demolition or permanent relocations.	Would result in extensive land acquisitions/ easements, housing demolition, or permanent relocations.

Screening Criteria		Comparative Concept Screening Metrics[10]			
		Good	Fair	Poor	Fatal Flaw
BUILT ENVIRONMENT/HUMAN ENVIRONMENT	**Potential to Provide Increased Waterfront Access**	Includes features that would improve waterfront access within the Project Area.	Does not include features that would improve waterfront access within the Project Area.	Would result in a minor decrease in waterfront access within the Project Area.	Would result in a significant decrease in waterfront access within the Project Area and/or would significantly preclude future waterfront access within the Project Area.
BUILT ENVIRONMENT/HUMAN ENVIRONMENT	**Effects to Recreational, Civic, and Cultural Amenities and Uses**	Incorporates many new and/or improved amenities to support recreational, commercial, and cultural activities.	Incorporates few new and/or improved amenities to support recreational, commercial, and cultural activities.	Incorporates no new and/or improved amenities to support recreational, commercial, and cultural activities.	N/A
BUILT ENVIRONMENT/HUMAN ENVIRONMENT	**Effects to Viewshed and Local Visual Quality**	Includes features that would enhance views of water and other natural areas.	Does not include features that would enhance views of water and other natural resources.	Includes features that would result in any decrease in views of water and natural areas.	Would result in extensive impacts to local viewshed and/or preclude future viewshed enhancements within the Project Area.
BUILT ENVIRONMENT/HUMAN ENVIRONMENT	**Effects to Air Traffic Safety at Teterboro Airport**	Includes features that would result in no increased threat to air traffic at Teterboro Airport, such as from plane collisions with wildlife.	N/A	Includes features that may result in a minor, but mitigatable, increased threat to air traffic at Teterboro Airport.	Includes features that may result in a moderate or high increased threat to air traffic at Teterboro Airport.

Screening Criteria		Comparative Concept Screening Metrics[10]			
		Good	Fair	Poor	Fatal Flaw
CONSTRUCTION/ MAINTENANCE & OPERATIONS	**Constructability**	No need to relocate major infrastructure and minimal disruption to business operation/public access during construction.	Some need to relocate major infrastructure and/or some major disruption to business operation/public access during construction.	Need to relocate major infrastructure and/or would result in major disruption to business operation/public access during construction.	Construction could not be completed within the scope and budget of the Project.
	Minimizes Long-Term Maintenance & Operation Requirements for Overall System	Features include a large proportion of permanent, self-sustaining structures, with fewer deployable or high maintenance structures, that require a low, long-term operations and maintenance (O&M) commitment. Few or no features with potential for human error are included.	Features include a moderate proportion of permanent, self-sustaining structures, with more deployable or high maintenance structures, that require a moderate, long-term O&M commitment. Features with potential for human error are included.	Features include a small proportion of permanent, self-sustaining structures, with a greater number of deployable or high maintenance structures, that require a high, long-term O&M commitment. Several features with potential for human error are included.	N/A
	Potential to Complete by September 2022	High probability that construction would meet Project temporal requirements. Permits required pose no/low risk to project schedule.	Moderate probability that construction would meet Project temporal requirements. Permits required pose a moderate risk to project schedule.	Low probability that construction would meet Project temporal requirements. Permits required pose a significant risk to project schedule.	Construction and initial operating condition could not be achieved by September 2022.

Screening Criteria		Comparative Concept Screening Metrics[10]			
		Good	**Fair**	**Poor**	**Fatal Flaw**
NATURAL ENVIRONMENT	**Effects to Existing Hazardous Waste Sites**	Features may facilitate the implementation of remedial investigation and remedial actions or reduce the potential to spread contamination, a long-term beneficial effect.	Features are primarily compatible with ongoing remedial investigations and remedial actions.	Features would interfere with ongoing remedial investigations or remedial actions, but not preclude such investigations or actions.	Significant impacts to hazardous waste sites, remedial investigations, and/or remedial actions, and/or results in potential to spread contamination in the environment.
	Effects to Berry's Creek Remediation	No potential for physical, hydrologic, or hydraulic impacts to Berry's Creek Study Area that may impact remediation plan.	Potential physical, hydrologic, or hydraulic impacts to Berry's Creek Study Area that may impact remediation plan.	Physical, hydrologic, or hydraulic impacts to Berry's Creek Study Area that may impact remediation plan.	Would result in significant impacts to Berry's Creek remedial activities, and/or result in potential to spread contamination in the environment.
	Effects on the Transport of Environmental Contaminants/ Sediments during Flood Events	In affected areas, would prevent the inadvertent transport of unsecured hazardous materials during flooding. Contaminated sediments would not be re-suspended. No increase in impacts in unaffected areas.	In affected areas, would reduce the inadvertent transport of unsecured hazardous materials during flooding. The resuspension of contaminated sediments may occur, but effects would be of short duration and could be mitigated using best management practices. No increase in impacts in unaffected areas.	In affected areas, unsecured hazardous materials would continue to be subject to transport by floodwaters as under current conditions. The ongoing resuspension of contaminated sediments would occur, as would the continued dispersion of same throughout the environment similar to existing levels.	Would increase transportation or resuspension of contamination and/or contaminated sediments during flood events as compared to current conditions.

Screening Criteria		Comparative Concept Screening Metrics[10]			
		Good	**Fair**	**Poor**	**Fatal Flaw**
NATURAL ENVIRONMENT	**Effects to Water Resources, including Water Quality, "Waters of the US," Wetlands, and Mitigation Banks**	Includes features that protect, enhance, and/or create water resources in the Project Area. Would result in long-term water resource and water quality improvements.	Does not include features that protect, enhance, and/or create water resources in the Project Area. Would result in no potential for long-term water resource or water quality improvements. May have neutral or minor adverse effects.	Does not include features that protect, enhance, and/or create water resources in the Project Area. Includes features that would result in adverse, but mitigatable, impacts to water resources or water quality over the long term. No adverse effects to wetland mitigation banks and ongoing wetlands restoration activities.	Would result in significant adverse impacts to water resources or water quality in the Project Area or elsewhere, and/or would adversely impact existing wetland mitigation banks and ongoing wetlands restoration activities.
	Effects to Fisheries and Essential Fish Habitat (EFH)	Includes features that protect and/or enhance connectivity of fisheries habitats and/or facilitate fish migration. Would result in long-term beneficial effects. No adverse impacts to EFH.	Does not include features that protect and/or enhance connectivity of fisheries habitats and/or facilitate fish migration. Would result in no potential for long-term beneficial effects. May have neutral or minor adverse impacts to EFH.	Does not include features that protect and/or enhance connectivity of fisheries habitats and/or facilitate fish migration. Potential adverse, but mitigatable, impacts to EFH (including the potential loss of EFH).	Would result in significant adverse impacts to EFH in the Project Area or elsewhere.

Screening Criteria		Comparative Concept Screening Metrics[10]			
		Good	Fair	Poor	Fatal Flaw
NATURAL ENVIRONMENT	**Effects on Protected Species and their Habitats**	Includes features that protect and/or enhance protected species habitats. Would result in long-term beneficial effects and no adverse effects to protected species or their habitats.	Does not include features that protect and/or enhance protected species habitats, but may afford opportunities for further habitat enhancements. No adverse effects to protected species or their habitats.	Does not include features that protect and/or enhance protected species habitats, and does not afford opportunities for further habitat enhancements. Potential adverse, but mitigatable, effects to protected species or their habitats.	Would result in significant adverse effects to protected species or their habitats.
NATURAL ENVIRONMENT	**Effects on Other Sensitive Ecological Resources, including Biodiversity, Habitat, and Migration/Movement Corridors**	Includes features that protect, enhance, and/or create wildlife habitat and/or connectivity of existing habitat. Would result in long-term beneficial effects and **no** adverse effects to sensitive ecological resources in the Project Area.	Does not include features that protect, enhance, and/or create wildlife habitat and/or connectivity of existing habitat. Would result in no potential for long-term beneficial effects. Overall, neutral or minor adverse effects to sensitive ecological resources in the Project Area.	Does not include features that protect, enhance, and/or create wildlife habitat and/or connectivity of existing habitat. Potential adverse, but mitigatable, effects to sensitive ecological resources in the Project Area.	Would result in significant adverse effects to sensitive ecological resources, including biodiversity, habitat, and migration corridors in the Project Area or elsewhere.
NATURAL ENVIRONMENT	**Effects to Historic and Prehistoric Cultural Resources**	Includes features that protect and/or enhance cultural resources management in the Project Area. No effects to cultural resources listed on or potentially eligible for listing on the National Register of Historic Places (NRHP).	Does not include features that protect and/or enhance cultural resources management in the Project Area. No adverse effects to cultural resources listed on or potentially eligible for listing on the NRHP.	Does not include features that protect and/or enhance cultural resources management in Project Area. Would result in adverse effects to cultural resources listed on or potentially eligible for listing on the NRHP.	Would result in significant adverse impacts to cultural resources in the Project Area or elsewhere.

	Screening Criteria	Comparative Concept Screening Metrics[10]			
		Good	Fair	Poor	Fatal Flaw
COSTS & BENEFITS	**Provides Benefits to the Project Area and Community**	Concept has a relatively high potential to achieve maximum monetary benefits, including flood risk reduction, co-benefits, and others.	Concept has a relatively moderate potential to achieve monetary benefits, including flood risk reduction, co-benefits, and others.	Concept has a relatively low potential to achieve monetary benefits, including flood risk reduction, co-benefits, and others.	Concept has no potential to achieve monetary benefits, including flood risk reduction, co-benefits, and others.
	Can be Implemented within Available Funding Limits	Concept could be implemented within available funding limits.	N/A	Cost to implement concept exceeds available or other identified funds, but a subset of the concept's features that achieve independent utility could be implemented within available funding limits.	Concept could not be implemented within available or other identified funding limits.
	Has a Positive Benefit-Cost Ratio (BCR)	Concept has a relatively high potential to have a BCR > 1.0.	Concept has a relatively moderate potential to have a BCR > 1.0.	Concept has a relatively low potential to have a BCR > 1.0.	Concept has no potential to have a BCR > 1.0.

2.4 Alternatives Considered, but Eliminated from Further Consideration

Using the Concept Screening Criteria Matrix described in **Section 2.3**, the NJDEP eliminated an array of initially considered coastal storm surge and stormwater flood reduction design concepts during the alternatives development process. In addition, the NJDEP considered other alternatives early in the alternatives development process that did not pass the screening criteria or meet the Proposed Project's purpose and need, including some alternatives identified by the public during the Proposed Project's public scoping process. These eliminated alternatives, as well as the rationale for eliminating them, are presented below.

2.4.1 Coastal Storm Surge Flood Reduction Concepts Eliminated

Design concepts initially considered and subsequently eliminated during the development of the coastal storm surge flood reduction alternative are described below. These concepts, and their reasons for elimination, are further detailed in the Feasibility Study Report (NJDEP 2018).

- **100-Year Storm Protection/Expanded Project Area.** This concept included the development of a LOP at a height of 12.6 feet (NAVD 88) to protect an expanded Project Area extending south from I-80 to State Route 3. This height would be sufficient to provide a FEMA-certified level of protection against the 100-year flood event, and could result in reduced flood insurance premiums for protected properties. This concept was dismissed from further consideration because preliminary cost estimates indicated that it could not be implemented within the available funding limits of the Proposed Project.
- **100-Year Storm Protection/Project Area.** This concept included the development of a FEMA-certified level of protection against the 100-year flood for only the Project Area (i.e., from the northern boundary of Little Ferry south to Paterson Plank Road). This concept was dismissed from further consideration because preliminary cost estimates indicated that it could not be implemented within the available funding limits of the Proposed Project.
- **Reduced Flood Protection (7-foot to 12.6-foot LOP)/Project Area.** This concept included the development of a LOP at some elevation higher than 7 feet but lower than 12.6 feet (NAVD 88) for the Project Area. This concept was dismissed from further consideration due to public safety concerns. Any constructed LOP that is less than the FEMA-certified level of protection against the 100-year flood (12.6 feet [NAVD 88]) must account for the possibility of overtopping during the 100-year flood. In this scenario, floodwaters would pour over the LOP and into the Project Area, filling it rapidly. Residents would have limited opportunity to evacuate once the overtopping occurred; more importantly, depending on the height of the LOP, the water depth could be at a level that would create a risk of drowning. To alleviate this risk, extensive, costly flood reduction features would need to be added to the concept design. Therefore, this concept was eliminated from further consideration because an LOP that would not create an unacceptable potential for loss of life due to drowning when overtopped could not be implemented within the available funding limits of the Proposed Project.
- **Ring Levees/Reduced Project Area.** This concept included the development of a FEMA-certified level of protection against the 100-year flood around small, select areas within the current Project Area. Because very few areas within the Project Area exceed 12.6 feet (NAVD 88), this level of protection would have taken the form of berms and/or walls constructed in circles around areas which HUD has identified as priority for protection (i.e., low- and moderate-income [LMI] areas). This concept was dismissed from further consideration because it would have provided flood risk reduction benefits to only a very limited number of people at very high cost,

and thus would have provided an unacceptably low Benefit-Cost Ratio (BCR; i.e., a BCR < 1.0). In addition, this concept would divide existing communities and neighborhoods under normal conditions, and would adversely impact transportation infrastructure.

- **Hackensack River Surge Barrier.** This concept included the construction of a large storm surge barrier across the Hackensack River near Portal Bridge, which would have provided coastal storm surge protection for the entire 100-year floodplain north of that location. However, preliminary cost estimates indicated that this alternative could not be implemented within the available funding limits of the Proposed Project. Further, preliminary modeling showed that this concept could induce additional flooding of the Passaic River, thus increasing the threat of flooding for other residents, businesses, and municipalities. Consequently, this concept was eliminated from further consideration.

2.4.2 Inland Flood Reduction Concepts Eliminated

Design concepts initially considered and subsequently eliminated during the development of the inland flood reduction alternative are described below. These concepts, and their reasons for elimination, are further detailed in the Feasibility Study Report (NJDEP 2018).

- **Stormwater Drainage Improvement Projects** – Revision and combination of various concepts occurred iteratively, with a total of 30 stormwater drainage improvement design concepts initially considered and screened during the alternatives development process. Overall, the initial 30 concepts differed from each other in three primary ways:
    - *Type of infrastructure:* Concepts included either only grey infrastructure, only green infrastructure, or a combination of both grey and green infrastructure.
    - *General location:* The concepts concentrated on 11 general locations within the Project Area. These locations were developed based on existing drainage patterns and watershed boundaries within the Project Area, in conjunction with existing data on frequently flooded areas gathered from the CAG, ESC, and prior studies and reports.
    - *Scale:* The concepts addressed stormwater improvements in each of the 11 general locations over varying geographic footprints. For example, one concept considered stormwater improvements along the entire East Riser Ditch, while other concepts addressed improvements to only the lower, middle, or upper segments of East Riser Ditch.

  Several of these stormwater drainage improvement components were eliminated due to their potential to result in potentially significant adverse impacts to existing resources within the Project Area (e.g., impacts to hazardous waste sites, large wetland areas), or their inability to meet the basic feasibility requirements (e.g., funding limitations, BCR < 1.0). By analyzing many combinations of possible stormwater drainage improvements, including using varying types of infrastructure in varying locations and scales throughout the entire Project Area, the NJDEP was able to identify and assemble concepts that would both achieve the greatest levels of precipitation-related flood risk reduction and maximize the total benefits (e.g., ecological restoration, new public open space, public access to the Hackensack River).

- **Conduct Maintenance of Existing Local Stormwater Drainage Infrastructure** – This concept included restoration of existing ditches, pump stations, tide gates, and other stormwater infrastructure within the Project Area, but would not include new stormwater infrastructure or fundamental changes to the existing infrastructure. This concept was dismissed from further consideration because the Proposed Project's funding cannot be used to address past actions, ongoing actions by others, or operations and maintenance (O&M) issues associated with existing infrastructure. The available HUD funding can only be used for the development of new flood reduction measures and to conduct the associated analyses (e.g., environmental, engineering, flood modeling) required for design and implementation. Therefore, this concept is outside the scope of the Proposed Project. However, the Proposed Project would be designed to be compatible with, or improve, the capacity of existing stormwater drainage infrastructure.

- **Conduct Reexamination of Existing Municipal Stormwater Policies** – This concept included conducting a detailed analysis of existing stormwater policies of the affected municipalities, culminating in a list of recommendations to the municipalities of measures they could implement to improve stormwater drainage within the Project Area. This concept was dismissed from further consideration due to schedule constraints. The Proposed Project must be complete by September 2022, and due to the number of municipal and regulatory entities that would be involved in a review and/or revision of stormwater policies, it would not be feasible to complete this alternative within the mandated timeframe.

2.4.3 Other Alternatives Eliminated

Other potential flood reduction alternatives that were initially considered but subsequently eliminated, as well as the rationale for eliminating them, are summarized below.

- **Dredging the Hackensack River** – This alternative included dredging the Hackensack River and maintaining it at a deeper depth in order to increase its floodwater storage and conveyance capacities. This alternative was dismissed from further consideration because dredging the river, in and of itself, would not change the water surface elevation. Without extensive additional infrastructure that would exceed the available funding, such as a lock and dam system and/or storm surge barrier, this alternative would not provide additional flood risk reduction. Therefore, it would not meet the purpose of and need for the Proposed Project.
- **Increase Capacity of Oradell Dam or Other Upstream Impoundments** – This alternative included increasing the capacity of upstream impoundments through dredging, increasing the height of the dam, or other similar measures. While this alternative would provide relief from flooding of the Hackensack River that results from increased freshwater flows during storm events, it would not provide flood risk reduction to the Project Area from inland stormwater drainage deficiencies or tidal storm surges, which are the two primary sources of flooding that the Proposed Project seeks to address. Therefore, this alternative was eliminated because it would not provide meaningful flood risk reduction and would not meet the purpose of and need for the Proposed Project.
- **Permanent Relocation of Residents Out of the Highest Risk Areas** – This alternative included: (1) the assisted relocation of residents from areas most at risk of flooding to new places of residence outside of the 100-year floodplain, and (2) the conversion of those existing developed areas back to wetlands/open space. Due to the fact that a large portion of the development in the Project Area exists on historically filled wetlands, and that wetlands provide natural flood risk reduction benefits, this alternative would have been part of a planned "undevelopment" strategy of certain portions of the Project Area. This alternative would, in effect, help restore the historical natural hydrology of the Meadowlands District and reduce flood risk to residents and businesses. This alternative was dismissed from further consideration for several reasons:

  - This alternative would have substantial, long-term adverse impacts on LMI populations in the Project Area, which are HUD's priority for assistance from the Proposed Project. This would be due to the logistics of many residences being moved *en masse* and potential conflicts with those residents' current livelihoods (i.e., changes to work commutes, burden of finding affordable housing elsewhere, and having to leave their established community).
  - This alternative could have potentially significant adverse impacts on the areas to which the residents are relocated (e.g., available housing, schools, or public services).
  - The relocation of residents, demolition of existing development, and creation of new natural areas could not be conducted within the available funding limits of the Proposed Project.
  - This alternative would have a BCR < 1.0 when the relatively few benefits are compared to the total incurred monetary and social costs.
- **Original RBD Design Concept** – This alternative included implementing the original, award-winning concept design, including the *Protect, Connect,* and *Grow* components (see **Section 1.3.1**). This alternative was dismissed from further consideration early in the planning process as it could not be implemented within the available funding limits of the Proposed Project, and could induce flooding in other areas. However, this alternative constituted the basis for the Proposed Project and the conceptual solutions (i.e., coastal and inland flood reduction alternatives) that were designed.

2.5 Alternatives Carried Forward for Evaluation in this EIS

Through intensive screening and evaluation, detailed examination within the Feasibility Study Report, and public input, the NJDEP identified three Build Alternatives that meet the purpose of and need for the Proposed Project, including the majority of the Proposed Project's established goals and objectives (see **Section 1.4.1**). The development and evaluation of alternatives and the screening criteria used are presented in **Section 2.3**. A detailed description of the alternatives considered to meet the purpose of and need for the Proposed Project is presented in the following subsections. Each Build Alternative contains a range of grey infrastructure, green infrastructure, and parks/open space. These features, and their respective locations, were determined based on a range of factors, including flood reduction potential, available land, potential to impact other technical resource areas (e.g., wetlands or contaminated sites), estimated cost, and proximity to intended beneficiaries (e.g., residential areas for parks). Each Build Alternative must also produce a positive BCR and provide flood reduction without relying on any future potential projects. The NJDEP has identified Alternative 3 as the Preferred Alternative for implementation.

While the No Action Alternative would not satisfy the purpose of or need for the Proposed Project, this alternative is carried forward to provide a comparative baseline against which to analyze the effects of the Proposed Project, pursuant to NEPA and CEQ Regulations (40 CFR Part 1502.14[d]). The No Action Alternative reflects both a continuation of the *status quo*, as well as projected future conditions, and serves as a benchmark against which the effects of the Proposed Project can be evaluated.

2.5.1 No Action Alternative

Anticipated future conditions within the Project Area without implementation of the Proposed Project include the following:

- Continued coastal flooding from tidal storm surges during severe coastal storm events (see **Section 1.4.2**);

- Continued inland flooding during heavy rainfall events due to local stormwater drainage problems (see **Section 1.4.2**); and
- Increased exposure to the effects of climate change and sea level change, including increased frequency of intense rainfall events and anticipated rise in regional sea level (see **Section 3.10.3**), which would be likely to worsen coastal and inland flooding conditions in the Project Area over time. **Figure 2.5-1** and **Figure 2.5-2** show the projected increases in flooding due to sea level change (under the 1.2-foot and 2.4-foot SLR scenarios (NOAA 2013a)) over the next 50 years for both the normal tide[11] and for the 50-year storm, respectively.

Under existing normal tide conditions, approximately 17 percent of the Project Area has the potential to flood[12]. By 2075, as much as 19 to 42 percent of the Project Area could have the potential to flood under normal tide conditions based on the 1.2-foot and 2.4-foot SLR scenarios, respectively. Similarly, during a 50-year flood, approximately 36 percent of the Project Area has the potential to flood under existing conditions; by 2075, as much as 47 to 62 percent of the Project Area could flood under each respective SLR scenario. The anticipated changes in coastal flooding under each alternative, including the No Action Alternative, are described in further detail in **Section 4.1.2.1**.

As floods worsen over time, there would be increased adverse impacts on residents, property, and the quality of the human and natural environment in the Project Area. Failure to provide the Project Area with additional protection from coastal storm surges and/or inland flooding would likely lead to increased and more frequent damage to local infrastructure and property, direct harm to economic activity, and increased potential for human health effects, including loss of life.

Although the Project Area is mostly developed, it is expected that continued in-fill development would occur in the Project Area based on existing zoning. This would include additional development in the 100-year floodplain in accordance with local floodplain management ordinances. Continued development could further reduce the limited existing undeveloped areas, and increase the amounts of impervious surfaces and stormwater runoff. This would, therefore, further increase the need to address the existing stormwater drainage issues in the Project Area.

With the selection of the No Action Alternative, the Proposed Project would not be implemented and current conditions and operations would generally continue in the Project Area. Flood protection measures in the Project Area under this alternative would generally be limited to the O&M of existing infrastructure.

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[11] As defined in AECOM's coastal models, 'normal tide' is when the driving forces for water elevations in the model are tidal consitutents only (i.e., no external driving forces like wind or pressure are applied), and represents the water elevation range between -3.63 and 3.63 feet (NAVD 88). This definition was sourced from the advanced circulation (ADCIRC) model of the FEMA Region II Coastal Storm Surge Study dated September 2014 (FEMA 2014c). Normal tide is not NOAA's mean higher high water or spring high tide, but rather is a tidal range that includes both of those tides.

[12] Please note the "area at risk of flooding" (i.e., area with the potential to flood) described in this EIS was determined based on the total acreage within the Project Area for the No Action Alternative and Alternative 1. As shown in **Figure 2.5-1**, the majority of the area "at risk of flooding" under existing normal tide conditions occurs within the southern and eastern portions of the Project Area that are largely dominated by tidal wetlands/waters (e.g., Hackensack River, MRI Wetland Mitigation Bank, the Richard P. Kane Natural Areas and Wetland Mitigation Bank, and Berry's Creek).

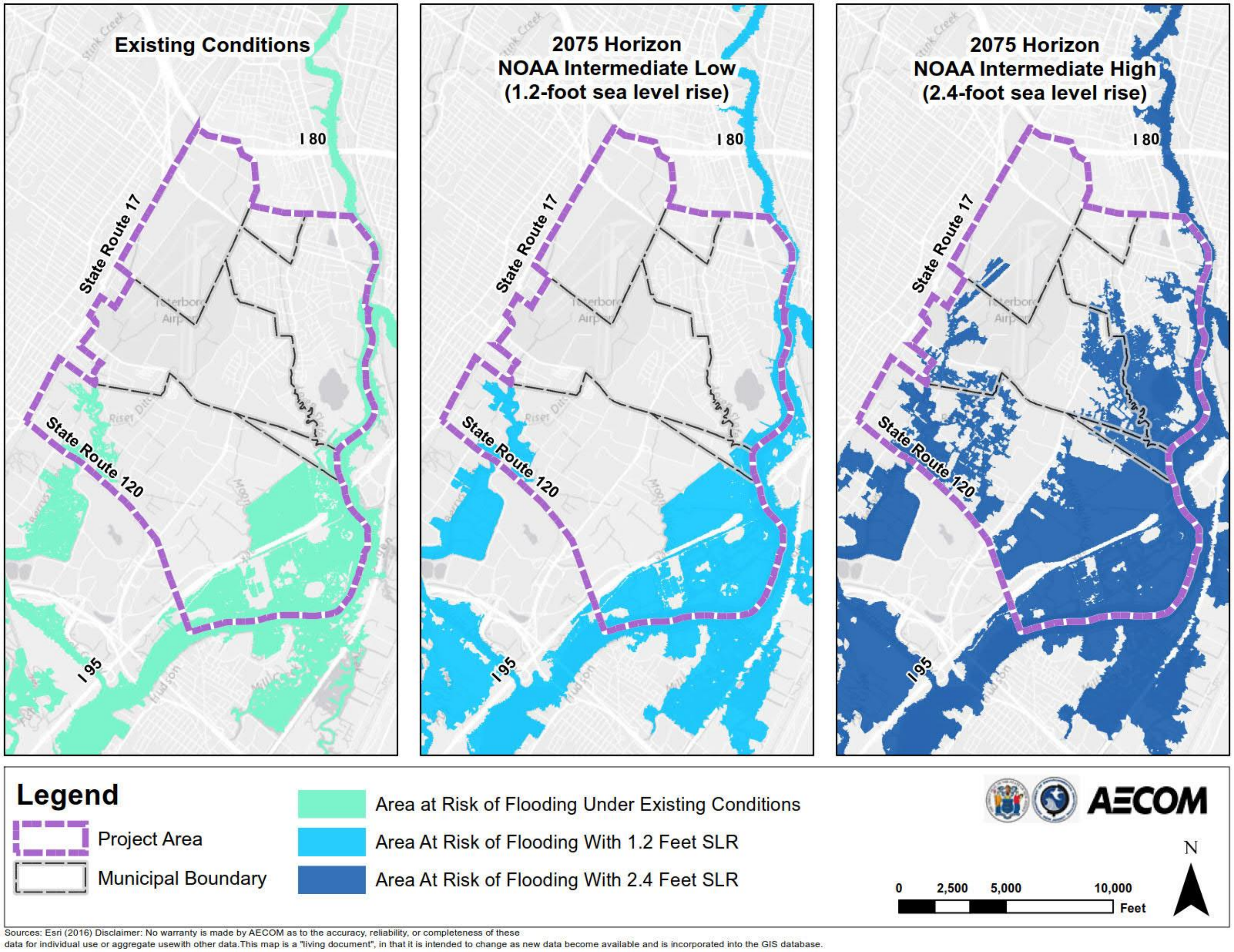


Figure 2.5-1: Area at Risk of Flooding During Normal Tide Under No Action Alternative

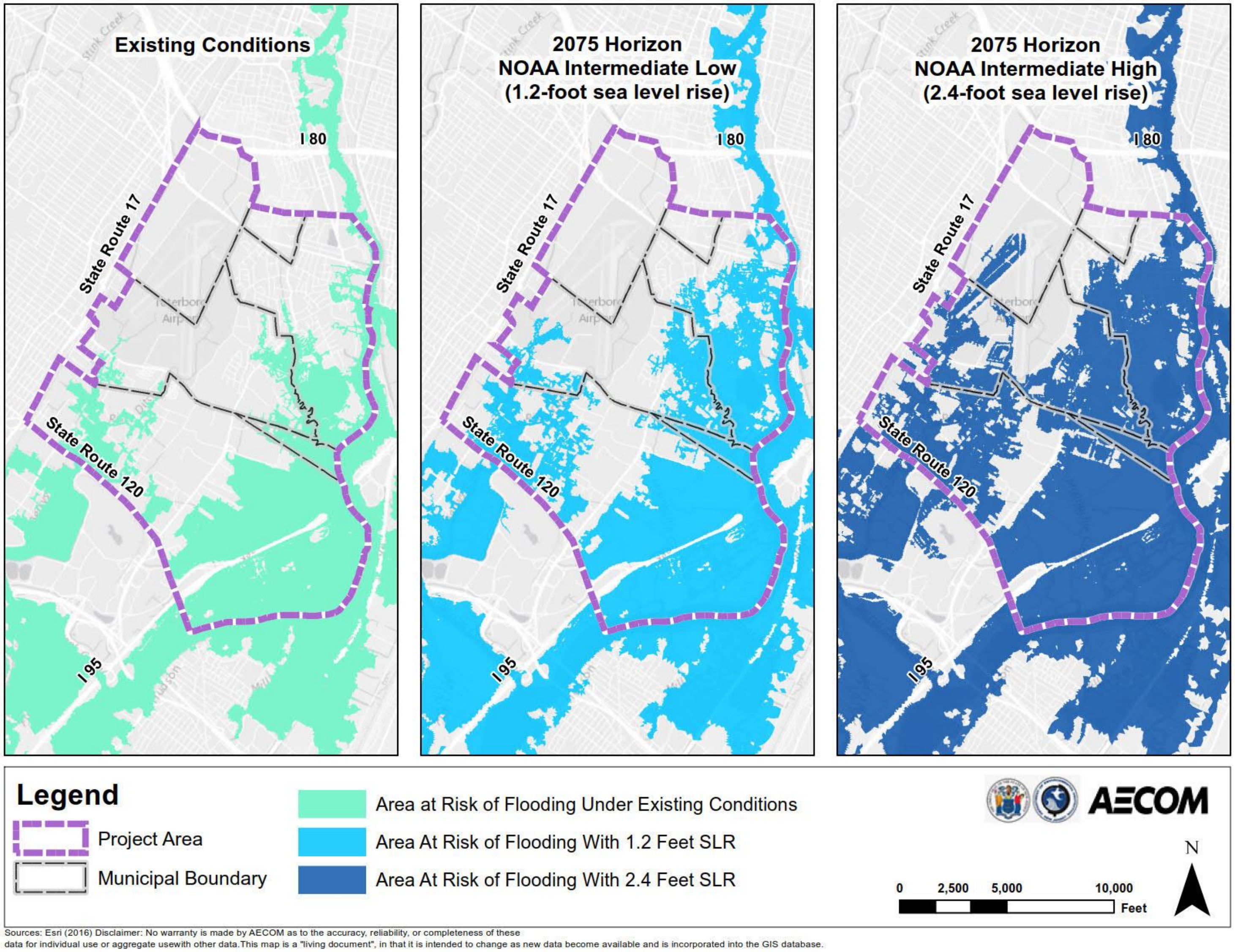


Figure 2.5-2: Area at Risk of Flooding During 50-year Flood Tide Under No Action Alternative

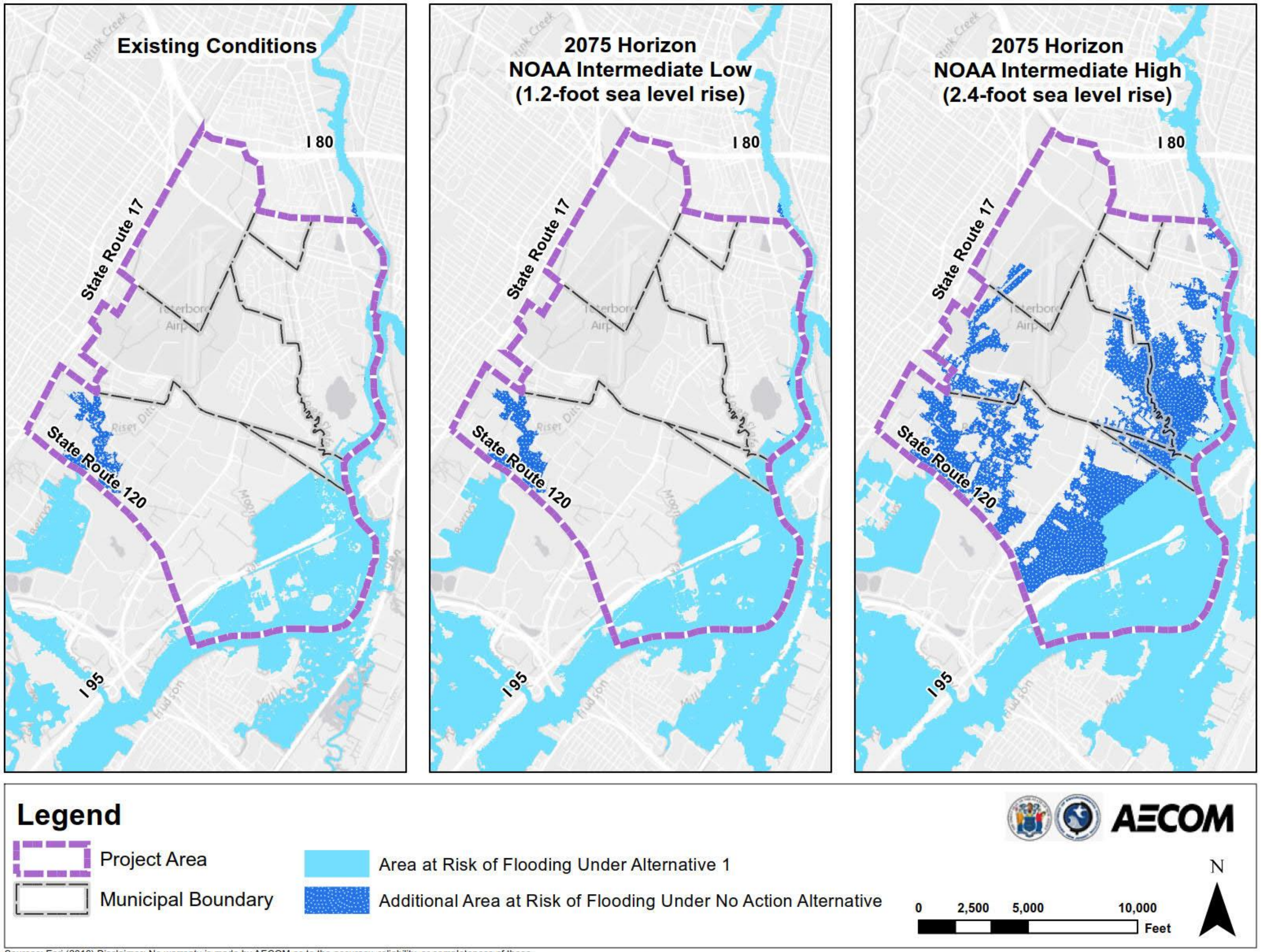
2.5.2 Alternative 1

Alternative 1 includes various infrastructure-based solutions intended to provide protection against coastal storm surges. This alternative would protect the Project Area from coastal flooding; however, chronic inland flooding from heavy or frequent precipitation events would continue to adversely affect the Project Area.

Under Alternative 1, a LOP would be constructed using of a range of grey infrastructure, including approximately 19,700 linear feet (LF) of floodwalls, approximately 900 LF of levees/berms, a tide gate, eight closure gates, and a surge barrier and pump station, designed to provide flood protection up to an elevation of 7 feet (NAVD 88) (NJDEP 2018). A LOP at this height would be sufficient to provide protection against approximately the present-day 50-year storm (i.e., there would be an approximately 2 percent chance each year that the LOP would be overtopped), and against approximately the 10-year storm (i.e., 10 percent annual chance) in 50 years, based on SLR projections. **Figure 2.5-3** and **Figure 2.5-4** display the extent of flooding that could occur under existing conditions and future conditions (both the 1.2-foot and 2.4-foot SLR scenarios) for the normal tide and 50-year flood, respectively.

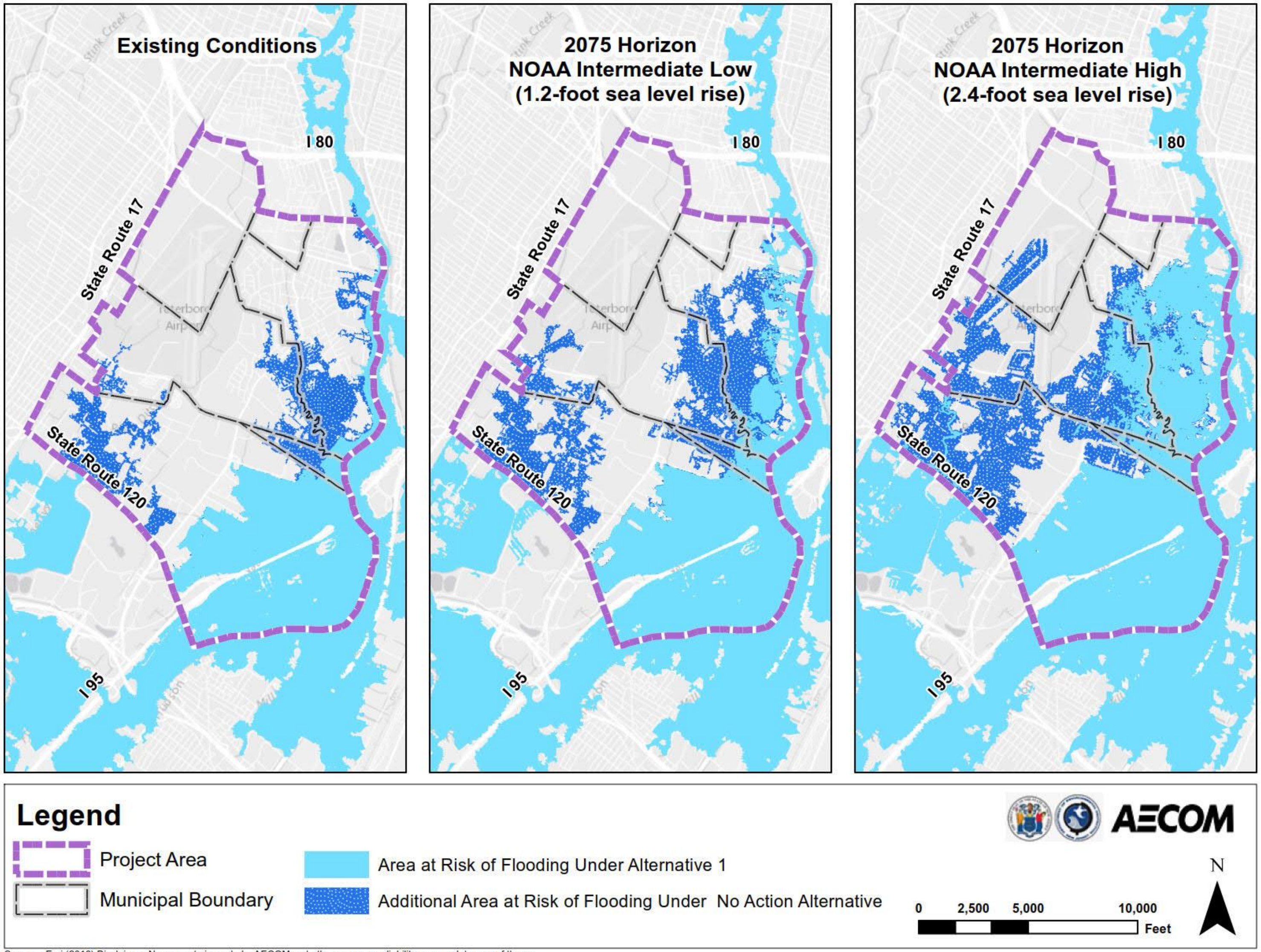
Modeling results for the 50-year flood event under existing conditions suggest that approximately 24 percent of the Project Area would flood under Alternative 1, in comparison to 36 percent under the No Action Alternative. During a future 50-year storm surge event (i.e., in 2075), approximately 29 percent to 41 percent of the Project Area (under the 1.2-foot and 2.4-foot SLR scenarios, respectively) would be at risk of flooding, compared to 47 to 62 percent, respectively, under the No Action Alternative. **Section 4.1.2.2** provides further details regarding flood risk reduction in the Project Area under Alternative 1.

In addition to flood reduction infrastructure, this alternative would integrate open space features and green infrastructure into the design, providing various co-benefits to the Project Area, thereby meeting the Proposed Project's established goals and objectives (see **Section 1.4.1**). A description of the proposed LOP components and their associated construction and operational activities are discussed in detail under **Sections 2.5.2.1** through **2.5.2.3**.



Sources: Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate usewith other data.This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 2.5-3: Difference in Area at Risk of Flooding During Normal Tide for Alternative 1 and No Action Alternative



Sources: Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate usewith other data.This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

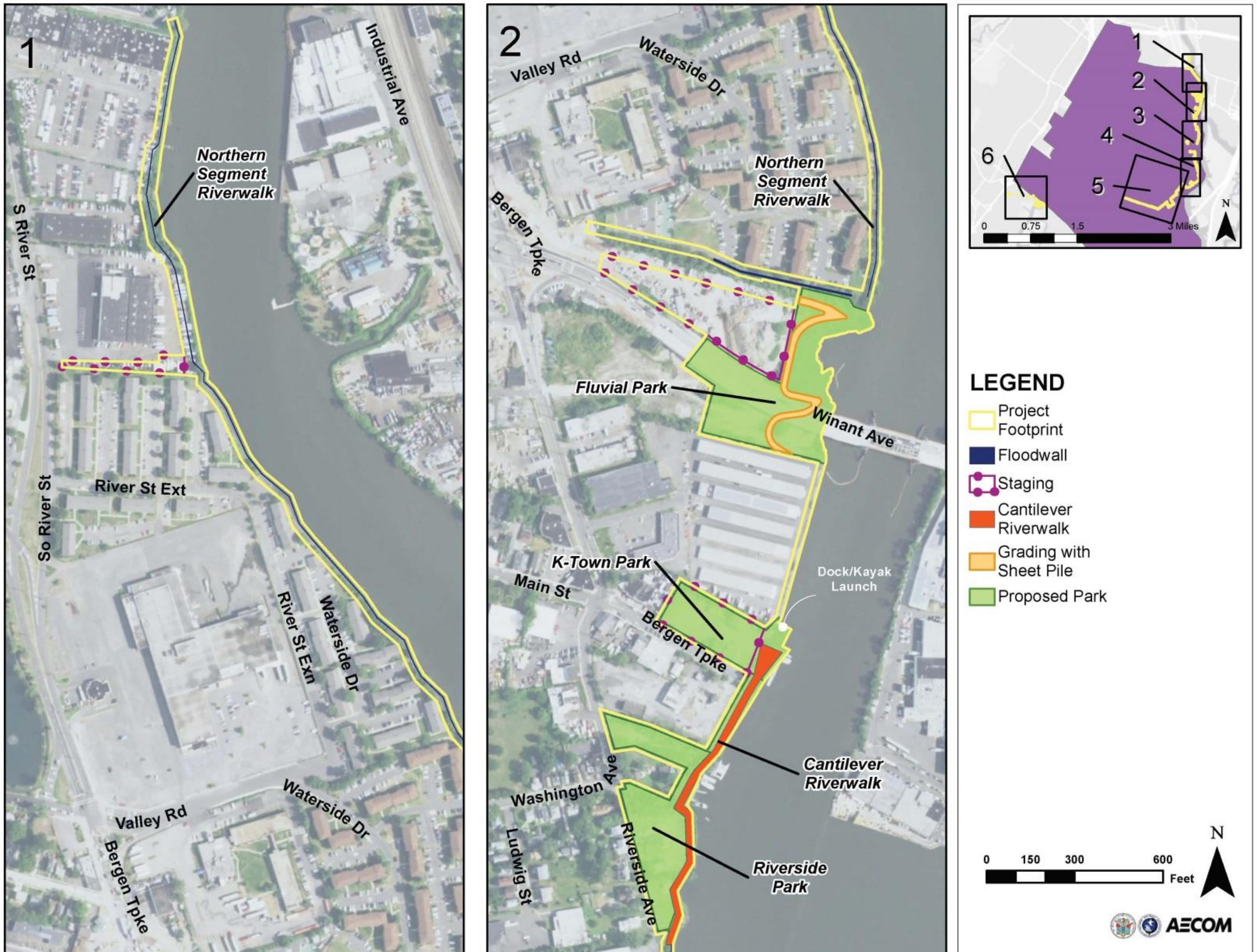
Figure 2.5-4: Difference in Area at Risk of Flooding During 50-year Flood Under Alternative 1 and No Action Alternative

2.5.2.1 Components of the LOP

During the development of Alternative 1, the NJDEP undertook an analysis that considered existing land use, the need for land acquisitions or displacements, existing environmental constraints, and other factors. As a result of this analysis, the proposed LOP components were sited to best meet the Proposed Project's goals and objectives, to incorporate available areas of high ground, to provide protection to the maximum amount of the developed Project Area, and to avoid and minimize environmental, socioeconomic, and cultural impacts to the extent practicable.

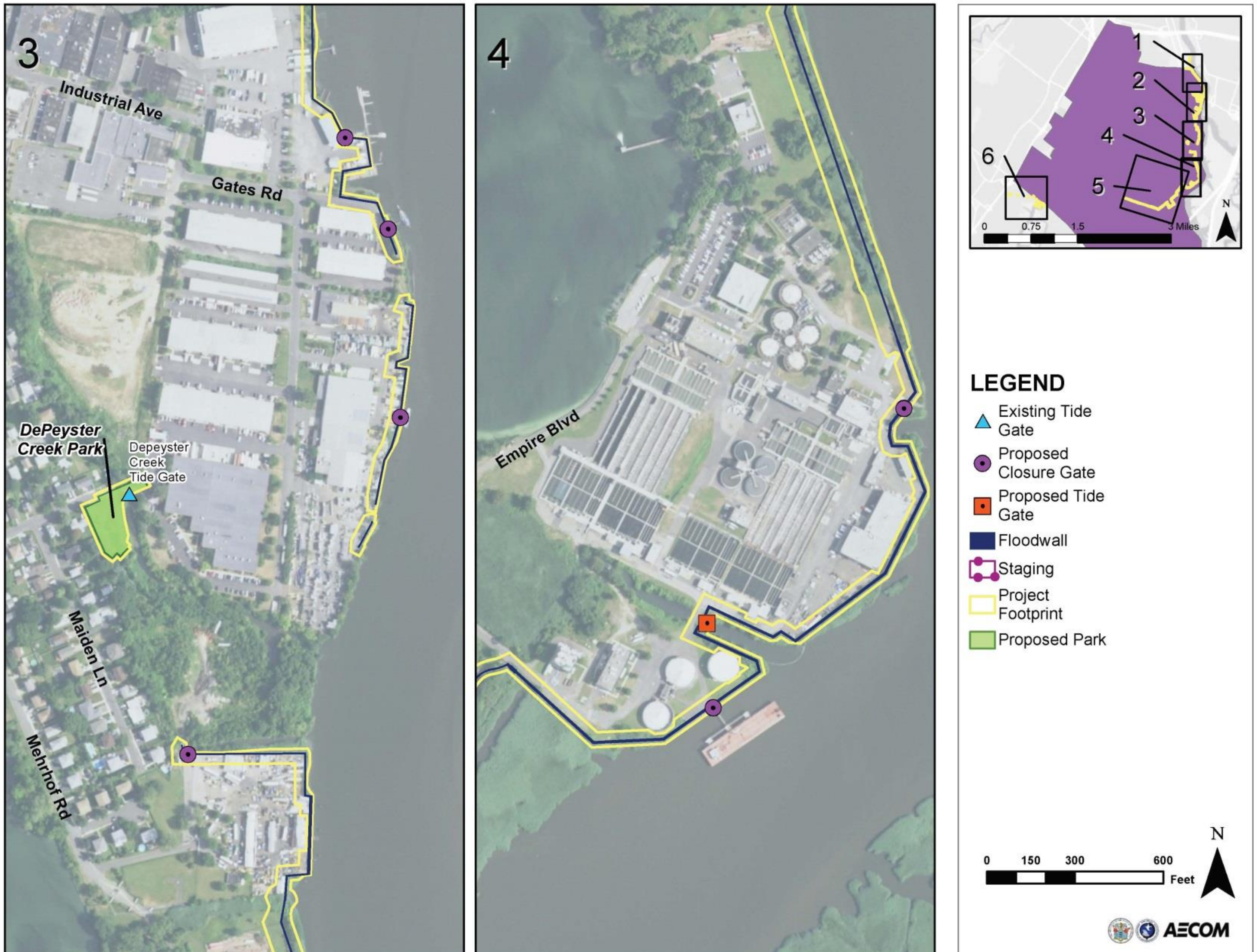
The proposed LOP would be constructed between existing points of high ground.[13] As such, under Alternative 1, the structural components of the LOP would not be contiguous throughout the Project Area. The LOP would consist of a Northern, Central, and Southern Segment, as well as a storm surge barrier along Berry's Creek. The four main geographic components of the LOP are described in detail below, and shown graphically in **Figure 2.5-5** through **Figure 2.5-8**. Please note that while the Alternative 1 components described in this section represent the current design, certain details (e.g., the arrangement of, or features in, each park) could change during the final design process.

[13] High ground indicates areas where the ground is at elevation 7 feet (NAVD 88) or higher.



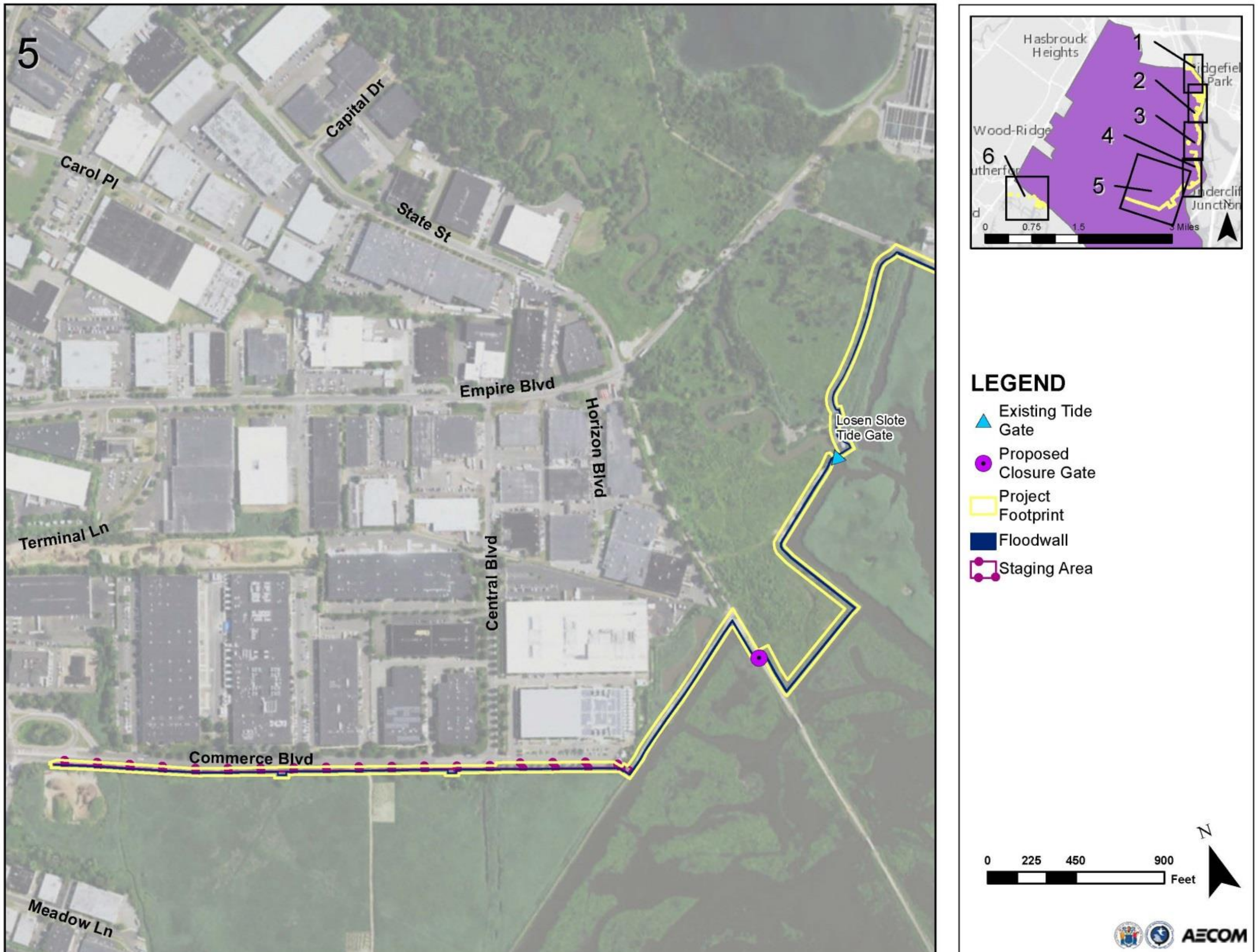
Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate usewith other data.This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 2.5-5: Alternative 1 LOP (Northern and Central Segments; Figure 1 of 4)



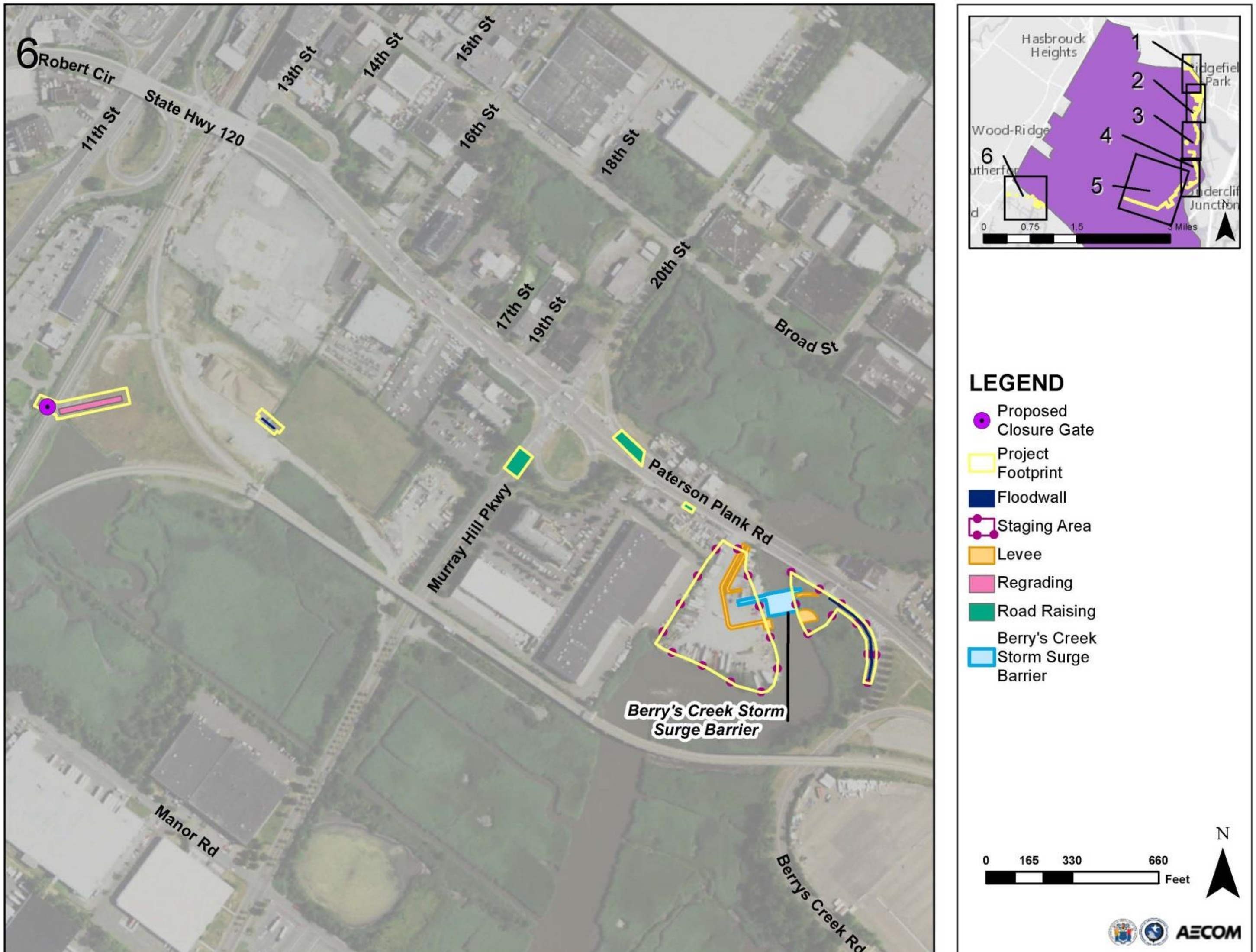
Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate usewith other data.This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 2.5-6: Alternative 1 LOP (Central Segment; Figure 2 of 4)



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate usewith other data.This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 2.5-7: Alternative 1 LOP (Central and Southern Segments; Figure 3 of 4)



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate usewith other data.This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 2.5-8: Alternative 1 LOP (Berry's Creek Storm Surge Barrier; Figure 4 of 4)

Northern Segment

The northern terminus of the LOP would be at the Hackensack Riverwalk located at the Riverfront shopping center in the City of Hackensack. From there, the LOP would extend south along the Hackensack River through industrial and residential areas east of South River Street and Bergen Turnpike. This segment of the LOP (see **Figure 2.5-5**) would provide continuous structural flood protection for approximately 0.8 mile to where it meets the proposed Fluvial Park, which would be located adjacent to and beneath the US Route 46 Bridge. The Northern Segment of the LOP would also include an approximately 450-foot long floodwall along the northern edge of the existing, unnamed ditch between the proposed Fluvial Park (discussed under the Central Segment below) and the existing Waterside Village apartments. Along the entire LOP, new backflow preventers would be installed on all stormwater outfalls.[14]

The LOP in this segment would consist of a sheet pile floodwall varying between 1 and 4 feet in height (i.e., average height of 2 feet). The corridor immediately landward of the floodwall would be filled to the height of the floodwall, and a continuous, 11-foot wide concrete access path would be constructed at that elevation. In addition to facilitating emergency and maintenance operations, this access path would be available for public recreation as a riverwalk. A guard rail would be constructed along the access path on the side of the river, and a screening fence would be constructed along the landward edge of the access path. A conceptual rendering of this portion of the LOP[15] is illustrated in **Figure 2.5-9**.

Figure 2.5-9: Rendering of Northern Segment of Alternative 1 LOP

[14] Bergen County is currently coordinating backflow preventer installation on existing stormwater outfalls to the Hackensack River. For this reason, and to avoid duplication of benefits in the BCA, backflow preventers were not included in the stormwater management improvements designed under Alternatives 2 or 3. Because Alternative 1 would require more extensive alterations to existing outfalls to accommodate them in the LOP, backflow preventers would be appropriate to include in the overall design.

[15] Conceptual renderings and concept drawings provided in this document are examples only, and are meant to provide the reader with a basic, preliminary understanding of the overall vision for the Build Alternatives. Actual implementation of Build Alternative components could vary from the images shown in this document.

The permanent easement required for the Northern Segment would vary between 15 and 40 feet in width; the temporary easement would vary between 37 and 70 feet in width. Throughout the length of the LOP, the temporary easements would maintain at least 10 feet of separation from existing buildings. Additionally, some areas of the LOP would have seating areas and plantings integrated into the design.

Central Segment

From US Route 46, the LOP would continue south along the Hackensack River and enter the central portion of the Project Area where residential areas are more prevalent. The proposed Central Segment of the LOP (see **Figure 2.5-5** through **Figure 2.5-7**) would consist of various components, including four proposed parks (i.e., Fluvial Park, K-Town Park, Riverside Park, and DePeyster Creek Park), a cantilever riverwalk, and concrete floodwalls. The Central Segment terminates at the proposed Losen Slote tide gate.

The proposed Fluvial Park (see **Figure 2.5-10**), located at the US Route 46 Bridge, would consist of approximately 3.8 acres. This park would include both upland and wetland components, separated by a flood protection feature (i.e., sheetpile covered by graded earth). The upland portion of the proposed park would contain a seating plaza/performance space (approximately 0.8 acre) and upland plantings (approximately 0.7 acre), while the portion of the park waterward of the flood protection feature would include approximately 1.1 acres of newly created wetlands and 0.4 acre of riparian plantings. Additionally, a pathway would wind throughout the park. This proposed pathway would be concrete in the upland portion of the park, and an elevated walkway through the wetlands and riparian areas. This pathway would connect to the access paths along the LOP both north and south of the park. Vehicular access would be available as well. The permanent easement required for this park would vary between 100 and 550 feet in width; the temporary easement would vary between 240 and 560 feet in width.

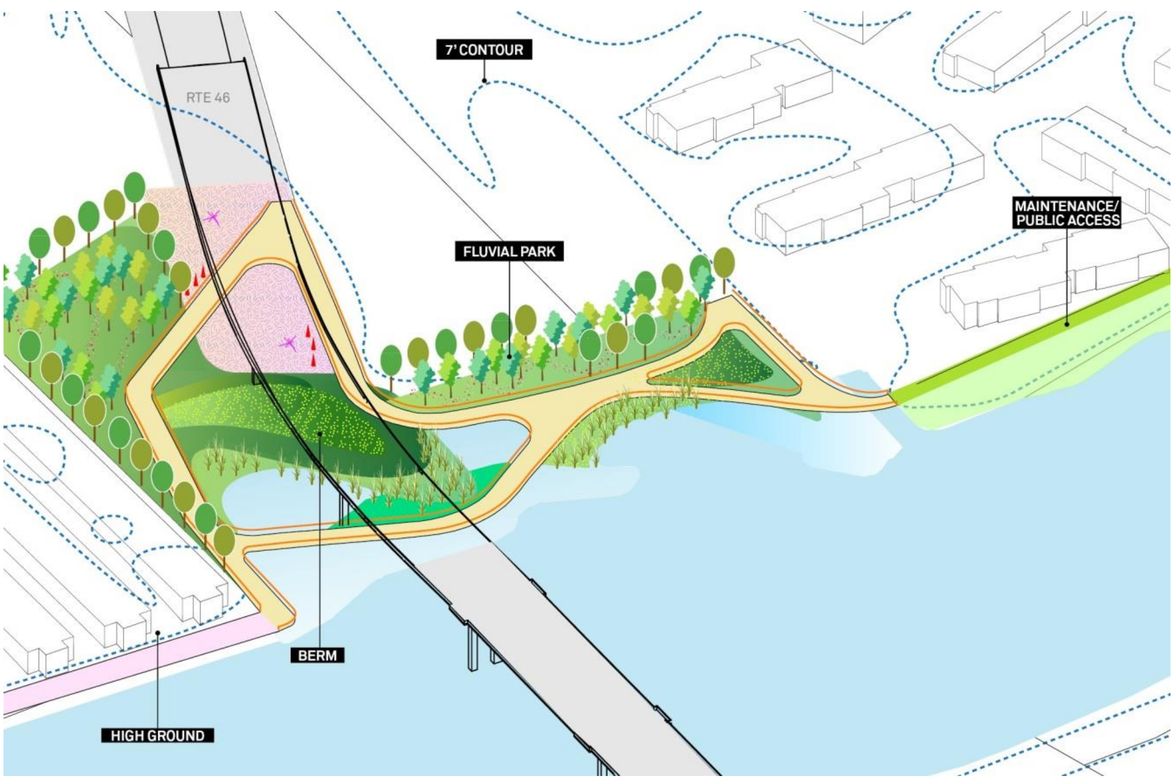


Figure 2.5-10: Concept Drawing of Proposed Fluvial Park

South of Fluvial Park, the LOP would continue along existing high ground. This high ground would not require a floodwall, but would contain a concrete access path. This path would connect to a proposed cantilever riverwalk at the existing K-Town industrial property. The proposed cantilever riverwalk would be an elevated walkway located atop a concrete floodwall integrated with benches and planters. It would be approximately 25 feet in width, nearly 0.2 mile long, and between 1 and 4 feet high. The permanent easement required for this proposed segment would vary between 40 and 55 feet in width; the temporary easement would vary between 50 and 65 feet in width. On the northern end of the proposed cantilever riverwalk, a proposed boat dock/kayak launch would be built in the Hackensack River to allow recreational access to the water. The northern and southern ends of the proposed cantilever riverwalk would be anchored by parks.

At the northern end of the proposed cantilever riverwalk, the proposed approximately 1.4-acre K-Town Park (see **Figure 2.5-11**) would be located on the existing K-Town industrial property. This proposed park would provide approximately 0.6 acre of active recreation space that could be used for formal and informal sports and recreational activities. In addition to this active recreational space, there would be a variety of seating areas and plantings (approximately 0.3 acre), a public parking lot (0.2 acre), and a concrete pathway connecting to the cantilever riverwalk. The permanent easement required for this park would vary between 400 and 430 feet in width; the temporary easement would vary between 410 and 430 feet in width.

Figure 2.5-11: Concept Drawing of Proposed K-Town Park

At the southern end of the proposed cantilever riverwalk, a proposed approximately 2.2-acre Riverside Park (see **Figure 2.5-12**) would be located along Riverside Avenue and Washington Avenue. This proposed park would incorporate passive open recreation space (approximately 1 acre) with sculptural landforms that would create views of the Hackensack River. There would also be a network of pathways lined with native plantings (approximately 0.5 acre) connecting the proposed park to the proposed cantilever riverwalk in various locations. Riverside Park would constitute the southern terminus of the proposed public access pathway along the LOP. The permanent easement for this park would vary between 45 and 390 feet in width; the temporary easement would vary between 55 and 390 feet in width.

Figure 2.5-12: Concept Drawing of Proposed Riverside Park

South of the proposed cantilever riverwalk, the LOP would consist of a series of concrete floodwalls constructed primarily following the Hackensack River to the northern limit of the Bergen County Utilities Authority (BCUA) property. The permanent easement required for these floodwalls would vary between approximately 12 and 40 feet in width; the temporary easement would vary between approximately 12 and 50 feet in width. A conceptual rendering of a concrete floodwall is provided in **Figure 2.5-13**. Small breaks in the floodwall would occur where the existing elevation is already at 7 feet (NAVD 88). These areas include: (1) the area parallel to the Protec Equipment Resources Inc. property; (2) the southern end of the Doka USA Ltd. property; and (3) the largely vegetated area south of DePeyster Creek. Additionally, four closure gates would be installed to maintain access to existing boat docks and access roads. These closure gates would remain open under normal circumstances, but would be closed prior to flood events to seal the LOP.

Figure 2.5-13: Rendering of a Concrete Floodwall

Immediately west of the existing DePeyster Creek tide gate, a proposed 0.6-acre DePeyster Creek Park (see **Figure 2.5-14**) would be created; this park would comprise an isolated component of the LOP, as it would tie into existing high ground on either side along DePeyster Creek. The proposed park would incorporate approximately 0.3 acre of passive recreational space that could include open lawn, picnic tables, chairs, and a bird watching platform. The proposed park would be surrounded by a new drainage swale on the northern and western sides, and by a proposed floodwall ranging from 1.6 to 3 feet in height on the southern and eastern sides. The proposed floodwall would tie into the existing tide gate to the north and into existing high ground to the south. The permanent easement required for this park would vary between 50 and 220 feet in width; the temporary easement would vary between 50 and 240 feet in width.

Figure 2.5-14: Concept Drawing of Proposed DePeyster Creek Park

Beginning at the northern limit of the BCUA property and following the Hackensack River southward to the existing Losen Slote tide gate, a proposed floodwall would be constructed. The proposed floodwall would be between 1.5 and 5.4 feet high. The permanent easement required for the floodwall would vary between approximately 39 and 95 feet in width; the temporary easement would vary between approximately 49 and 105 feet in width. Two additional proposed closure gates and a proposed tide gate would be included in the LOP on the BCUA property, as well.

Southern Segment

From the existing Losen Slote tide gate moving southward and westward, a double sheet pile floodwall would be constructed to the south (i.e., following the existing berms) until it reaches Commerce Boulevard. At this point, a single sheet pile floodwall would extend northwest along the southern side of Commerce Boulevard. The proposed Southern Segment of the LOP would tie into high ground near the intersection of Commerce Boulevard and Washington Avenue. **Figure 2.5-15** depicts a conceptual rendering of Alternative 1 along Commerce Boulevard. The proposed single and double sheet pile floodwalls would vary in height between 2.7 feet and 7.7 feet. The permanent easement required for this segment would vary between approximately 25 and 40 feet in width; the temporary easement would vary between approximately 40 and 50 feet in width. One proposed closure gate would be installed in this segment to accommodate the Transco Gas Pipeline Road. The proposed floodwall along Commerce Boulevard would also incorporate two bird watching platforms that would contain picnic tables and chairs. These proposed platforms would be approximately 40 feet long and 15 feet wide, and would have ramps for public access.

Figure 2.5-15: Rendering of Southern Segment of Alternative 1 Along Commerce Boulevard

Berry's Creek Storm Surge Barrier

A proposed surge barrier (see **Figure 2.5-16**) would be installed on Berry's Creek just south of where Berry's Creek passes beneath Paterson Plank Road. The proposed surge barrier would be constructed to an elevation of 10 feet (NAVD 88), and would be approximately 118 feet wide. Levees would connect the surge barrier to existing high ground on both banks of Berry's Creek. This proposed surge barrier would include two gates (i.e., a west gate and an east gate) to prevent flooding of Berry's Creek during large storm events. The surge barrier would typically be operated when the National Weather Service (NWS) issues a Coastal Flood Warning for the Project Area. A proposed pump station would also be constructed with the surge barrier on the western bank; this pump would have a capacity of 1,000 cubic feet per second, and would house controls for both the pump station and the surge barrier. These features would primarily be powered by electricity, but would also be connected to two backup diesel generators capable of maintaining operation for at least three days. Diesel would be stored in two above-ground storage tanks (ASTs) on site. A permanent acquisition would be required on the parcel of property containing the proposed pump station.

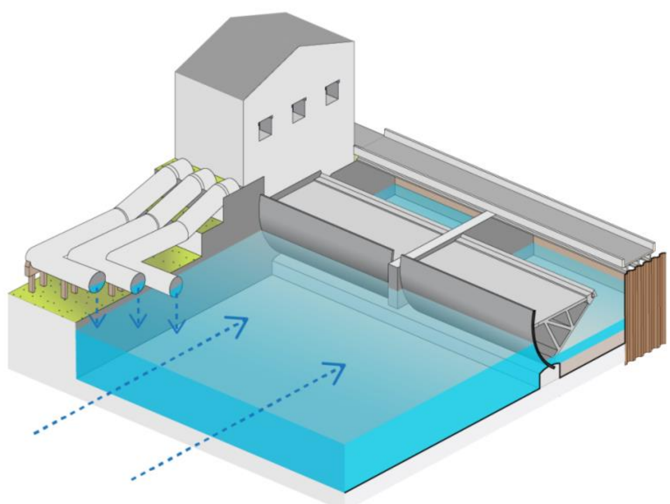


Figure 2.5-16: Diagram of Proposed Berry's Creek Storm Surge Barrier

In addition to the proposed surge barrier, several other small components would be necessary to provide a complete LOP to an elevation of 7 feet (NAVD 88) in the Berry's Creek watershed (see **Figure 2.5-8**). These components include the following:

- A floodwall (approximately 382 feet long and 2.1 feet in height) along the Road A Plaza exit ramp from Paterson Plank Road just east of the proposed surge barrier;
- Road-raising of certain portions of Paterson Plank Road (approximately 177 LF) and Murray Hill Parkway (approximately 100 LF) northwest of the surge barrier; and
- A small floodwall (approximately 60 LF) and regrading (approximately 245 LF) near the NJ Transit railroad tracks just east of the Rutherford Commons shopping center, as well as a closure gate over the railroad tracks.

2.5.2.2 Construction Activities

Construction of Alternative 1 would be expected to occur in multiple concurrent phases over an approximately 3-year (36-month) period. During this time, various access roads and staging areas would be required to accommodate construction materials and equipment. In advance of any on-site operations, the NJDEP and/or construction contractors would coordinate closely with all affected property owners and utility providers regarding all necessary access easements and utility relocations. Additional information pertaining to schedule and phasing, access points and staging, transportation and circulation requirements, and changes to utility infrastructure is provided below.

Schedule and Phasing

Implementation of Alternative 1 would begin with the NJDEP coordinating all necessary property and easement acquisitions in early 2019. Full property acquisitions would be required for the proposed parks/open spaces, and for the western bank of Berry's Creek where the proposed surge barrier and pump station would be located. Temporary and permanent easements, as described in **Section 2.5.2.1**, would be acquired along the full length of the LOP components to provide sufficient ability for both construction and future O&M activities, respectively. Throughout the final design stages for Alternative 1, the exact footprints of proposed property and easement acquisitions would continue to be refined to minimize them to the extent feasible; however, approximate easement acreages and the number of property parcels impacted in each segment are summarized in **Table 2.5-1** below. Potential impacts to property parcels from the implementation of Alternative 1 are further discussed in **Section 4.2.4.2**.

Table 2.5-1: Easement Requirements for Alternative 1

	Permanent Easement (acres)	Temporary Easement (acres)	Number of Property Parcels Impacted
Northern Segment	2.8	2.2	10
Central Segment	15.8	5.2	44
Southern Segment	3.4	0.7	10
Berry's Creek Storm Surge Barrier	4.6	0.1	5
Total	26.6	8.3	69

Mathematical inconsistencies due to rounding.

In accordance with the CDBG-DR funding requirements, the Proposed Project must be complete and functional by September 2022. Therefore, a 3-year construction program would be anticipated for Alternative 1, with construction commencing in late 2019/early 2020, peaking in 2021, and reaching completion in the late summer of 2022.

Construction would most likely occur under multiple concurrent contracts due to the geographic separation of the various sections of the LOP. The project's configuration allows flexibility in the sequencing of work and allows many concurrent operations to occur throughout the Project Area. The exact construction sequence for each portion of the LOP is expected to depend on the access points. Generally, work is expected to begin with those areas that are furthest from the points of access, and then proceed incrementally back to the access points. For example, the proposed parks/open spaces would likely be constructed last because they would be dual-purposed as construction access points and staging areas.

Although construction timeframes are dependent on the number and location of construction access points, the following general timeframes are anticipated within the overall 3-year construction window. The Northern Segment is anticipated to require between 9 and 18 months, the Central Segment is anticipated to require between 24 and 30 months, and the Southern Segment is anticipated to require between 12 and 18 months to construct.

The proposed Berry's Creek storm surge barrier would be constructed in three phases in order to maintain flow in the channel. The proposed pump station and west gate structure would be constructed in the first phase, followed by the proposed east gate structure in a second phase. Upon completion of the east gate structure, a third phase is anticipated for any remaining mechanical/electrical construction, as well as the commissioning and start-up of the facility. Construction of the proposed Berry's Creek storm surge barrier is anticipated to require 24 to 30 months in total. This time frame includes 12 to 15 months for the proposed pump station and west gate structure, 6 to 9 months for the proposed east gate structure, and approximately 6 months for the remaining mechanical/electrical work, including commissioning and start-up.

Construction of Alternative 1 would require the use of typical heavy equipment, including, but not limited to, backhoes, graders, bulldozers, concrete pumps, dump trucks, front-end loaders, and cranes. With a 3-year construction program and multiple contracts underway concurrently, an accelerated construction effort would not be anticipated. As such, contractors would be expected to work one shift per day, with each shift averaging 9 hours in length. A six-day work week (Monday through Saturday) is anticipated. Additionally, due to the nature of Alternative 1, tide conditions may necessitate irregular work shifts in order to schedule select operations during periods of low tide. In total, approximately 20,000 man-days would be required for the construction of Alternative 1, not including overall project management, supervisory, and inspection personnel. **Table 2.5-2** displays the man-days of work anticipated for each segment of the LOP. This level of effort would be expected to produce a total of 490 direct job-years[16] throughout the construction of Alternative 1 (NJDEP 2018).

Table 2.5-2: Man-days Required for Construction of Alternative 1 by Segment

Work Area Location	Man-days (9-hour average shift)
Northern Segment	1,117
Central Segment	11,728
Southern Segment	1,290
Berry's Creek	5,858
Total	**19,993**

[16] A job-year is equivalent to the full-time employment of one person for one year. For example, 10 job-years would represent the full-time employment of 10 people for 1 year, or of 1 person for 10 years.

Access and Staging Areas

Construction of Alternative 1 would be conducted using numerous access and staging points. These areas would be used to store and transport heavy equipment, construction materials, and construction personnel throughout the various construction phases. Field offices for the construction contractors may also be located in these areas. The areas expected to be used for access and staging are shown in **Figure 2.5-5** through **Figure 2.5-7**; they include the following:

- Portions of industrial/commercial properties along South River Street
- Fluvial Park site and adjacent industrial property
- K-Town Park site and Main Street
- Riverside Park site and Riverside Avenue
- Dietrich Street
- Mehrhof Road, and possibly Maiden Lane, and McCabe Court
- BCUA property and Losen Slote tide gate access road
- Empire Boulevard and Transco Gas Pipeline Road
- Commerce Boulevard
- Berry's Creek storm surge barrier site

Generally, the proposed park sites would be used for staging throughout the majority of the construction phase. This would minimize the total area required for disturbance. These properties would be acquired prior to the start of construction, and then cleared and converted into the proposed park space during the final phases of construction. The proposed Berry's Creek storm surge barrier and pump station site would also be permanently acquired, so this location would likely be used for long-term staging. In order to minimize impacts on residents, businesses, and property owners, non-park locations, such as Commerce Boulevard or private industrial/commercial properties, would be used for access and staging only as long as necessary to complete the project components proximal to those specific locations.

In addition to the locations described above, some construction work on the Northern Segment of the LOP may be conducted from a barge in the Hackensack River. Existing space along the river is narrow in portions of this segment, particularly in the residential areas. Accessing the LOP footprint from the river would help to provide enough space to complete construction activities, and to avoid potential impacts to existing riverfront buildings and properties.

Transportation and Circulation

Roads in the Project Area to be used for transportation of construction equipment, materials, and personnel would primarily include the following:

- South River Street
- Hudson Street
- Bergen Turnpike
- US Route 46
- Industrial Avenue
- Gates Road
- Riverside Avenue
- Merhoff Road
- Dietrich Street
- Empire Boulevard

- Washington Avenue
- Paterson Plank Road
- State Route 17

As part of the proposed LOP, road-raising activities would occur to portions of Paterson Plank Road and Murray Hill Parkway. Temporary lane realignments would be required on these roads during construction. Further, construction of the closure gate on the NJ Transit railroad tracks would require temporarily track closure; this closure would be coordinated with NJ Transit. Temporary lane realignments could also be required for select roads while they are being used for staging or access to other portions of the proposed LOP. These roads would include Main Street, Riverside Avenue, Dietrich Street, and Commerce Boulevard. Traffic Management Plans (TMP) would be developed under each construction contract in order to minimize impacts on existing traffic patterns and ensure the safe and efficient coexistence of construction-related and non-construction-related vehicles within the Project Area, including adequate detouring and associated signage for non-construction-related traffic. Construction personnel are also expected to park their personal vehicles at the construction staging areas or at available public parking spaces on-street or in lots near the work sites. A complete analysis of the potential impacts to Transportation and Circulation in the Project Area under Alternative 1 is provided in **Section 4.7.4.2**.

Utility Infrastructure

Construction of Alternative 1 would require the relocation of existing sanitary wastewater, underground electric, natural gas, and stormwater utility lines where they cross the LOP. All utility relocations would be coordinated with the utility providers. Utility providers would provide advance notice of anticipated disruptions to all affected customers, and any service disruptions would be scheduled for times likely to result in the least inconvenience to consumers to the extent feasible.

Utilities would not be expected to be used during the construction of Alternative 1, as most construction activities would be conducted using diesel-powered equipment. However, it is possible that individual contractors could use utilities (i.e., water or electricity) for specific construction activities or their construction trailers. Use of utilities by construction contractors would be negotiated in advance with utility providers and/or local officials to ensure existing utility lines are capable of supporting those construction activities. Additionally, a cofferdam and water diversion equipment would be required to divert the flow of Berry’s Creek around the in-channel construction footprints (i.e., for the proposed surge barrier). Flow diversion would be conducted according to standard engineering practice.

Section 4.12.4.2 provides a detailed description of potential impacts to utility services that could result from construction of Alternative 1, as well as appropriate mitigation measures.

2.5.2.3 Operations and Maintenance Activities

The estimated useful life of Alternative 1 is anticipated to be 50 years, or approximately 2022 through 2072. In accordance with the CDBG-DR funding requirements, the NJDEP must develop an O&M Plan for the Proposed Project. In early 2019, the NJDEP would form an O&M subcommittee with local and State partners to develop this plan. The participants in the O&M planning and development process would include, but not be limited to, entities such as the NJDEP, Bergen County, BCUA, PANYNJ, NJSEA, and the Boroughs of Little Ferry, Moonachie, Carlstadt, and Teterboro, and the Township of South Hackensack. The O&M Plan would contain five functions (Operations, Maintenance, Engineering, Training, and Administration) and describe the procedures and responsibilities for routine maintenance, communication, and timing of activation in the event of an impending storm. Activities associated with flood events, routine maintenance, and emergency maintenance and repair are discussed at a high level in the following subsections, as are potential ongoing uses of transportation or utilities resources.

Transportation and Circulation

Operation of Alternative 1 would not close or restrict public roadways, as the LOP (including closure gates) would not be located on any public roads. However, the proposed closure gate on the New Jersey Transit railroad tracks would impede rail use if the impending flooding has not already shut down train service. O&M personnel would coordinate the operation of that closure gate with New Jersey Transit prior to, and throughout the duration of, flood events. A complete analysis of the potential impacts to Transportation and Circulation in the Project Area under Alternative 1 is provided in **Section 4.7.4.2**.

Utility Infrastructure

Alternative 1 would not require any sanitary wastewater, potable water, or natural gas connections for operation.

Electricity would be required for two purposes under Alternative 1. First, the proposed public parks and pathways would include lighting features, which would operate on a consistent basis and require nominal amounts of electricity. Second, the Berry's Creek storm surge barrier would be powered primarily by electricity. It would be connected to the electric grid via overhead lines that tap into existing overhead power lines along Paterson Plank Road, and would be constructed and wired in accordance with all applicable building code requirements. Electricity would power the proposed surge gates and pump station. The typical monitoring and control equipment associated with these features would draw a small amount of electricity on a continuous basis to operate. The surge gates and pump station would consume greater amounts of electricity on an intermittent basis, as they would typically only operate during large flood events (i.e., when a Coastal Flood Warning is issued by the NWS).

Operation of the pump station is expected to represent peak electrical consumption during the operation of the Berry's Creek storm surge barrier. This peak electrical consumption would be expected to persist for several days during each flood event until the surge gates are reopened when the flood has sufficiently receded. An emergency backup diesel generator would also be located at the Berry's Creek storm surge barrier, which would be capable of operating the facility for at least 3 days in the event of an electric power outage.

Stormwater drainage features (e.g., a drainage swale on the landward side of the LOP) would be incorporated into the LOP design, but stormwater would not be collected or treated in any new or existing stormwater mains. Approximately 43 stormwater drainage outlets to the Hackensack River are expected to be constructed along the entire LOP.

Solid waste receptacles would be available in the public parks and pathways. Disposal of collected refuse would be facilitated in the same manner as for the existing parks within the Project Area.

The only telecommunication feature that would be included under Alternative 1 is a landline telephone that would be installed in the pump station at Berry's Creek.

Section 4.12.4.2 provides a detailed description of potential impacts to utility services that could result from operation of Alternative 1, as well as appropriate mitigation measures.

Flood Event Operations

Flood event operations include the activities conducted leading up to, during, and immediately following a flood event. The O&M Plan would identify the roles, responsibilities, and training required of all O&M personnel. Before flood events occur, the weather and tidal conditions would be monitored, and necessary coordination among the various agencies and organizations (e.g., public works, safety, and emergency response personnel) would occur. Gate closures along the LOP would be conducted using heavy equipment (e.g., a backhoe), and the Berry's Creek storm surge barrier and pump station would be initiated prior to an anticipated flood event using programmed controls at the facility.

During a flood event, the LOP would be monitored if necessary, and as conditions permit. Besides the closure gates mentioned previously, other operational project components (e.g., the tide gate) would be designed to function under most circumstances without human assistance or intervention. Following a flood event, closure gates and the Berry's Creek storm surge barrier would be reopened once the water level dropped to a safe level.

Routine Maintenance

Routine inspections would be conducted along the LOP to ensure long-term maintenance and to identify any issues requiring corrective measures. Maintenance crews would drive trucks to the site and use access roads and ramps within the permanent/maintenance easements to gain access to the floodwalls. Pump stations and closure gates would be accessed from existing roads/streets and parking lots. Drainage structures, such as flap and sluice gates, would be installed in underground chambers and, therefore, would be accessed through manholes.

Any necessary corrective maintenance actions identified during these routine inspections would be conducted as appropriate. Examples of routine corrective actions would include repairing concrete that has cracked, chipped, or broken; re-caulking joints; repairing accessory items such as railings or fences; replacing dislodged riprap; or repairing road surfacing materials.

In addition to routine inspections, continuing long-term maintenance would be scheduled and performed on a regular basis. Examples of regular continuing maintenance may include mowing, fertilizing, and seeding grass areas; removing accumulated brush, trash, or debris; removing graffiti; and greasing operational LOP components (e.g., closure gates).

Emergency Maintenance and Repairs

Significant maintenance issues would be corrected according to procedures identified in the O&M Plan. All repairs would be accomplished by methods acceptable in standard engineering practice. Examples of conditions that could require immediate maintenance include the following:

- A breach or near breach of a levee caused by severe progressive erosion;
- Uncontrolled seepage through a levee;
- Severe damage to a floodwall;
- Malfunction of a tide gate or closure gate; and/or
- Malfunction of a pump station.

2.5.2.4 Conclusion

In summary, implementation of Alternative 1 would provide approximately 50 years of coastal flood protection for the Project Area. In the near term, it would have an approximately 2 percent annual chance of being overtopped, compared to the approximately 10 to 20 percent annual chance of the existing flood protection berms being overtopped. Alternative 1 would not provide protection against existing or anticipated inland flooding from high-intensity rainfall/runoff events. By providing approximately 50 years of coastal flood protection, as described in **Section 4.1.2.2**, Alternative 1 would satisfy the purpose and need for the Proposed Project. Specifically, per the goals and objectives identified in **Section 1.4.1**, implementation of Alternative 1 would contribute to community resiliency, reduce risks to public health, deliver co-benefits, enhance and improve use of public space, consider impacts from sea level change, protect ecological resources, and improve water quality. The impacts of Alternative 1 are summarized in **Section 2.6**.

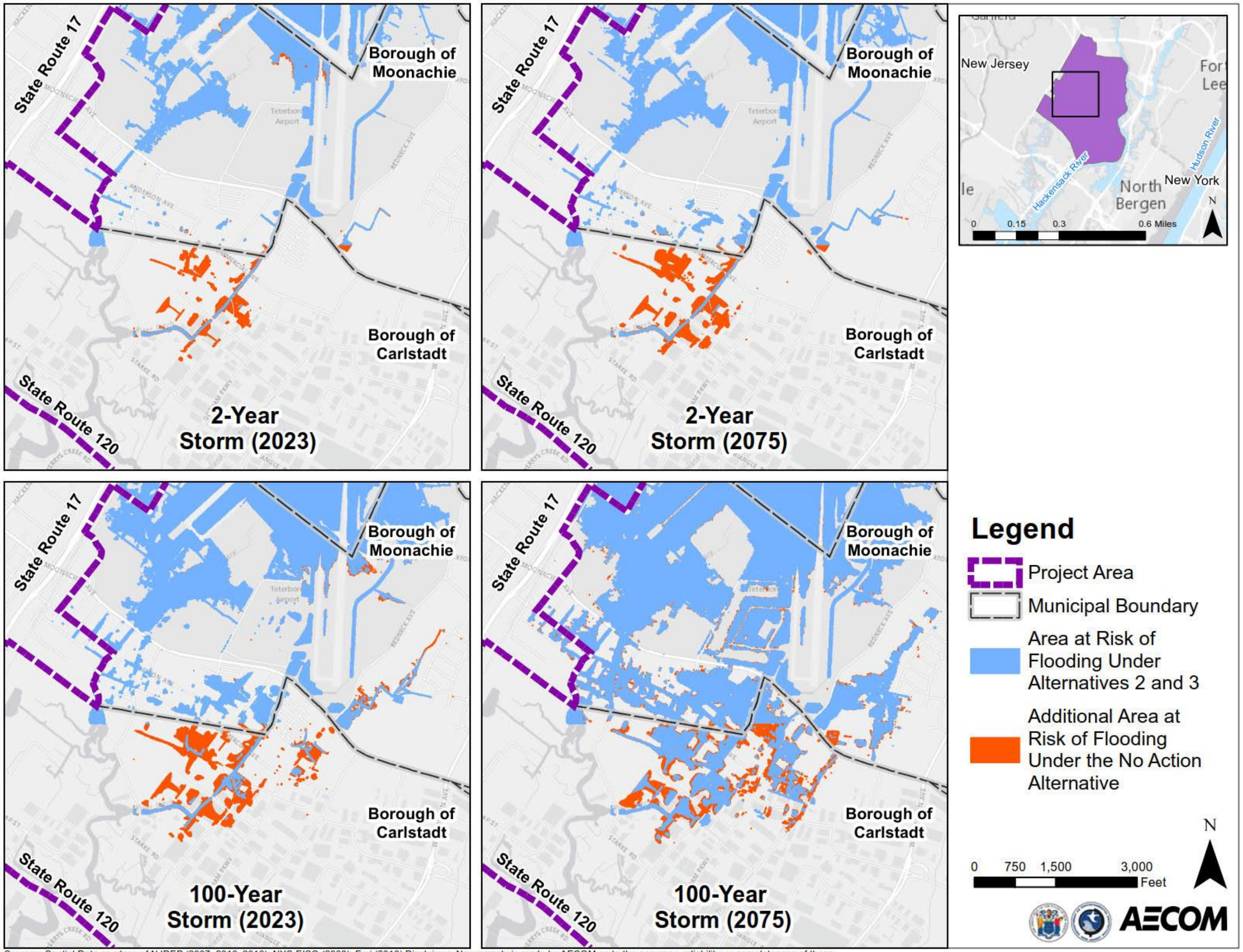
2.5.3 Alternative 2

Alternative 2 includes various grey and green infrastructure-based solutions, as well as new parks and improved open spaces, intended to improve stormwater management in key locations throughout the Project Area. This alternative would reduce chronic inland flooding from heavy or frequent precipitation events up to approximately the 100-year storm, but coastal flooding would continue to adversely affect the Project Area.

Under Alternative 2, stormwater management would be improved through the installation of 41 green infrastructure systems (bioswales, storage/tree trenches, and rain gardens) along roadways, five new parks, improvements to five existing open spaces/public amenities, three new pump stations, two new force mains, and dredging of the lower reach of East Riser Ditch, as described in **Section 2.5.3.1** (NJDEP 2018).

This alternative would primarily reduce inland flooding from East Riser Ditch and Losen Slote during heavy rainfall events. Flood depths (i.e., the water level) in East Riser Ditch would be reduced to the greatest extent between the existing tide gate and Moonachie Avenue, where the channel improvements would be implemented. Flood depth reduction in this reach of the channel would be between approximately 2.5 and 2.9 feet during a 2-year storm, 2.1 and 2.7 feet during a 10-year storm, 1.9 and 2.5 feet during a 25-year storm, and 1.6 and 2.2 feet during a 100-year storm. Additionally, residual flood reduction would occur in the channel north to US Route 46 as a result of the improved conveyance capacity in the lower reach. As shown in **Figure 2.5-17**, the extent of flooding would also be reduced in the East Riser Ditch floodplain; these flood extent reductions would be concentrated in the Borough of Carlstadt in the area adjacent to the proposed improvements.

Alternative 2 would also provide measurable flood depth reduction in the Main Reach and Park Street Reach (a fully piped tributary) of Losen Slote. In the Main Reach, flood depths would be reduced in the channel primarily between approximately Bertolotto Avenue and Niehaus Avenue. These flood depth reductions would vary between approximately 0.2 and 0.6 feet during a 2-year storm, 0.1 and 0.5 feet during a 10-year storm, 0.1 and 0.4 feet during a 25-year storm, and 0.2 and 0.7 feet during a 100-year storm, depending on specific locations. In the Park Street Reach, flood depths would be reduced between its confluence with the Main Reach and approximately Union Avenue. Flood depth reduction would vary between approximately 0.1 and 0.5 feet during a 2-year storm, 0.2 and 0.6 feet during a 10-year storm, 0.1 and 0.6 feet during a 25-year storm, and 0.1 and 0.5 feet during a 100-year storm. Overall, reductions in the extent of the Losen Slote floodplain would be minimal and disperse.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate usewith other data.This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 2.5-17: Comparison of East Riser Ditch Flooding Under Alternative 2 and the No Action Alternative

Finally, the green infrastructure systems, new parks, and improved open spaces would also provide minor localized flood reduction proximate to their locations. The green infrastructure systems would be designed to accommodate the NJDEP Water Quality Design Storm, as described above, and the parks and open spaces would be designed to store and treat stormwater through the use of additional green infrastructure, new or enhanced wetlands, native vegetation, and permeable pavement. Further, Alternative 2 would reduce impervious surfaces in the Project Area by approximately 3.4 acres. By implementing these features, Alternative 2 would increase the rate and capacity of stormwater infiltration and treatment in the Project Area, thereby potentially decreasing stormwater runoff and flooding in the vicinity of its footprint during low intensity rainfall events. Flood reduction provided under Alternative 2 is further detailed in **Section 4.1.2.3**.

2.5.3.1 Components of Alternative 2

As described in **Section 2.4.2**, the development process for Alternative 2 included numerous potential concepts designed to reduce inland flooding in particular locations. From among those concepts, the most efficient flood reduction components were assembled into the final Build Alternative. Under Alternative 2, stormwater management improvements would consist of new green infrastructure, new parks, improved open spaces, and grey infrastructure improvements to the East Riser Ditch and Losen Slote drainage basins. These four types of stormwater management improvements are described below, and are illustrated in **Figure 2.5-18** through **Figure 2.5-20**. These improvements were determined to best meet the Proposed Project's goals and objectives while minimizing adverse environmental, socioeconomic, and cultural impacts to the extent feasible. Please note that while the Alternative 2 components described in this section represent the current design, certain details (e.g., the arrangement of or features in each park) could change during the final design process.

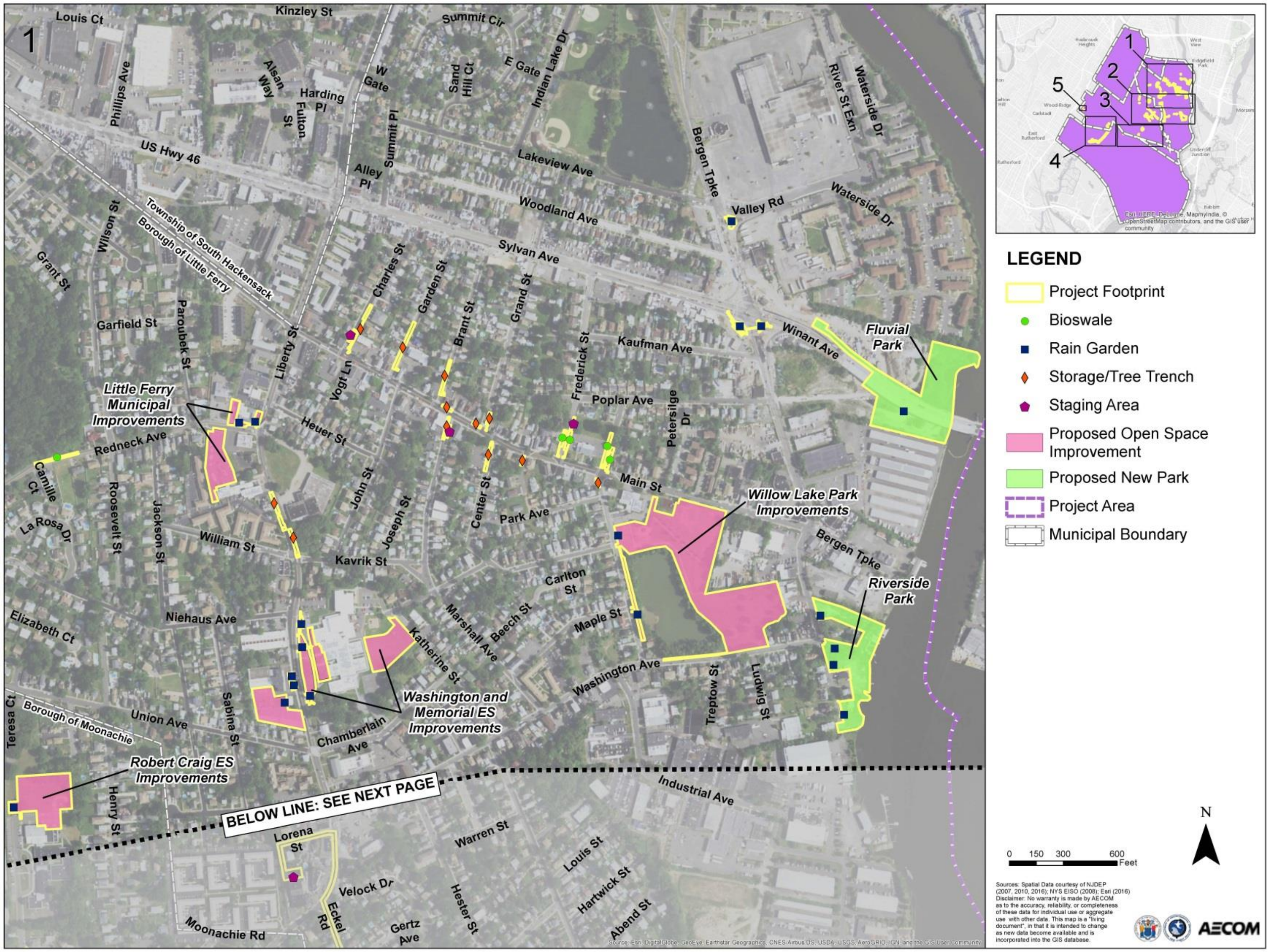


Figure 2.5-18: Alternative 2 Components (Figure 1 of 3)

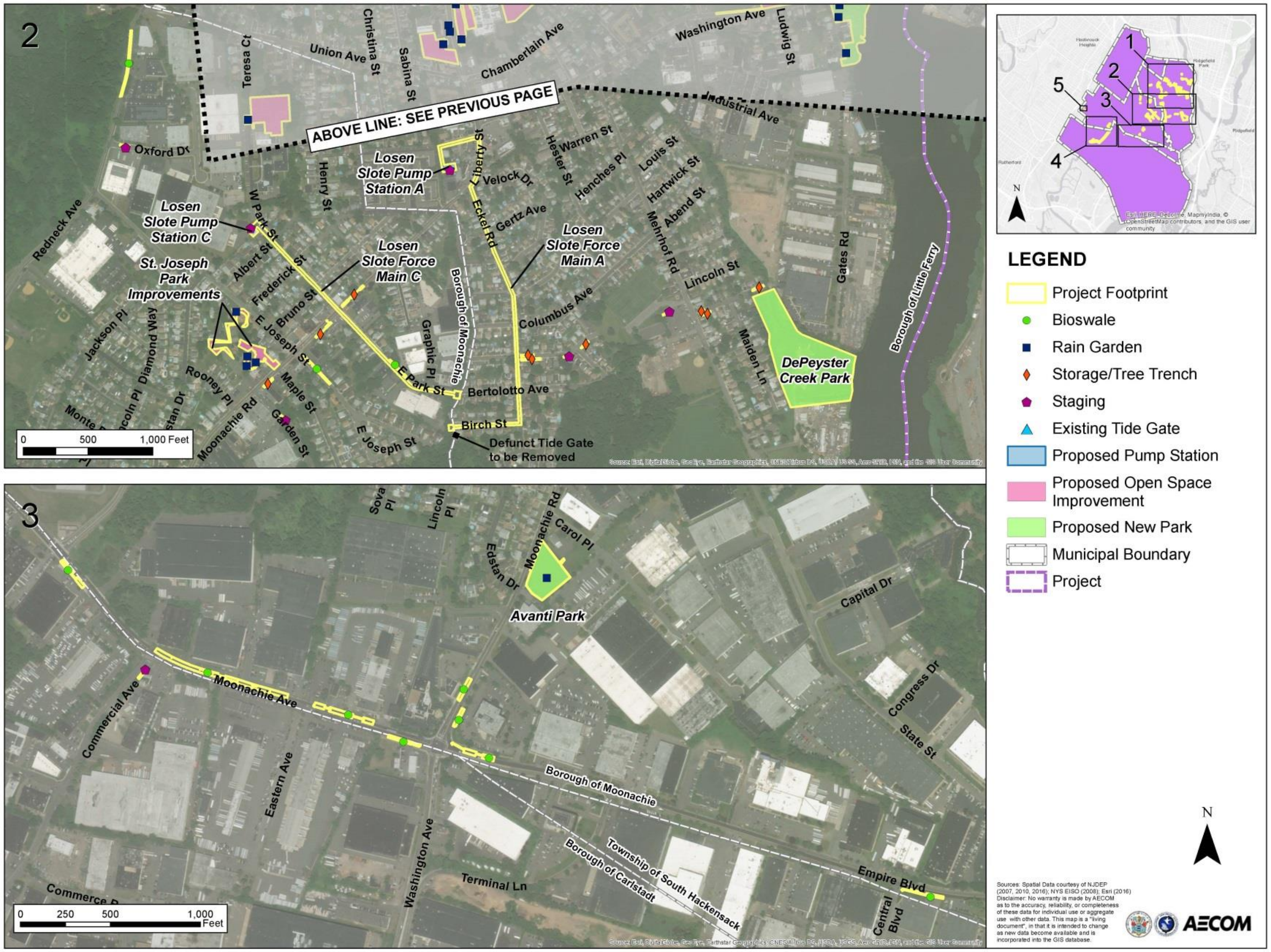


Figure 2.5-19: Alternative 2 Components (Figure 2 of 3)

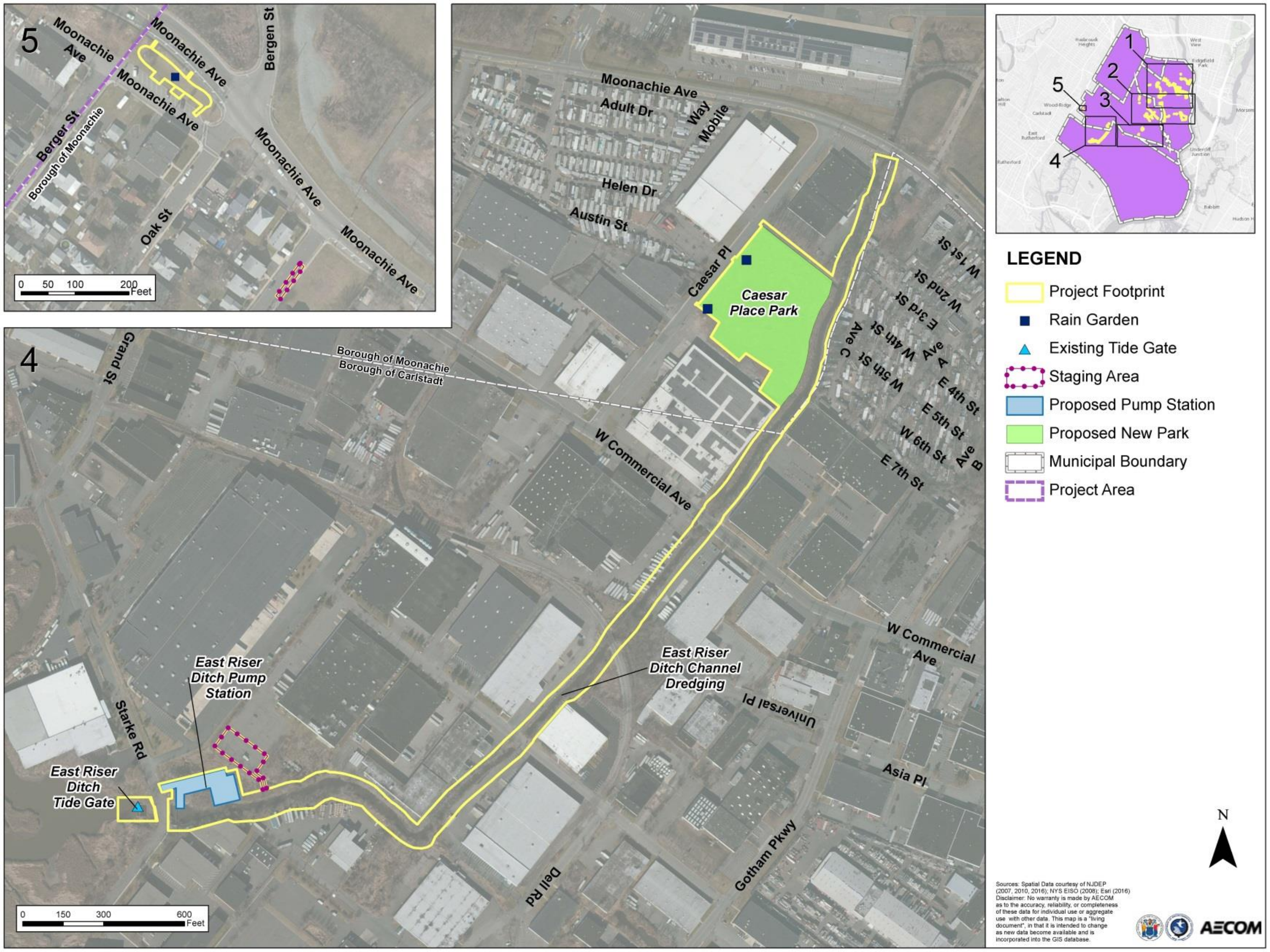


Figure 2.5-20: Alternative 2 Components (Figure 3 of 3)

Green Infrastructure

Alternative 2 would include the installation of 41 new green infrastructure systems along roadways within the Project Area. These systems would consist of bioswales, rain gardens, and storage/tree trenches, as described in **Section 2.2.2.2** and illustrated in **Figure 2.2-3**, and would be constructed across five different general drainage areas: DePeyster Creek, Carol Place, West Riser Ditch, Park Street, and Main Street. A list of the green infrastructure types and locations is provided in **Table 2.5-3**. In total, these green infrastructure systems would capture stormwater from approximately 287,296 SF, or approximately 6.6 acres, of existing roadways. As described in **Section 2.2.2.2**, in addition to storing stormwater and enabling stormwater to infiltrate back into the ground, these green infrastructure systems would filter out sediment, nutrients, and pollutants from the stormwater before they reach waterbodies.

Table 2.5-3: Green Infrastructure Systems Proposed Under Alternative 2

System Type	Location	Drainage Area (SF)	Square Foot (SF)
DePeyster Creek Area			
Storage/Tree Trench	Monroe Street at Eckel Road	5,934	535
Storage/Tree Trench	Monroe Street from dead end to Bertolotto Avenue	3,136	440
Storage/Tree Trench	Monroe Street from Bertolotto Avenue to Eckel Street	6,490	1,024
Storage/Tree Trench	Dietrich Street from Maiden Lane to Mehrhof Road	1,314	128
Storage/Tree Trench	Dietrich Street from Maiden Lane to Mehrhof Road	1,781	294
Tree Trench	Dietrich Street from dead end to Maiden Lane	2,497	395
	Total:	**21,152**	**2,816**
Carol Place Area			
Bioswale	Moonachie Avenue at Redneck Avenue	11,412	902
Bioswale	Moonachie Avenue from Commercial Avenue to Eastern Avenue	16,351	3,345
Bioswale	Moonachie Avenue from Eastern Avenue to Washington Avenue	10,224	1,411
Bioswale	Moonachie Avenue from Eastern Avenue to Washington Avenue	8,528	755
Bioswale	Empire Boulevard from Moonachie Road to Terminal Lane	4,889	663
Bioswale	Moonachie Road from Moonachie Avenue to Edstan Drive	3,143	794
Bioswale	Moonachie Road from Moonachie Avenue to Edstan Drive	3,587	573
Bioswale	Empire Boulevard from Central Boulevard to Horizon Boulevard	4,546	480

System Type	Location	Drainage Area (SF)	Square Foot (SF)
	Total:	**62,861**	**8,923**
West Riser Ditch Area			
Rain Garden	Moonachie Avenue from Park Place to Oak Street	20,329	2,853
	Total:	**20,329**	**2,853**
Park Street Area			
Bioswale	East Joseph Street at Moonachie Road	8,660	1,460
Bioswale	East Park Street from Moonachie Road to Graphic Place	2,309	405
Storage/Tree Trench	Liberty Street at Kavrik Street	3,329	720
Bioswale	Redneck Avenue from Union Avenue to Franklin Street	10,906	2,735
Bioswale	Redneck Avenue from Wilson Street to Mariani Drive	9,254	863
Storage/Tree Trench	Liberty Street from Redneck Avenue to William Street	11,346	1,028
Storage Trench	Moonachie Road from Garden Street to Maple Street	3,026	448
Storage Trench	Moonachie Road from Park Street to Joseph Street	5,351	468
Storage Trench	Moonachie Road from Park Street to Broad Street	6,889	423
	Total:	**61,070**	**8,549**
Main Street Area			
Storage Trench	Main Street at Garden Street west	10,317	1,890
Storage Trench	Charles Street at Main Street (northeast)	13,762	1,307
Storage Trench	Main Street from Brandt Street to Grant Street	2,400	132
Storage Trench	Main Street from Garden Street to Brandt Street	1,978	169
Storage Trench	Center Street from Park Street to Main Street	6,796	939
Storage Trench	Herman Street from dead end to Main Street	2,482	147
Bioswale	Frederick Street from Poplar Street to Main Street	3,793	624
Bioswale	Werneking Place from Poplar Street to Main Street	6,923	936
Bioswale	Werneking Place from Poplar Street to Main Street	6,151	700
Rain Garden	Valley Road at Bergen Turnpike	14,400	1,867
Rain Garden	Sylvan Avenue at Bergen Turnpike	16,479	1,572
Rain Garden	Sylvan Avenue at Bergen Turnpike	14,395	1,159
Storage Trench	Brandt Street from Sylvan Avenue to Main Street	10,249	866
Storage Trench	Marshall Avenue from Kavrik Street to Main Street	3,116	450
Storage Trench	Grand Street from US Route 46 to Main Street	1,294	275

System Type	Location	Drainage Area (SF)	Square Foot (SF)
Storage Trench	Frederick Street from Poplar Street to Main Street	5,788	760
Storage Trench	Pickens Street from Park Street to Main Street	1,561	185
	Total:	**121,884**	**13,977**
	GRAND TOTAL:	**287,296**	**37,118**

New Parks

Alternative 2 would include the construction of five new parks within the Project Area. Three of these five parks (Fluvial Park, Riverside Park, and DePeyster Creek Park) share the same names and general locations as proposed parks in Alternative 1, but were designed differently. In total, approximately 20.0 acres of new park space would be established, which would be designed to assist with storage and treatment of both on-site stormwater, as well as stormwater from adjacent roadways. To this end, each park would focus on wetland restoration or creation, additional green infrastructure, and increased pervious surfaces and native plantings, while providing varied recreational opportunities. Details for each park are provided below:

Fluvial Park is proposed to be a new 4.4-acre riverfront park (see **Figure 2.5-21**) in the same general location as it would be under Alternative 1. Under Alternative 2, Fluvial Park would provide open space, passive and active recreation opportunities, native habitat, stormwater storage and filtration, and public access to approximately 560 LF of riverfront. The park would further include elevated walkways over constructed wetlands and native vegetation; approximately 0.6 acre of permeable play surface; a kayak launch; and opportunities for fishing and birdwatching. An access path (approximately 500 LF) would connect the park to Bergen Turnpike. Stormwater would be filtered in an approximately 3,484 SF bioswale, and lawn areas (approximately 1.2 acres) would allow for activities such as picnicking, sunbathing, and informal games (e.g., Frisbee or bocce ball). Along the edge of the Hackensack River, approximately 1.0 acre of naturalized wetland and 0.3 acre of native woodland would improve the ecological habitat and performance of the site.

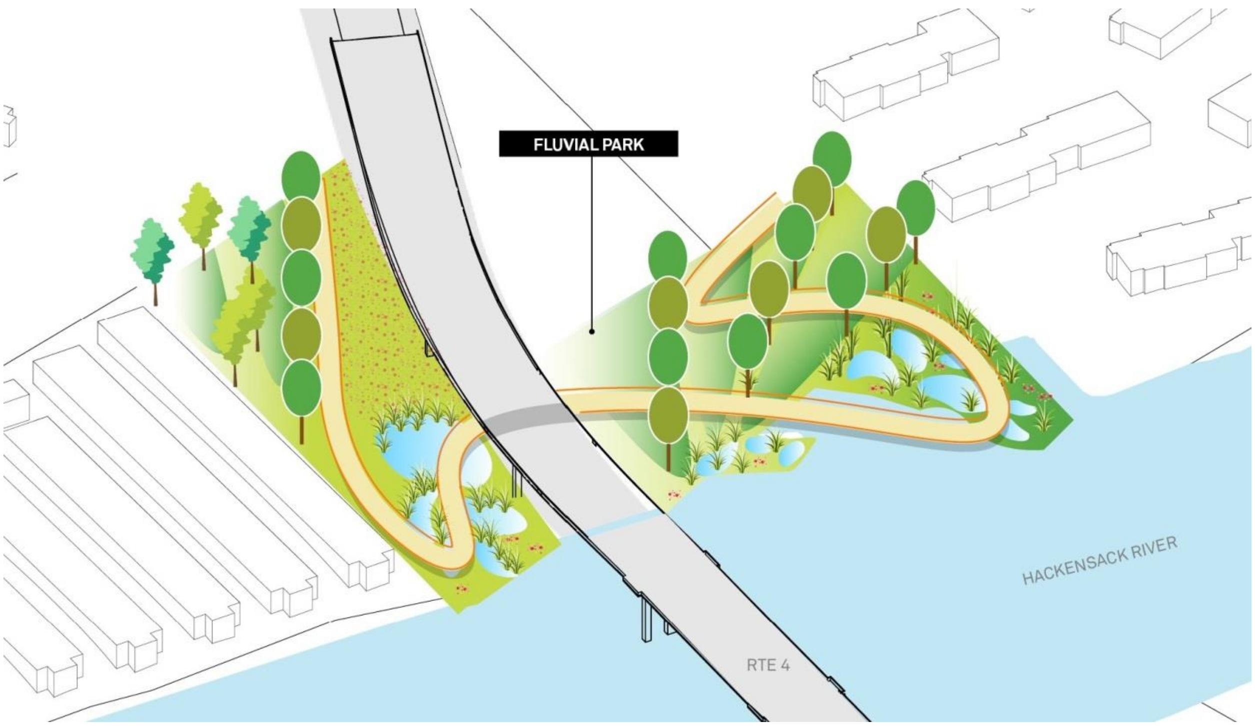


Figure 2.5-21: Concept Drawing of Proposed Fluvial Park

Riverside Park is proposed to be a new 2.6-acre riverfront park (see **Figure 2.5-22**) in the same general location as it would be under Alternative 1. It would transform an existing boat dock area and parking lot into a park with approximately 600 LF of accessible riverfront. Riverside Park would include walking paths that weave through approximately 0.7 acre of native plantings and bioswales, and 0.3 acre of mowed lawn for informal recreation and gathering. A restored riparian wetland (approximately 0.1 acre) would create new intertidal wetland habitat and would be accessible by an elevated walkway, and improved boat docks and a boat launch, which would be capable of launching trailered vessels, would create recreational opportunities for boating, kayaking, birdwatching, and fishing.

Figure 2.5-22: Concept Drawing of Proposed Riverside Park

DePeyster Creek Park is proposed to be a new 8.0-acre riverfront park and natural area (see **Figure 2.5-23**) located along DePeyster Creek where it meets the Hackensack River. The park would transform existing disturbed shrubland and deciduous forest habitats into higher quality habitat, such as a protected shallow embayment with intertidal marsh, native shrub habitat, and native woodland with pollinator habitat. These improvements would be expected to provide substantial ecological uplift for both upland and riparian species. The park would further transform approximately 360 LF of the Hackensack River into publicly accessible riverfront, with approximately 0.7 acre of trails (including an elevated walkway) and plazas (congegration areas) allowing opportunities for walking, running, picnicking, group assembly, and bird-watching along both the river and the newly created intertidal marshland.

Figure 2.5-23: Concept Drawing of Proposed DePeyster Creek Park

Caesar Place Park is proposed to be a new 4.0-acre park (see **Figure 2.5-24**) along the east side of Caesar Place in Moonachie. This park would provide open space, native habitat, stormwater storage and filtration, wetland enhancement and expansion, and opportunities for passive recreation. Caesar Place Park would improve and expand the existing wetland on site, creating approximately 1.5 acres of wooded wetland and 1.6 acres of emergent wetland. Elevated boardwalks (approximately 0.2 acre), which could potentially include outlooks and viewing platforms, would allow visitors to access these habitats. Further, there would be approximately 0.5 acre of open lawn and approximately 0.3 acre of native vegetation to provide recreational opportunities. Rain gardens (approximately 1,224 SF) would also be located on site to filter stormwater from Caesar Place Road, and additional native plantings would frame the park and provide aesthetic transition within the surrounding urban context.

Figure 2.5-24: Concept Drawing of Proposed Caesar Place Park

Avanti Park is proposed to be a new 1.0-acre park (see **Figure 2.5-25**) located on an existing open lot along Moonachie Road just north of Edstan Drive. The park would feature open space, native habitat, stormwater storage and filtration capability, and passive and active recreation opportunities. The primary feature of the park would be an approximately 0.3-acre constructed wetland that would collect and infiltrate stormwater from both the park and the adjacent lot. An elevated walkway (approximately 0.1 acre) would traverse this wetland, and connect back to approximately 0.2 acre of permeable pavement along Moonachie Road. Adjacent to the permeable pavement would be approximately 0.1 acre of permeable play surface. Additional park elements would include approximately 0.1 acre of woodland to screen adjacent warehouses, approximately 0.2 acre of native plantings to increase biodiversity, and stormwater filtration.

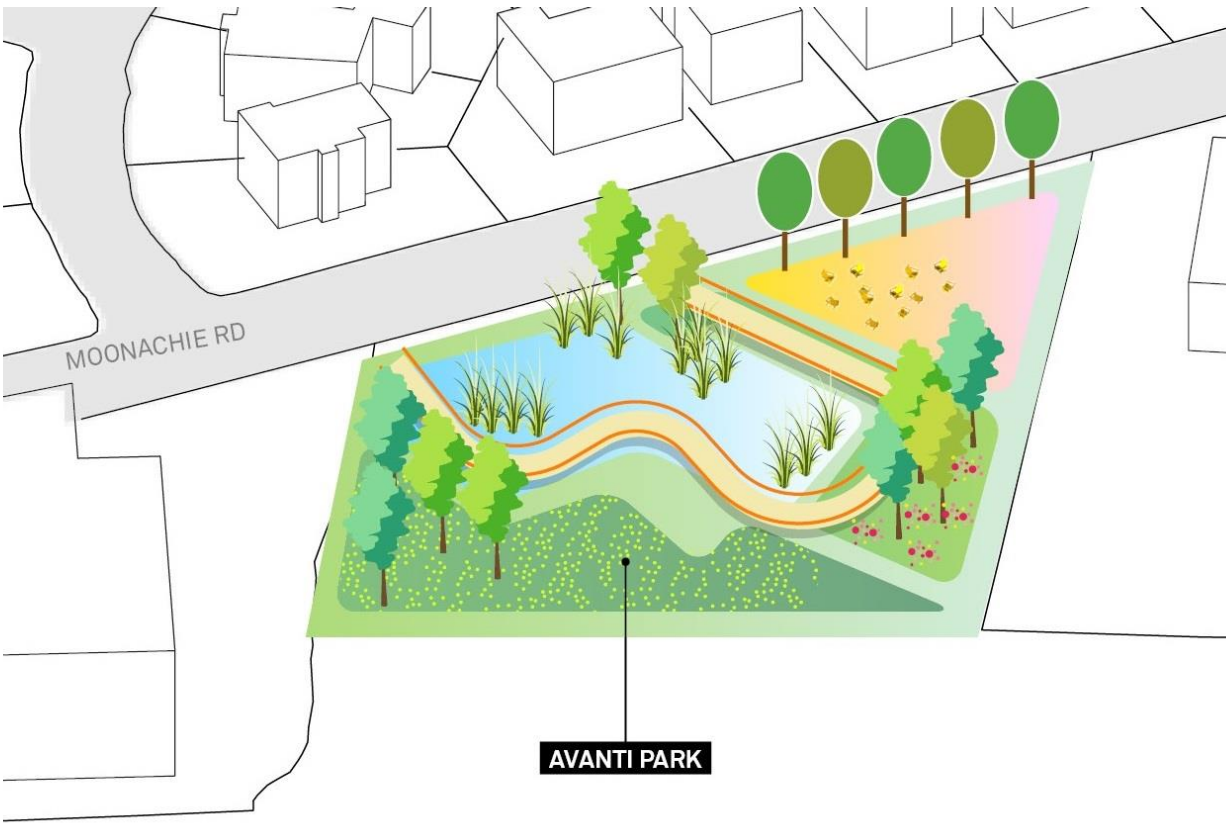


Figure 2.5-25: Concept Drawing of Proposed Avanti Park

Improved Open Spaces

Additionally, Alternative 2 would include improvements to five existing open spaces within the Project Area, as described below. Generally, these improvements would include features such as replacement of impervious surfaces with permeable materials (i.e., permeable paving of parking lots), installation of additional native plantings and green infrastructure systems, and sports field renovations. Like the proposed new parks, these improvements would be intended to increase overall stormwater storage and treatment at these locations.

Willow Lake Park is an existing 7.0-acre public park that is proposed to be improved for pedestrian circulation and ecological benefit (see **Figure 2.5-26**). Existing pedestrian trails would be expanded to connect the northern and southern areas of the park. These trails would be approximately 0.5 mile long, and would be woven through dynamic earthwork mounds supporting approximately 2.0 acres of native vegetation and 1.9 acres of low meadow with scattered trees. These vegetation areas would provide habitat for pollinators and birds. Bioswales (approximately 1,134 SF) would store and filter stormwater from Pickens Street, and a large expanse of open lawn (approximately 2.4 acres) would allow for informal active play.

Figure 2.5-26: Concept Drawing of Proposed Improvements to Willow Lake Park

Little Ferry Municipal Improvements would be stormwater management practices installed at the Little Ferry Library and Little Ferry Municipal Building (see **Figure 2.5-27**). The improvements to the library would include approximately 0.3 acre of native plantings and rain gardens, as well as replacement of existing asphalt parking lot with permeable paving to improve stormwater infiltration.

Little Ferry Public Schools would receive a series of proposed campus improvements (see **Figure 2.5-27**). The improvements would be made to Washington Elementary School and Memorial Middle School, and would include open space, native habitat, stormwater storage and filtration, and passive and active recreation opportunities. Approximately 0.4 acre of an existing sports field would be improved (e.g., turf repair/seeding), while approximately 1.1 acres of native vegetation (with trees) would be planted to increase stormwater filtration and biodiversity. Proposed rain gardens along Liberty Avenue would also collect and infiltrate stormwater. At Washington Elementary School, approximately 0.8 acre of impervious pavement would be converted to permeable pavement or a permeable play area. Existing active programming areas would remain, but overall stormwater filtration and conveyance would be improved on site.

Figure 2.5-27: Concept Drawing of Proposed Improvements to Little Ferry Municipal Facilities and Little Ferry Public Schools

Joseph Street Park is an existing public park with lawn, a gazebo, and basketball, soccer, and tennis courts. Under Alternative 2, landscape improvements (see **Figure 2.5-28**) would be made to 0.2 acre of the park through the planting of native vegetation. Bioswales would also improve stormwater storage and filtration, and an existing parking lot would receive treatment to increase its permeability and improve its stormwater filtration capabilities and reduce runoff.

Robert Craig Elementary School is an existing elementary school campus that would receive approximately 1.7 acres of proposed improvements (see **Figure 2.5-28**). Improvements would include approximately 1.4 acres of new sports field at an existing baseball diamond and open lawn, replacement of an existing impermeable play surface with approximately 0.3 acre of permeable play surface, and the construction of an approximately 2,519 SF rain garden in an existing open lawn. Existing active programming would not change, but overall stormwater filtration and conveyance would be improved on site.

Figure 2.5-28: Concept Drawing of Proposed Improvements to Joseph Street Park and Robert Craig Elementary School

Grey Infrastructure

Alternative 2 would include grey infrastructure improvements along both East Riser Ditch and in the Losen Slote drainage basin. These improvements would include channel dredging, three new pump stations, and two new force mains.

East Riser Ditch would be dredged between Moonachie Avenue and the East Riser Ditch tide gate (see **Figure 2.5-29**). In total, approximately 20,200 cubic yards (CY) of sediment would be removed from the ditch and displosed of off-site at a facility licensed to receive the dredged material in order to improve stormwater conveyance within the channel. To complete this work, the railroad bridge that crosses this reach of East Riser Ditch, as well as the culverts beneath Amor Avenue and West Commercial Avenue, would need to be removed and replaced. Dredged sediment and all debris associated with these channel improvements would be disposed of offsite at a licensed facility, and channel boundaries and adjacent areas (approximately 9.5 acres) would be revegetated following the channel improvements. Long-term O&M activities would be facilitated by establishment of a new two-track O&M access road/easement (at least 10 feet wide) along the ditch.

In addition to channel dredging, a new 500 cfs pump station would be constructed in the open space immediately northeast of the existing East Riser Ditch tide gate. This new East Riser Ditch pump station would utilize eight Archimedean screw pumps, which would be powered primarily by electricity, but would also be connected to a backup generator in case of electricity outages. The pump station would collect water from an intake bay constructed along the northern bank of the channel, and discharge into a new modified forebay inlet (approximately 40 feet wide and 60 feet long) to the existing tide gate. The modified forebay inlet would be installed upstream of Starke Road to convey discharge to the existing culverts under Starke Road and through the existing tide gate. When the pump station is not operating, normal flow from the channel would flow through flap gates in the forebay and tide gate similar to existing conditions. Access to East Riser Ditch pump station would be provided by a 0.2-acre parking lot along Starke Road.

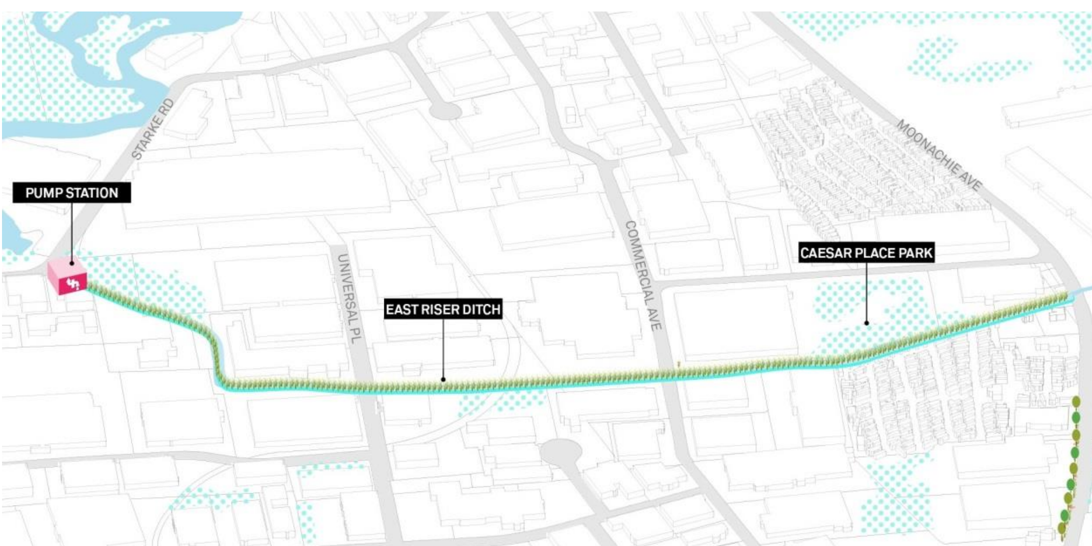


Figure 2.5-29: Concept Drawing of Proposed Improvements to East Riser Ditch

In the **Losen Slote** drainage basin, two new stormwater pump stations (Losen Slote pump stations A and C; see **Figure 2.5-30**) and associated force mains are proposed. Pump station A would be located in the back parking lot of 15 Liberty Street in Little Ferry, immediately east of the Liberty Bell Village. This pump station would have one 50 cfs pump, and would discharge stormwater through a force main in the Lorena Street, Liberty Street, Eckel Road, and Birch Street rights-of-way. This force main would be approximately 3,300 feet long, and would consist of a ductile iron pipe. It would discharge into Losen Slote at the western terminus of Birch Street.

Pump station C would be located in an existing truck bay at an industrial complex, along West Park Street northwest of the intersection with Albert Street. This pump station would have a capacity of 100 cfs (i.e., two 50 cfs pumps), and would discharge stormwater through a 2,200-foot long, ductile iron pipe force main in the West Park Street and East Park Street rights-of-way. The force main would discharge into Losen Slote at the eastern terminus of East Park Street.

Both Losen Slote pump stations would additionally have a backup pump and a backup generator installed in case of pump malfunction or electricity outages. Additionally, an old, defunct tide gate would be removed from the Losen Slote channel immediately downstream of the discharge point for force main C, and energy dissipation structures would be constructed at the discharge points for both force mains A and C in order to prevent erosion of the channel during operation.

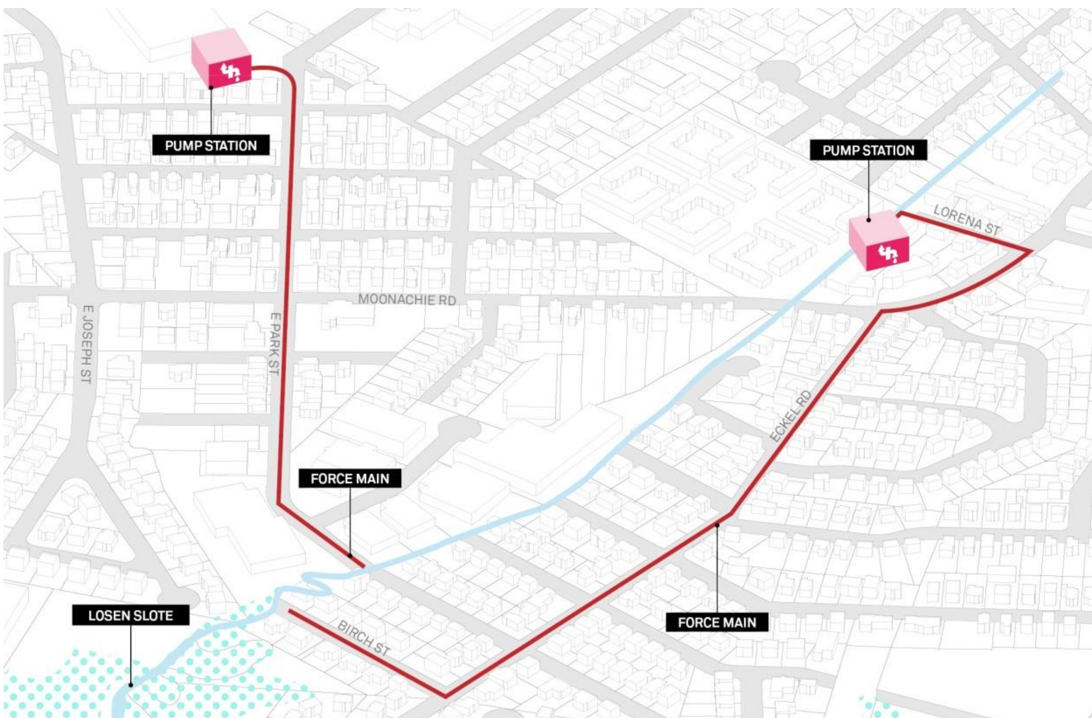


Figure 2.5-30: Concept Drawing of Proposed Improvements to Losen Slote

2.5.3.2 Construction Activities

Construction of Alternative 2 would be expected to occur in three sequential phases over an approximately 3-year period. During this time, various access roads and staging areas would be required to accommodate construction materials and equipment. In advance of any on-site operations, the NJDEP and/or construction contractors would coordinate closely with all affected property owners and utility providers regarding all necessary access easements and utility relocations. Additional information pertaining to schedule and phasing, access points and staging, transportation and circulation requirements, and changes to utility infrastructure is provided below.

Schedule and Phasing

Implementation of Alternative 2 would begin with the NJDEP coordinating all necessary property and easement acquisitions in late 2018 and early 2019. Full property acquisitions would be required for the proposed new parks. Temporary and/or permanent easements would be acquired along each of the remaining Alternative 2 components to provide sufficient ability for both construction and future O&M activities, respectively. Throughout the final design stages for Alternative 2, the exact footprints of proposed property and easement acquisitions would continue to be refined to minimize them to the extent feasible; however, approximate easement acreages and the number of property parcels impacted are summarized in **Table 2.5-4**. Compared to Alternative 1, Alternative 2 would require an additional approximately 14.5 acres of permanent easements, approximately 4.2 fewer acres of temporary easements, and would impact approximately 5 fewer parcels. Potential impacts to property parcels from the implementation of Alternative 2 are further discussed in **Section 4.2.4.3**.

Table 2.5-4: Easement Requirements for Alternative 2

	Permanent Easement (acres)	Temporary Easement (acres)	Number of Property Parcels Impacted
Green infrastructure	0.0	0.0	0
New Parks	20.5	0.2	16
Improved Open Spaces	13.3	0.3	15
Grey Infrastructure	7.3	3.6	33
Total	41.1	4.1	64

Note: Green and grey infrastructure would require additional permanent and temporary easements (4.2 acres and 1.5 acres, respectively) within public roadways. These values were not incorporated into this table because they would not impact property parcels.

Construction would likely begin in late 2019. In accordance with the CDBG-DR funding requirements, the Proposed Project must be complete and functional by September 2022. Therefore, like Alternative 1, a 3-year construction program would also be anticipated for Alternative 2, with construction commencing in late 2019 and reaching completion in the late summer of 2022. However, under Alternative 2, the peak construction year would be 2020 instead of 2021. The three phases of construction under Alternative 2 are detailed below:

- **Phase 1** of construction would occur between approximately November 2019 and February 2021. This phase would include all the green infrastructure installations; construction of/improvements to Fluvial Park, Riverside Park, Willow Lake Park, Little Ferry Public Schools, and Robert Craig Elementary School; and all East Riser Ditch components, including channel dredging and pump station construction.
- **Phase 2** of construction would be conducted between March 2021 and December 2021. It would include construction of Avanti Park, improvements to Joseph Street Park, and construction of force main C.

- **Phase 3** of construction would be conducted between January 2022 and August 2022, and would include construction of Caesar Place Park, DePeyster Creek Park, Losen Slote force main A, and Losen Slote pump stations A and C.

Within each phase, construction would most likely occur under multiple concurrent contracts due to the geographic separation of the various components throughout the Project Area. Construction of green infrastructure would be concentrated between February and May 2020 and between July and October 2020, and each individual system would be constructed within approximately 3 weeks or less. Anticipated duration of the park and grey infrastructure components are provided in **Table 2.5-5**.

Table 2.5-5: Anticipated Duration of Park and Grey Infrastructure Improvements

Location	Anticipated Duration of Construction		
	Phase 1	Phase 2	Phase 3
New Parks and Improved Open Spaces			
Fluvial Park (new)	150 days		
Riverside Park (new)	70 days		
DePeyster Creek Park (new)			220 days
Caesar Place Park (new)			120 days
Avanti Park (new)		130 days	
Willow Lake Park	170 days		
Joseph Street Park		20 days	
Little Ferry Municipal Improvements	50 days		
Little Ferry Public Schools	60 days		
Robert Craig Elementary School	20 days		
Grey Infrastructure			
East Riser Ditch Dredging and Pump Station	510 days		
Losen Slote Force Main C		300 days	
Losen Slote Pump Stations A and C, and Force Main A			240 days

Construction of Alternative 2 would require the use of typical heavy equipment. Among others, this equipment would include vibratory and hydraulic impact pile hammers, backhoes, bulldozers, asphalt rollers, dump trucks, front-end loaders, and cranes. Generally, green infrastructure systems would be installed using smaller equipment and trucks than the grey infrastructure and park components, due to their smaller overall size and the limited space available for construction activities.

With a 3-year construction program and multiple contracts underway concurrently, an accelerated construction effort would not be anticipated. As such, contractors would be expected to work one shift per day, with each shift averaging 9 hours in length. A six-day work week (Monday through Saturday) is anticipated. Additionally, due to the nature of Alternative 2, tide conditions may necessitate irregular work shifts in order to schedule select operations (i.e., particular aspects of Fluvial Park, Riverside Park, or DePeyster Creek Park construction) during low tide periods, and components at the elementary schools would be completed while school is not in session (i.e., during the summer break). In total, approximately 8,000 man-days would be required for the construction of Alternative 2, not including overall project management, supervisory, and inspection personnel. **Table 2.5-6** displays the man-days of work anticipated for each category of Alternative 2 construction. This level of effort would be expected to produce a total of 500 direct job-years throughout the construction of Alternative 2 (NJDEP 2018).

Table 2.5-6: Man-days Required for Construction of Alternative 2 by Component Category

Work Area Location	Workers (man-days at 9 hour average shift)			
	Phase 1	Phase 2	Phase 3	Totals
Green Infrastructure	256	0	0	256
New Parks and Improved Open Spaces	3,731	542	844	5,117
Grey Infrastructure	1,338	584	721	2,643
Total	**5,325**	**1,126**	**1,565**	**8,016**

Access and Staging Areas

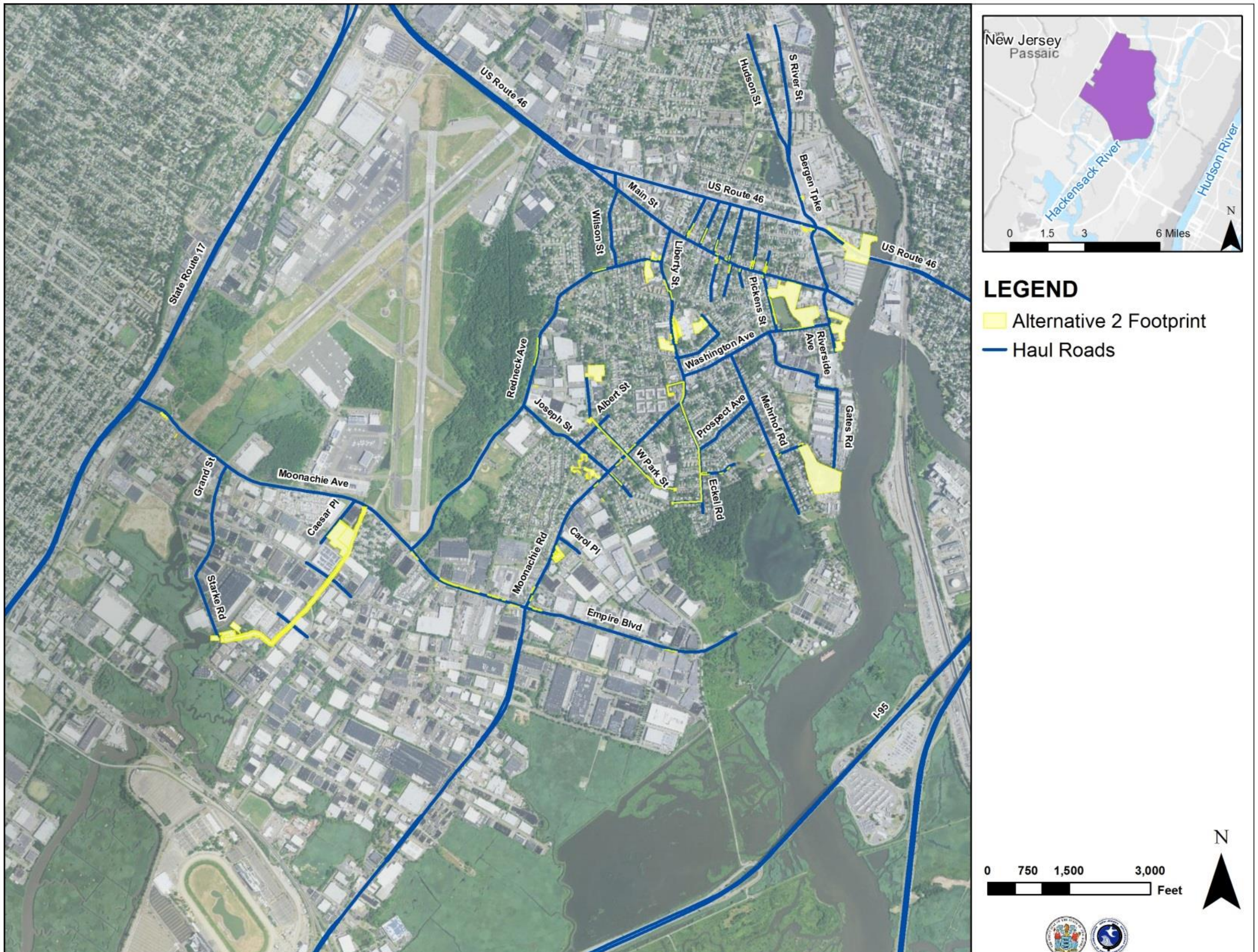
Construction of Alternative 2 would be conducted using numerous access and staging points. These areas would be used to store and transport heavy equipment, construction materials, and construction personnel throughout the various construction phases. Field offices for the construction contractors may also be located in these areas. Generally, most Alternative 2 components would be accessed from adjacent public roadways and/or properties being acquired for the Proposed Project, although construction activities associated with dredging East Riser Ditch would need to be conducted from the parking lots of adjacent businesses.

Staging for the proposed parks and open space improvements would be fully contained within those sites, while staging for green infrastructure components would primarily occur in parking lanes or shoulders adjacent to those construction sites, or in nearby park/open space improvement sites. The roads to be used for staging are detailed in the next section. Staging for the grey infrastructure components would occur in parking lots adjacent to the proposed pump stations and in the Caesar Place Park property for channel dredging activities.

In order to minimize impacts on residents, businesses, and property owners, non-park locations, such as parking lanes or private parking lots, would be used for access and staging only as long as necessary to complete the project components proximal to those specific locations.

Transportation and Circulation

Roads in the Project Area would be used for both staging for roadside green infrastructure components, as described previously, and for transportation of construction equipment, materials, and personnel (i.e., haul routes). Roads used for staging would primarily use parking lanes and/or shoulders to avoid impacts to traffic; however, in some circumstances, these features are not available, and partial lane closures may be necessary to accommodate construction. The roads to be used during construction of Alternative 2 are illustrated in **Figure 2.5-31**.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 2.5-31: Roads That May Be Used During Construction of Alternative 2

Alternative 2 would require lane and/or road closures for several components. As noted previously, partial lane closures may be required for construction of green infrastructure systems. Additionally, Losen Slote force mains A and C would both be constructed along existing public roads. While these force mains are being installed, single lane closures would be expected; these lane closures would most likely affect 200-foot sections of road at a time. Overall, each force main would likely require 10 weeks or fewer for installation. Further, construction of the force mains and some green infrastructure systems would require trenching (i.e., digging a narrow trench in which to place the stormwater pipes) along residential and commercial streets. This would result in some driveways being inaccessible from the road during both the initial trenching process and the repaving process (approximately one day each).

Dredging activities at East Riser Ditch would require removal and replacement of culverts beneath both Amor Avenue and West Commercial Avenue, as well as removal and replacement of the railroad bridge supporting the NJ Transit Seaman Lead. These roads and railroad tracks would be temporarily closed for approximately 5 weeks or fewer during these construction activities. Finally, construction personnel would be expected to park their personal vehicles at the construction staging areas or at available public parking spaces on-street or in lots near the work sites.

Similar to Alternative 1, TMPs would be developed under each construction contract in order to minimize impacts on existing traffic patterns and ensure the safe and efficient coexistence of construction-related and non-construction-related vehicles within the Project Area, including adequate detouring and associated signage for non-construction-related traffic. A complete analysis of the potential impacts to Transportation and Circulation in the Project Area under Alternative 2 is provided in **Section 4.7.4.3**.

Utility Infrastructure

Construction of Alternative 2 would require coordination regarding overhead and underground electric, natural gas, potable water, sanitary sewer, and stormwater infrastructure. Generally, most of the Alternative 2 components could be constructed without requiring relocation of existing utility infrastructure. However, several components, particularly the grey infrastructure improvements, may require alterations to utility infrastructure.

Green infrastructure systems would typically be located and designed to accommodate existing utilities. However, underdrains from the green infrastructure systems generally would reconnect to the existing stormwater sewer system by tying into an existing catch basin to minimize impacts to the roadway. Depending on the condition of the catch basins, some may need to be replaced if they are not sufficiently capable of accommodating the new underdrains.

Construction associated with the new and improved parks/open spaces would mostly consist of land surface alterations (i.e., regrading, new plantings, etc.). These activities would therefore pose limited risk to existing underground utility lines. However, there would be several locations where construction activities (i.e., more substantial excavations, pile driving, etc.) would require deeper ground disturbance. Features that require these construction activities, such as elevated boardwalks, would be designed around existing utility lines to the extent possible. Utility lines would only be relocated under circumstances in which the construction design cannot be sufficiently adjusted.

Construction of the grey infrastructure improvements has the highest likelihood of utility conflicts. For example, several stormwater mains, catch basins, and discharge outlets are located within or adjacent to the East Riser Ditch temporary easement. If necessary, the East Riser Ditch improvements would include redesign of existing stormwater infrastructure to maintain an existing or improved level of service.

Additionally, numerous utility lines are located in the rights-of-way where Losen Slote force mains A and C are proposed. Due to the high costs of utility relocations within rights-of-ways, it would be expected that installation of the force mains would be designed to avoid existing utilities to the extent practical; however, some utility relocations could be necessary.

All utility relocations would be coordinated with the utility providers. Utility providers would provide advance notice of anticipated disruptions to all affected customers, and the service disruptions would be scheduled for times likely to result in the least inconvenience to consumers to the extent feasible.

Most construction activities would be conducted using diesel-powered equipment. However, it is possible that individual contractors could use utilities (i.e., water or electricity) for specific construction activities, or to power construction trailers. Use of utilities by construction contractors would be negotiated in advance with utility providers and/or local officials to ensure existing utility lines are capable of supporting those construction activities. Additionally, a cofferdam and water diversion equipment would be required to divert the flow of East Riser Ditch around the in-channel construction footprints (i.e., for the East Riser Ditch forebay). Flow diversion would be conducted according to standard engineering practice.

Section 4.12.4.3 provides a detailed description of potential impacts to utility services that could result from construction of Alternative 2, as well as appropriate mitigation measures.

2.5.3.3 Operations and Maintenance Activities

Like Alternative 1, the anticipated useful life of Alternative 2 is anticipated to be 50 years, or approximately 2022 through 2072. In accordance with the CDBG-DR funding requirements, the NJDEP would develop an O&M Plan for the Proposed Project. This plan would be developed through the same general process, and include the same overall components, as described for Alternative 1. Activities associated with flood events, routine maintenance, and emergency maintenance and repair are discussed at a high level in the following subsections, as are potential ongoing uses of transportation or utilities resources.

Transportation and Circulation

Operation of Alternative 2 would not close or restrict any rail lines or public roadways during normal conditions. However, green infrastructure systems would primarily be accessed from public streets, so adjacent parking areas may be temporarily closed while each system is being maintained (approximately once per year). Further, force mains A and C would both be constructed in existing public rights-of-way. Therefore, there could be temporary lane closures while future O&M construction activities are conducted. A complete analysis of the potential impacts to Transportation and Circulation in the Project Area under Alternative 2 is provided in **Section 4.7.4.3**.

Utility Infrastructure

Alternative 2 would not require any sanitary wastewater, potable water, natural gas, or telecommunication connections for operation.

Electricity would be required for two purposes under Alternative 2. First, similar to Alternative 1, lighting features would be installed at several of the proposed new and improved public parks/open spaces, including Fluvial Park, Riverside Park, DePeyster Creek Park, Caesar Place Park, Avanti Park, and

Willow Lake Park. These lights would operate on a consistent basis and require nominal amounts of electricity.

Second, the three proposed pump stations would be powered primarily by electricity. They would be connected to existing overhead power lines adjacent to each location, and would be constructed and wired in accordance with all applicable building code requirements. The typical monitoring and control equipment associated with these features would draw a small amount of electricity on a continuous basis to operate, while the pumps would consume greater amounts of electricity on an intermittent basis, as they would typically only operate during heavy precipitation events. Peak electrical consumption would be expected to persist for several hours or days at a time, depending on the intensity of the precipitation events. An emergency backup diesel generator would also be located at each pump station, which would be capable of operating the facilities for at least 3 days in the event of an electric power outage.

Operational use of existing stormwater drainage infrastructure would be limited to the proposed green infrastructure systems, some of which would include underdrains that tie into existing stormwater catch basins. However, the purpose of the green infrastructure is to capture stormwater before it enters the existing drainage infrastructure and increase its ability to infiltrate back into the ground. Therefore, although underdrains would discharge into the existing drainage infrastructure, this stormwater would represent a minor overall reduction as compared to existing conditions. Additionally, the increased channel capacity of East Riser Ditch and the three proposed new pump stations would substantially improve the conveyance of stormwater out of the developed portions of the Project Area.

Solid waste receptacles would be installed at Fluvial Park, Riverside Park, DePeyster Creek Park, Caesar Place Park, Avanti Park, and Willow Lake Park. Disposal of collected refuse would be facilitated in the same manner as for the existing parks within the Project Area.

Section 4.12.4.3 provides a detailed description of potential impacts to utility services that could result from operation of Alternative 2, as well as appropriate mitigation measures.

Flood Event Operations

Similar to Alternative 1, an O&M Plan would identify the roles, responsibilities, and training required of all O&M personnel. Before flood events occur, the weather conditions would be monitored, and necessary coordination among the various agencies and organizations (e.g., public works, safety, and emergency response personnel) would occur.

During a flood event, O&M personnel would monitor the Alternative 2 components as necessary, conditions permitting. Operational project components, such as the pump stations, would be designed to function under most circumstances without human assistance or intervention. Following a flood event, all components would be evaluated for functionality according to the procedures identified in the O&M Plan.

Routine Maintenance

Routine maintenance for Alternative 2 would vary by component. Green infrastructure systems would generally receive standard landscaping upkeep (i.e., weeding, mulching, and pruning), and the stormwater pipes/inlets would be cleaned. The parks and open space improvements would receive various types of routine maintenance, depending on their features. For example, vegetation features would be weeded, mulched, pruned, mowed, or controlled for invasive species, as appropriate; play features and elevated walkways would be inspected for safety and cleaned; and waste receptacles and lights would be changed. Grey infrastructure features would be inspected to ensure proper functioning. Additionally, pump stations would be cleaned, and East Riser Ditch (including culverts) would be cleaned. The frequency of these activities, and entities responsible for them, would be established in the O&M Plan.

Emergency Maintenance and Repairs

Significant maintenance issues would be corrected according to procedures identified in the O&M Plan. All repairs would be accomplished by methods acceptable in standard engineering practice. Examples of conditions that would require immediate maintenance include the following:

- Malfunction of a pump station
- Collapse of East Riser Ditch shoreline
- Break in the proposed force mains
- Presence of a public safety threat at public parks

2.5.3.4 Conclusion

In summary, implementation of Alternative 2 would provide approximately 50 years of inland flood reduction for portions of the Project Area. Flood reduction would be greatest in the improved reach of East Riser Ditch, but would also be prominent in the Main Reach and Park Street Reach of Losen Slote and upper reach of East Riser Ditch (north to approximately US Route 46). Alternative 2 would not provide protection against existing or anticipated coastal flooding from storm surges. By providing approximately 50 years of inland flood reduction, as described in **Section 4.1.2.3**, Alternative 2 would satisfy the purpose and need for the Proposed Project. Specifically, per the goals and objectives identified in **Section 1.4.1**, implementation of Alternative 2 would contribute to community resiliency, reduce risks to public health, deliver co-benefits, enhance and improve use of public space, protect ecological resources, and improve water quality. The impacts of Alternative 2 are summarized in **Section 2.6**.

2.5.4 Alternative 3

Alternative 3 would consist of a hybrid of coastal flood protection and stormwater drainage improvements. To achieve this, the majority of both Alternatives 1 and 2 would be implemented. However, due to funding and construction constraints associated with a project of this magnitude, the Alternative 3 features would be separated into two stages: a *Build Plan*, which includes all features to be constructed as part of the Proposed Project, and a *Future Plan*, which includes the remaining features that could be constructed over time by others as funding sources become available and construction feasibility permits. The *Build Plan* and *Future Plan* are described in further detail in **Section 2.5.4.1**.

The NJDEP has identified Alternative 3 as the Preferred Alternative for implementation of the Proposed Project, as it would provide the most comprehensive flood reduction to the Project Area, including both storm surge protection and stormwater drainage improvements. The Alternative 3 *Build Plan* would reduce flooding in the East Riser Ditch and Losen Slote watersheds similar to Alternative 2, with the exception of the Park Street Reach of Losen Slote. Implementation of the *Build Plan* would also remain within both the budget and schedule associated with the RBD funding. Beyond 2022, as future funding becomes available, implementation of the *Future Plan* would incorporate inland flood reduction in the Park Street Reach of Losen Slote, as discussed under Alternative 2, and coastal flood protection during storm surges, as discussed under Alternative 1. A hybrid solution of both coastal and inland flooding reduction would constitute the most holistic flood reduction strategy for the Project Area; provide numerous co-benefits, including new recreational opportunities, water quality improvements, new and enhanced habitats, and aesthetic benefits; and adhere to the feasibility constraints of the Proposed Project.

2.5.4.1 Components of Alternative 3

The Alternative 3 *Build Plan* would consist of all of the Alternative 2 components identified and described in **Section 2.5.3**, with the exceptions of Fluvial Park, DePeyster Creek Park, Losen Slote pump station C, and Losen Slote force main C (NJDEP 2018). During the development of the Hybrid Alternative, these features were not included among the stormwater drainage improvements due to generally lower contributions to the BCR and potential scheduling concerns. Therefore, these four features were not included in the *Build Plan*. Additionally, the improvements proposed for Willow Lake Park under Alternative 2 would be altered under the Alternative 3 *Build Plan*; the current design for this park is described below. As noted for Alternatives 1 and 2, certain details of the Alternative 3 *Build Plan* components, such as the amenities of Willow Lake Park, could change during the final design process.

Willow Lake Park – The proposed improvements (see **Figure 2.5-32**) include pedestrian circulation, recreation, play, and ecological benefits. Existing pedestrian trails would be expanded to connect the northern and southern areas of the park, and programed activity areas, including two lawns of approximately 2.7 acres, would be added to support informal active play and recreation (such as picnicking, Frisbee, or lawn games). Approximately 1.6 acres of plazas and circulation trails, with a centralized plaza near Willow Lake, would frame the park and draw people in from Main Street, Pickens Street, and Washington Avenue. A new play area would be added to expand the existing playground with approximately 0.4 acre of permeable play surface and play equipment for the community. Approximately 1.3 acres of native plantings and low meadows with scattered trees would provide habitat for pollinators and birds, while approximately 1.0 acre of woodland areas would frame the park and provide habitat. Approximately 1,134 SF of rain gardens would filter stormwater from Pickens Street.

Figure 2.5-32: Concept Drawing of Proposed Improvements to Willow Lake Park

Under the Alternative 3 *Build Plan*, the total acreage of new parks created would be approximately 7.6 acres, which is 12.4 acres fewer than would be created under Alternative 2 due to the elimination of Fluvial Park and DePeyster Creek Park. Riverside Park, Caesar Place Park, and Avanti Park, which would be constructed as described under Alternative 2, would still be designed to improve local stormwater drainage, and would include wetlands, green infrastructure, and increased pervious surfaces and native plantings.

The Alternative 3 *Future Plan* would consist of all of the features from Alternative 1 (see **Section 2.5.2**), including Fluvial Park, DePeyster Creek Park, and K-Town Park. The addition of these three parks would provide approximately 5.7 additional acres of new park space, bringing the total new park acreage under Alternative 3 to approximately 13.3 acres. Losen Slote pump station C and Losen Slote force main C, as described under Alternative 2, would also be included. In addition to these features from Alternatives 1 and 2, the *Future Plan* would include channel improvements (i.e., dredging and culvert replacement) to the remainder of East Riser Ditch (i.e., Upper East Riser Ditch) from Moonachie Avenue to Wesley Street.

Table 2.5-7 summarizes the components included in both the *Build Plan* and the *Future Plan* under Alternative 3. The *Build Plan* and *Future Plan* are illustrated in **Figure 2.5-33**.

Table 2.5-7: Summary of Build Plan and Future Plan under Alternative 3

Build Plan	**Additional Components Under *Future Plan***
All green infrastructure systems, Riverside Park, Caesar Place Park, Avanti Park, Little Ferry Municipal improvements, Little Ferry Public Schools improvements, Robert Craig Elementary School improvements, and Joseph Street Park improvements, *as described under Alternative 2*	Complete Alternative 1 design, including Fluvial Park, DePeyster Creek Park, and K-Town Park, *as described under Alternative 1*
Willow Lake Park improvements, *as described in Alternative 3*	Losen Slote pump station C and force main C, *as described under Alternative 2*
East Riser Ditch dredging and pump station, Losen Slote pump station A, and Losen Slote force main A, *as described in Alternative 2*	Upper East Riser Ditch improvements, *as described in **Section 5.5***

Although Alternative 3 is the Preferred Alternative, only the *Build Plan* would be implemented as part of the Proposed Project. As such, only the *Build Plan* is further described in this section and analyzed in detail in **Section 4.0**. The *Future Plan* is described and analyzed as a reasonably foreseeable action in the cumulative impacts analysis (see **Section 5.0**). As additional funding is made available for components of the *Future Plan*, those features may be subject to additional impact analysis due to changes in the existing conditions of the Project Area, or due to specific regulations associated with the funding (i.e., Federal, State, or local agencies, non-profit organizations, etc.). Additionally, the features included in the *Future Plan* would not be required to be constructed as a single project; future proponents could implement one or more of these features (e.g., just the Alternative 1 LOP, or just Upper East Riser Ditch improvements) independent of the others.

Unless otherwise noted, references to Alternative 3 in the remainder of **Section 2.0**, and all of **Sections 4.0** and **6.0**, refer to the Alternative 3 *Build Plan*.

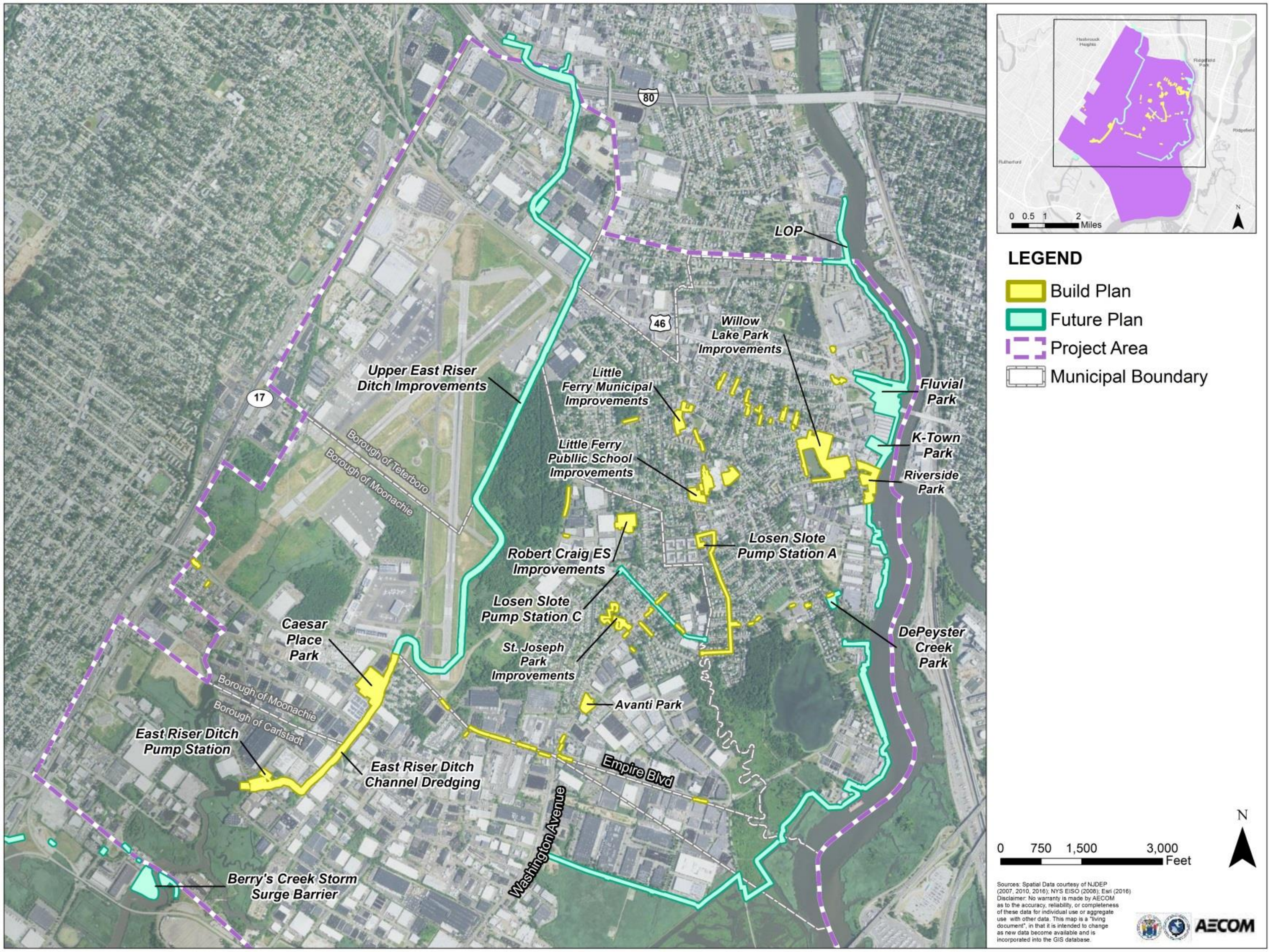


Figure 2.5-33: Alternative 3 Components (*Build Plan* and *Future Plan*)

2.5.4.2 Construction Activities

Construction activities and phasing of Alternative 3 would be the same as those for Alternative 2, as described in **Section 2.5.3.2**, except that Fluvial Park, DePeyster Creek Park, Losen Slote pump station C, and Losen Slote force main C would not be constructed. Although Alternative 3 has fewer overall components, no changes would be made to the overall phasing and schedule identified under Alternative 2.

However, the removal of those components would result in fewer easements required under Alternative 3 as compared to Alternative 2. As shown in **Table 2.5-8**, Alternative 3 would require 12.6 fewer acres of permanent easements, and would impact 8 fewer parcels.

Table 2.5-8: Easement Requirements for Alternative 3

	Permanent Easement (acres)	Temporary Easement (acres)	Number of Property Parcels Impacted
Green Infrastructure	0.0	0.0	0
New Parks	8.0	0.2	10
Improved Open Spaces	13.3	0.3	15
Grey Infrastructure	7.2	3.6	31
Total	28.5	4.1	56

Note: Green and grey infrastructure would require additional permanent and temporary easements (3.3 acres and 1.5 acres, respectively) within public roadways. These values were not incorporated into this table because they would not impact property parcels.

Additionally, construction of Alternative 3 would require fewer man-days of effort. As shown in **Table 2.5-9**, construction of Alternative 3 would require a total of approximately 6,400 man-days, which is approximately 1,600 fewer man-days than would be required to construct Alternative 2. Similarly, construction of Alternative 3 would produce approximately 320 job-years, which is approximately 180 fewer job-years than would be produced by the construction of Alternative 2.

Table 2.5-9: Man-days Required for Construction of Alternative 3 by Component Category

Work Area Location	Workers (man-days at 9 hour average shift)			
	Phase 1	Phase 2	Phase 3	Totals
Green Infrastructure	256	0	0	256
New Parks and Improved Open Spaces	3,228	542	416	4,186
Grey Infrastructure	1,338	0	613	1,951
Total	**4,822**	**542**	**1,029**	**6,393**

Finally, due to the widespread geographic nature of the stormwater drainage improvements under both Alternative 2 and Alternative 3, the associated transportation and utility components of construction would be approximately the same. However, Alternative 3 would not require the use of Albert Road to access Losen Slote pump station C, and force main C would not be constructed in the West Park Street and East Park Street rights-of-way, resulting in slightly fewer transportation and utility conflicts than would occur under Alternative 2.

2.5.4.3 Operations and Maintenance Activities

O&M of Alternative 3 would be the same as O&M of Alternative 2 (see **Section 2.5.3.3**). However, since Fluvial Park, DePeyster Creek Park, Losen Slote pump station C, and force main C would not be constructed, these features would not be operated or maintained.

Overall, Alternative 3 would also have an estimated useful life of approximately 50 years, and the NJDEP would create an O&M Plan to define all personnel, responsibilities, and procedures associated with O&M requirements.

2.5.4.4 Conclusion

In summary, implementation of Alternative 3 would provide approximately 50 years of inland flood reduction for portions of the Project Area. Similar to Alternative 2, flood reduction would be greatest in the improved reach of East Riser Ditch, but also prominent in the Main Reach of Losen Slote and upper reach of East Riser Ditch. Alternative 3 would not reduce flooding in the Park Street Reach of Losen Slote or provide protection against existing or anticipated coastal flooding from storm surges. By providing approximately 50 years of inland flood reduction, as described in **Section 4.1.2.4**, Alternative 3 would satisfy the purpose and need for the Proposed Project. Specifically, per the goals and objectives identified in **Section 1.4.1**, implementation of Alternative 3 would contribute to community resiliency, reduce risks to public health, deliver co-benefits, enhance and improve use of public space, protect ecological resources, and improve water quality. The impacts of Alternative 3 are summarized in **Section 2.6**.

2.6 Comparison of the Impacts of the Alternatives

The anticipated impacts from the No Action Alternative and the three Build Alternatives are summarized and compared in **Table 2.6-1**.

Table 2.6-1: Impact Summary and Comparison

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Land Use and Land Use Planning	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to existing land use (conflicts or restrictions on land use patterns or options) and zoning (zoning changes that could substantially decrease development intensity).	*Direct:* Long-term, ***potentially significant adverse*** impacts due to the displacement of 1 business; Short-term, less-than-significant adverse impacts to existing land uses during construction from temporary easements on 8.3 acres (63 parcels); Long-term, less-than-significant adverse impacts to existing land uses from permanent land easements (26.6 acres over 63 parcels, including 6 full parcel acquisitions) and potential zoning changes (12.2 acres); Long-term, beneficial impacts due to the improved utility of land use types. *Indirect:* Long-term, beneficial impacts to existing land uses from increased coastal flood protection.	*Direct:* Short-term, less-than-significant adverse impacts to existing land uses during construction from temporary easements on 5.6 acres (36 parcels); Long-term, less-than-significant adverse impacts to existing land uses from permanent land easements (45.2 acres over 61 parcels, including 3 full parcel acquisitions) and potential zoning changes (20.4 acres); Long-term, beneficial impacts due to the improved utility of land use types. *Indirect:* Long-term, beneficial impacts to existing land uses from increased inland flood protection. Additionally, short-term, less-than-significant adverse impacts to adjacent land uses (275 parcels) during construction in public rights-of-way; Long-term, less-than-significant adverse impacts on land use compatibility with Teterboro Airport and on aviation safety from increased wildlife hazards.	*Direct:* Same as Alternative 2, except there would be fewer temporary easement impacts (5.6 acres on 34 parcels), fewer permanent easement impacts (31.8 acres over 55 parcels, including 2 full parcel acquisitions), and fewer zoning changes (8.0 acres). *Indirect:* Beneficial impacts would be the same as Alternative 2, but adverse impacts would be slightly less than Alternative 2 due to fewer impacted adjacent land uses (242 parcels) and a decrease in proposed habitat improvements (i.e., fewer wildlife hazards).
Visual Quality / Aesthetics	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from degradation of, or loss of access to, a high-value visual resource due to future flooding.	*Direct:* Short-term, less-than-significant adverse impacts to the natural harmony, cultural order, and visual quality within Landscape Unit 4a (Commercial/Industrial Area) and Landscape Unit 5 (Hackensack River Waterfront Area) during construction; Long-term, less-than-significant adverse impacts to the natural harmony, cultural order, and visual quality of Landscape Unit 4a from proposed LOP elements; Long-term, beneficial impacts to the natural harmony, cultural order, and visual quality within Landscape Unit 5 from proposed waterfront improvements. *Indirect:* Long-term, beneficial impacts to the visual sensitivity of the viewing population to visual resources within Landscape Unit 4a and Landscape Unit 5, and to visual resources within all landscape units due to increased flood protection against coastal storm surges.	*Direct:* Short-term, less-than-significant adverse impacts to the natural harmony, cultural order, and visual quality within Landscape Unit 2 (Residential Area), Landscape Unit 4a, and Landscape Unit 5 during construction; Long-term, beneficial impacts to the natural harmony, cultural order, and visual quality within Landscape Unit 2, Landscape Unit 4a, and Landscape Unit 5 from proposed waterfront improvements. *Indirect:* Long-term, beneficial impacts to the visual sensitivity of the viewing population to visual resources within Landscape Unit 2, Landscape Unit 4a, and Landscape Unit 5, and to visual resources within all landscape units due to increased flood protection against inland flooding.	*Direct:* Impacts would be the same as Alternative 2 in Landscape Unit 4a, but adverse and beneficial impacts in Landscape Unit 2 and Landscape Unit 5 would be slightly less because Fluvial Park, DePeyster Creek Park, and Losen Slote pump station C and its force main would not be constructed. *Indirect:* Alternative 3 would not include Fluvial Park and DePeyster Park within Landscape Unit 5 and Losen Slote pump station C and its force main in Landscape Unit 2; therefore, the beneficial impacts to visual sensitivity and increased flood protection would be slightly less than Alternative 2.
Socioeconomics, Community / Populations, and Housing	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to public safety; business finances, employment, access, and services; demographic composition; and/or journey-to-work times.	*Direct:* Short-term and long-term, less-than-significant adverse impacts to businesses and residents in the Project Area from land acquisition, traffic/limited access, dust, noise, and vibration during construction; Long-term, less-than-significant adverse impacts to vacant buildings that would be demolished during construction; Short-term and-long term, beneficial impacts from created jobs during construction (990 job-years) and operation (20 annual jobs); Long-term, beneficial impacts on social amenities due to increased access to greenspace and the Hackensack River waterfront. *Indirect:* Long-term, beneficial effects to sense of safety, community infrastructure, property values, employment, and resident/visitor perceptions from increased coastal storm surge protection.	*Direct:* Short-term and long-term, less-than-significant adverse impacts to businesses, schools, municipal facilities, and residents in the Project Area from land acquisition, traffic/limited access, dust, noise, and vibration during construction; Short-term and long-term, beneficial impacts from created jobs during construction (1,000 job-years) and operation (22 annual jobs); Long-term beneficial effects on social amenities due to increased access to greenspace and the Hackensack River waterfront. *Indirect:* Long-term beneficial effects to community infrastructure, property values, and resident/visitor perception from increased protection against inland flooding.	*Direct:* Same as Alternative 2, except there would be approximately 640 job-years created during construction and 16 annual jobs during operation. *Indirect:* Slightly less beneficial effects than Alternative 2 since there would be fewer stormwater drainage improvements constructed, thereby providing less protection against inland flooding.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Environmental Justice	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to housing, public/community safety, long-term employment, short-term and/or long-term access to community facilities, and/or demographic composition.	*Direct:* Short-term, less-than-significant adverse impacts to EJ populations from dust, noise, vibration, traffic/access restrictions during construction (there are 13 residential units within 100 feet of the proposed LOP; all 13 units occur in areas where the percentage of EJ populations exceeds County thresholds); Short-term, beneficial impacts from created jobs during construction and operation. *Indirect:* Long-term, beneficial effects to EJ community infrastructure, sense of safety, housing and property values, and long-term employment from increased coastal flood protection.	*Direct:* Same as Alternative 1, except there are 385 residential units within 100 feet of the proposed footprint, and some of these units occur in areas where the percentage of EJ populations exceeds County thresholds: 219 units are in areas where the percentage of persons in poverty is higher; 287 units are in areas where the percentage of minority persons is higher, and 383 units are in areas where the percentage of LMI persons is higher. *Indirect:* Long-term, beneficial effects from reduced damages to EJ community infrastructure from reduced inland flooding.	*Direct:* Same as Alternatives 1 and 2, except there are 339 residential units within 100 feet of the proposed features in areas where the percentage of EJ populations exceeds County thresholds: 204 units are in areas where the percentage of persons in poverty is higher; 264 units are in areas where the percentage of minority persons is higher, and 337 units are in areas where the percentage of LMI persons is higher. *Indirect:* Slightly less beneficial effects than Alternative 2 since there would be fewer stormwater drainage improvements constructed, thereby providing less protection against inland flooding.
Cultural and Historical Resources	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to the character-defining features, viewshed, acoustic environment, or other environmental component of historic resources.	*Direct:* Long-term, ***potentially significant adverse*** impacts to known or unanticipated archaeological sites (5 high archaeological sensitivity areas), and to the US Route 46 Bascule Bridge; Short-term, less-than-significant adverse effects to the US Route 46 Bascule Bridge from dust, noise, and vibration during construction. *Indirect:* Long-term, ***potentially significant adverse*** impacts to the viewshed of the US Route 46 Bascule Bridge; Short-term, less-than-significant adverse effects to the physical and acoustic environment of the US Route 46 Bascule Bridge and 4 potentially National Register of Historic Places (NRHP)-eligible historic architectural resources within the indirect APE during construction; Long-term, less-than-significant adverse effects to the viewshed of 4 potentially NRHP-eligible historic architectural resources in the Project Area; Long-term beneficial effects to the protection of archaeological and historic architectural resources from increased coastal flood protection.	*Direct:* Same as Alternative 1, including the long-term, ***potentially significant adverse*** impacts, except there are only 3 high archaeological sensitivity areas associated with Alternative 2. *Indirect:* Same as Alternative 1, including the long-term, ***potentially significant adverse*** impacts, except there is only 1 potentially NRHP-eligible historic architectural resource (besides the US Route 46 Bascule Bridge) that would experience short-term, less-than-significant adverse effects to the physical and acoustic environment during construction and long-term, less-than-significant adverse effects to the viewshed. Additionally, beneficial effects would be associated with reduced inland flooding instead of reduced coastal flooding.	*Direct:* Slightly less long-term, ***potentially significant adverse*** impacts than Alternative 2 since there are only 2 high archaeological sensitivity areas associated with Alternative 3, and the US Route 46 Bascule Bridge would not be impacted. *Indirect:* Slightly less adverse impacts than Alternative 2 since there would be no indirect impacts to the US Route 46 Bascule Bridge (and therefore no potentially significant indirect impacts), and slightly less beneficial effects since there would be fewer stormwater drainage improvements constructed.
Transportation and Circulation	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to traffic, safety, available parking, pedestrian and bicycle facilities, transit demand, and/or freight operations.	*Direct:* Short-term, less-than-significant adverse impacts to traffic and circulation (87 additional vehicles projected in the AM peak hour in the peak month), on-street parking supply, and transit and freight services during construction; Long-term, less-than-significant adverse impacts to traffic (6 additional vehicle trips are projected in the weekday AM and PM peak hours) and the NJ Transit railroad track (suspended service during major flood events) during operation; Long-term, beneficial effects to pedestrian transportation and circulation from proposed paths, walkways, and boat dock/kayak launch. *Indirect:* Long-term, beneficial effects to the sustainability of existing transportation and circulation from increased coastal flood protection.	*Direct:* Generally the same as Alternative 1, except only 59 additional vehicles are projected in the AM peak hour in the peak month during construction, and only 5 additional vehicle trips are projected in the weekday AM and PM peak hours during operations. Additionally, there would be short-term, less-than-significant adverse impacts to the Seaman Lead due to the removal and replacement of a railroad bridge, and to pedestrian circulation due to sidewalk closures, during construction; however, there would be no impacts to the NJ Transit railroad track under this alternative. *Indirect:* Same as Alternative 1, except beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Slightly less than Alternative 2, as only 54 additional vehicles are projected in the AM peak hour in the peak month during construction, and only 3 additional vehicle trips are projected in the weekday AM and PM peak hours during operation; impacts to road/lane closures and parking during construction would be slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed, but impacts to transit and freight services and pedestrian circulation would be the same as Alternative 2. *Indirect:* Slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed, thereby providing less protection against inland flooding.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Noise and Vibration	*Direct:* No direct impacts. *Indirect:* Less-than-significant adverse impacts due to increased vibration and noise levels from traffic congestion and the diversion of vehicles in flooded areas.	*Direct:* Short-term, ***potentially significant adverse*** impacts to properties and buildings from noise and vibration due to construction activities; Short-term, less-than-significant adverse impacts to marine life from noise during construction, Long-term, less-than-significant adverse impacts to properties due to increased noise during operation from generators at one pump station. *Indirect:* No indirect impacts.	*Direct:* Impacts would be similar to, but slightly greater than, those under Alternative 1, including the short-term, ***potentially significant adverse*** impacts, since more properties and buildings have the potential to be impacted by noise and vibration during construction, and there would be generators at three pump stations during operations. *Indirect:* No indirect impacts (same as Alternative 1).	*Direct:* Impacts from noise and vibration during construction, including the short-term, ***potentially significant adverse*** impacts, would be slightly less than under Alternative 2, but greater than under Alternative 1, and there would be generators at two pump stations during operations. *Indirect:* No indirect impacts (same as Alternatives 1 and 2).
Air Quality and Greenhouse Gas Emissions	*Direct:* No direct impacts. *Indirect:* Less-than-significant adverse impacts on regional air quality due to traffic congestion and diversion of vehicles in flooded areas, fugitive dust from flooding carrying fine sediments into the Project Area, and to human health of sensitive populations due to negligible emissions of criteria pollutants and Hazardous Air Pollutants (HAPs) within an attainment area.	*Direct:* Short-term and long-term, less-than-significant adverse impacts to air quality and human health of sensitive populations in the Project Area due to criteria pollutant and HAP emissions; criteria pollutant emissions would not cause a National Ambient Air Quality Standards (NAAQS) exceedance, change the category of non-attainment status, or conflict with applicable air quality plans; HAP emissions would not would not exceed major source thresholds or health benchmarks, or conflict with applicable air quality plans. *Indirect:* Short-term, less-than-significant adverse impacts outside the Project Area due to criteria pollutant and HAP emissions; criteria pollutant emissions would not cause a NAAQS exceedance, change the category of non-attainment status, or conflict with applicable air quality plans; HAP emissions would not would not exceed major source thresholds or health benchmarks, or conflict with applicable air quality plans.	*Direct:* Impacts would be similar to Alternative 1, except criteria pollutant and GHG emissions would be slightly less, and HAP emissions would be slightly greater. *Indirect:* Impacts would be similar to Alternative 1, except criteria pollutant and GHG emissions would be slightly less, and HAP emissions would be slightly greater.	*Direct:* Impacts would be similar to Alternatives 1 and 2, except criteria pollutant, HAP, and GHG emissions would be slightly less than both Alternatives 1 and 2. *Indirect:* Impacts would be similar to Alternatives 1 and 2, except criteria pollutant, HAP, and GHG emissions would be slightly less than both Alternatives 1 and 2.
Global Climate Change and Sea Level Change	***Potentially significant adverse*** impacts on the study area from future coastal and inland flooding, and because the effects of climate change and SLR would not be addressed.	***Potentially significant adverse*** impacts from climate change and SLR to the overall performance of Alternative 1 over time, and from future increased precipitation and inland flooding; Beneficial impacts through increased coastal flood protection.	***Potentially significant adverse*** impacts from future coastal flooding in the Project Area over time, and from climate change and SLR on the overall performance of Alternative 2 over time; Beneficial impacts to the Project Area through increased flood protection against inland flooding.	Same as Alternative 2, including the ***potentially significant adverse*** impacts, except benefits would be slightly less since Losen Slote pump station C and its force main would not be constructed, thereby providing less protection against inland flooding.
Recreation	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from damage, reduced visitation, and/or reduced accessibility to recreational resources due to future flooding.	*Direct*: Short-term, less-than-significant adverse impacts to the accessibility of recreational resources (i.e., public access to Riverside Boat Works and boat access at the Riverside Boat Works Marina and Little Ferry Marina) during construction; Long-term, beneficial effects due to the creation of new recreational resources (10.1 acres of new public recreational land) and improved accessibility (approximately 9,270 LF of new public paths and walkways, 0.2 acre of parking areas, and a new boat dock/kayak launch). *Indirect:* Long-term, beneficial effects to supply, capacity, and access to recreational resources from increased coastal flood protection.	*Direct:* Short-term, less-than-significant adverse impacts to the accessibility of recreational resources during construction due to lane closures and the establishment of staging areas in the parking lots and driveways of Little Ferry Public Schools, Robert Craig Elementary School, Joseph Street Park, and Willow Lake Park; Beneficial effects would be greater than under Alternative 1 since more land (20.0 acres) would be converted to accessible, public recreational land and there would be more accessibility improvements (9,900 LF of new trails and walkways, the conversion of existing private boat docks and a boat launch into public use, and a new kayak launch). *Indirect:* Same as Alternative 1, except beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Adverse impacts to accessibility would be the same as Alternative 2; Beneficial effects would be less than both Alternatives 1 and 2 since less land would be converted to accessible, public recreational land (7.6 acres) and there would be less accessibility improvements (6,400 LF of new trails and walkways and the conversion of existing private boat docks and a boat launch into public use). *Indirect:* Slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed, thereby providing less protection against inland flooding.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Utilities and Service Systems	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts on utility services by damaging infrastructure, increasing utility prices, and/or increasing service disruptions due to future flooding.	*Direct:* Short-term, less-than-significant adverse impacts to the supply, demand, capacity, and availability of utility services during construction; Long-term, less-than-significant adverse impacts to existing demand for electricity (from public lighting features and the Berry's Creek storm surge barrier), solid waste (from public parks and pathways), and telecommunication services (from a landline telephone at the Berry's Creek storm surge barrier). *Indirect:* Long-term, beneficial effects from increased coastal flood protection, which would reduce damages to utilities infrastructure and service disruptions, and decrease utility prices.	*Direct:* Same as Alternative 1, except electricity demands would be from public lighting features and the three proposed pump stations, and there would be no long-term demand for telecommunication services. Additionally, there would be long-term, beneficial impacts on stormwater drainage due to the proposed East Riser Ditch improvements and three new pump stations. *Indirect:* Same as Alternative 1, except beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Slightly less than Alternative 2 since fewer Proposed Project components would be constructed, thereby reducing potential construction impacts, operational utility demands, and beneficial impacts to stormwater drainage. *Indirect:* Slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed, thereby providing less protection against inland flooding.
Public Services	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts on public services by increasing service disruptions, response times, and/or demand, and from reducing access, supply, capacity, and/or reliability due to future flooding.	*Direct*: Short-term, less-than-significant adverse impacts to response times of public services due to road and/or lane closures during construction. *Indirect:* Short-term, less-than-significant adverse impacts to demand for public services during construction due to an influx of construction workers; Long-term, beneficial impacts to public service demand (fewer flood-related emergencies) and service reliability (fewer service interruptions and road closures) due to increased flood protection against coastal storm surges.	*Direct:* Impacts to response times would be slightly less than Alternative 1 because no road closures or realignments are proposed and lane closures under Alternative 2 are anticipated to be shorter in duration; however, Alternative 2 would have additional short-term, less-than-significant adverse impacts to access to public service facilities due to temporary lane closures and staging areas, and to disruption of public service facilities from increased noise during construction. *Indirect:* Generally the same as Alternative 1, but beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Slightly less than Alternative 2 since fewer Proposed Project components would be constructed, and therefore fewer impacts on response times, facility access, and disruptions from noise would be expected. *Indirect:* Adverse impacts would be slightly less than Alternative 2 due to fewer anticipated construction workers; beneficial effects would be slightly less since fewer stormwater drainage improvements would be constructed, thereby providing less protection against inland flooding.
Biological Resources	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from shoreline erosion, habitat alterations, reduction of ecological function, and/or increases in turbidity, sedimentation, or nutrient/contaminant inputs due to future flooding.	*Direct:* Long-term, ***potentially significant adverse*** impacts to aquatic habitats from dredge and fill activities; Short-term and long-term, less-than-significant adverse impacts to terrestrial habitats from vegetation removal; Short-term, less-than-significant impacts to terrestrial and aquatic habitats, wildlife (including threatened and endangered species), and EFH during construction (including increased turbidity, physical disturbance, and noise/vibration); Long-term, less-than-significant adverse impacts to aquatic habitats during operation from minor hydrology alterations, and to aquatic and terrestrial wildlife from limited loss of habitat; Long-term, beneficial impacts to terrestrial and aquatic habitats and wildlife from the removal of invasive species and proposed habitat enhancements. Under Alternative 1, about 6.3 acres of uplands would be impacted (4.0 acres permanently, 2.3 acres temporarily), and 7.4 acres of aquatic habitats would be impacted (5.9 acres permanently, 1.5 acres temporarily). Approximately 1.1 acres of vegetative habitat enhancements, and 1.1 acres of wetlands, would be created or enhanced. *Indirect:* Long-term, less-than-significant adverse impacts to terrestrial and aquatic wildlife (including threatened and endangered species) due to reductions in riparian habitat and increased human activity; Long-term beneficial effects to aquatic habitats and wildlife from the removal of invasive plants and improvements to wetlands, and to habitats from increased protection against coastal flooding and SLR, and decreasing turbidity, sedimentation, and nutrient/contaminant inputs.	*Direct:* Short-term, less-than-significant adverse impacts to terrestrial habitats from vegetation removal and disturbance during construction, and to terrestrial and aquatic habitats, wildlife (including threatened and endangered species), and EFH during construction (including increased turbidity, physical disturbance, and noise/vibration); Long-term, beneficial impacts to terrestrial and aquatic habitats and wildlife from proposed habitat and wetland enhancements. Under Alternative 2, approximately 20.3 acres of uplands would be impacted (0.6 acre permanently, 19.7 acres temporarily), and approximately 5.3 acres of aquatic habitats would be impacted (0.1 acre permanently, 5.2 acres temporarily). Additionally, approximately 11.9 acres of vegetative enhancements, and 7.2 acres of wetlands, would be created or enhanced. *Indirect:* Long-term, less-than-significant adverse impacts to terrestrial and aquatic wildlife, including threatened and endangered species, due to increased human activity; Long-term, beneficial effects to aquatic habitats and wildlife from anticipated reductions in sedimentation, turbidity, and nutrient/contaminant inputs in aquatic habitats.	*Direct:* Under Alternative 3, adverse impacts and beneficial effects would be slightly less than Alternative 2 due to fewer stormwater drainage improvements being constructed. Approximately 12.9 acres of uplands would be impacted (0.6 acre permanently, 12.3 acres temporarily), and approximately 4.0 acres of aquatic habitats would be impacted (0.1 acre permanently, 3.9 acres temporarily). Additionally, approximately 3.5 acres of wetlands would be created or enhanced. *Indirect:* Adverse and beneficial impacts would be slightly less than under Alternative 2 since Fluvial Park, DePeyster Creek Park, and the Losen Slote pump station C and its force main would not be constructed.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Geology and Soils	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts to soil resources through an increase in the potential for land subsidence within the Project Area and an increase in turbidity, sedimentation, nutrient input, and contaminant input due to soil erosion from future flooding.	*Direct:* Short-term, less-than significant adverse impacts to existing geologic and soil conditions in the Project Area during construction (approximately 39 acres of land disturbance and 84,900 CY of soil removed); Long-term, beneficial impacts to soil resources due to a slight decrease in impervious surface area (approximately 0.8-acre decrease). *Indirect:* Short-term, less-than-significant adverse impacts on the exposure of people within the Project Area to radon; Long-term, beneficial effects from reduced hydrocompaction, soil erosion, turbidity, sedimentation, and nutrient/contaminant transport due to reduced coastal flooding.	*Direct:* Same as Alternative 1, except there would be approximately 51 acres of land disturbance and 32,300 CY of soils removed during construction and the long-term decrease in impervious area would be approximately 3.4 acres. *Indirect:* Same as Alternative 1, except there would be no reduction in hydrocompaction since Alternative 2 would not address coastal flooding.	*Direct:* Adverse impacts would be slightly less than Alternative 2 since there would be less ground-disturbing activities and 28,000 CY of potentially contaminated soil would be removed; beneficial effects would be slightly greater than Alternative 2 since the long-term decrease in impervious area would be approximately 3.7 acres. *Indirect:* Adverse impacts and beneficial effects would be slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed.
Water Resources, Water Quality, and Waters of the US	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to surface water quality and quantity (including scour and transport of sediment, nutrients, and pollutants); groundwater flow, quantity, and quality; and/or the hydrology of WOUS or State-regulated waterbodies or wetlands.	*Direct:* Long-term, ***potentially significant adverse*** impacts to surface water quantity, flow, and quality from construction in surface waters, and to wetlands, open waters, wetland functions and services, and riparian zones from construction in wetlands or open water; Short-term less-than-significant adverse impacts to localized surface water flow and quality, and to wetland areas, functions, and services, and riparian zones from construction activities; Short-term and long-term less-than significant adverse impacts to localized groundwater flow and quality during construction and operation; Long-term, beneficial effects to wetland functions and services where wetlands would be enhanced or created. Under Alternative 1, approximately 2.8 acres of wetlands would be impacted (1.2 acres permanently, 1.6 acres temporarily), 1.5 acres of open waters would be impacted (1.0 acre permanently, 0.5 acre temporarily), and 11.1 acres of riparian zones would be impacted (8.8 acres permanently, 2.3 acres temporarily). Approximately 1.1 acres of wetlands would be created or enhanced. *Indirect*: Short-term, less-than-significant adverse impacts to surface water from construction activities; Long-term, less-than-significant adverse impacts to wetland area, functions, and services upstream of the proposed tide gate on the unnamed tributary to the Hackensack River; Long-term, beneficial effects to surface water quantity, flow, quality, and sediment quality and transport by increasing coastal flood protection, to wetland functions and services by providing protection from SLR effects and increasing coastal flood protection, and to localized surface water quality from proposed parks and habitat enhancements.	*Direct:* Long-term, ***potentially significant adverse*** impacts to surface water quantity, flow, and quality from proposed construction over the Hackensack River, to localized sediment and contaminant transport in East Riser Ditch and Losen Slote, and to wetlands, open waters, wetland functions and services, and riparian zones from construction in wetlands or open waters; Short-term less-than-significant adverse impacts to localized surface water flow and quality, to groundwater flow and quality, and to wetland areas, functions, and services, and riparian zones from construction activities; Long-term less-than-significant adverse impacts to groundwater quality during operation of green infrastructure systems from the localized accumulation of contaminants; Long-term, beneficial effects to wetland functions and services were wetlands would be created or enhanced. Under Alternative 2, approximately 4.5 acres of wetlands would be impacted (0.3 acre permanently, 4.2 acres temporarily), 5.4 acres of open waters would be impacted (0.3 acre permanently, 5.1 acres temporarily), and 8.7 acres of riparian zones would be impacted (1.4 acres permanently, 7.3 acres temporarily). Approximately 7.2 acres of wetlands would be created or enhanced. *Indirect:* Short-term less-than-significant adverse impacts to surface water from vegetation removal and grading activities during construction; Long-term less-than-significant adverse impacts to surface water flow, water quality, and sediment and contaminant transport downstream of proposed Losen Slote force main discharges and in the upper reach of East Riser Ditch; Long-term beneficial effects to surface water quantity, flow, quality, and sediment and contaminant transport, and to off-site wetland functions and services from proposed improvements and enhancements.	*Direct:* Adverse impacts (including the long-term, ***potentially significant adverse*** impacts) and beneficial effects would be slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed. Under Alternative 3, approximately 3.4 acres of wetlands would be impacted (0.3 acre permanently, 3.1 acres temporarily), 3.8 acres of open waters would be impacted (0.3 acre permanently, 3.5 acres temporarily), and 4.9 acres of riparian zones would be impacted (0.8 acre permanently, 4.1 acres temporarily). Approximately 3.5 acres of wetlands would be created or enhanced. *Indirect:* Adverse impacts and beneficial effects would be slightly less than Alternative 2 since fewer stormwater drainage improvements would be constructed.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Hydrology and Flooding	*Direct:* ***Potentially significant adverse*** impacts by permanently altering hydrology, flooding, or flood elevations; substantially and/or permanently disrupting the water table due to changes in surface water runoff; and substantially and/or permanently increasing normal water or flood levels. Over time, depending on SLR, an additional 11 to 26 percent of the Project Area could be at risk of coastal flooding during a 50-year storm surge. *Indirect:* No indirect impacts.	*Direct:* Short-term, less-than-significant adverse impacts to existing flood protection (berms) during construction; Long-term, less-than-significant adverse impacts to the normal water surface elevations of waterways in the Project Area due to disrupted groundwater movement from the LOP; Long-term, beneficial effects to the Project Area due to reduced coastal flooding, reduced impervious surfaces, and improved stormwater management in localized areas. During a 50-year storm surge, Alternative 1 would provide coastal flood protection to between 12 and 21 percent of the Project Area, as compared to the No Action Alternative, depending on SLR. *Indirect:* Long-term, ***potentially significant adverse*** impacts to developed areas outside the Project Area resulting from induced coastal flooding.	*Direct:* Long-term, less-than-significant adverse impacts to the groundwater table in localized areas; Long-term, beneficial effects to the Project Area due to reduced inland flooding from increased stormwater infiltration and conveyance capacity. Under Alternative 2, flood depths in the lower reach of East Riser Ditch would be reduced between 2.5 and 2.9 feet during a 2-year storm and between 1.6 and 2.2 feet during a 100-year storm, with residual flood reduction in the upper reach of East Riser Ditch. During a 100-year storm, approximately 182 buildings would receive inland flood protection against East Riser Ditch, totaling approximately $7.8M in avoided damages. For Losen Slote, flood depths would be reduced by up to 0.9 foot in the Main Reach between approximately Bertolotto Avenue and Niehaus Avenue, and by up to 0.6 foot in the Park Street Reach between its confluence with the Main Reach and approximately the south end of Teresa Court. Approximately 60 buildings would receive inland flood protection against Losen Slote during a 100-year storm, totaling approximately $1.1M in avoided damages. *Indirect:* No indirect impacts.	*Direct:* Generally the same as Alternative 2, except Alternative 3 would not provide flood reduction in the Park Street Reach of Losen Slote due to Losen Slote pump station C and its force main not being constructed. As such, only 44 buildings would receive inland flood protection against Losen Slote, totaling approximately $0.6M in avoided damages. *Indirect:* No indirect impacts (Same as Alternative 2).
Coastal Zone Management	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from increased long-term risks of coastal zone resources to identifiable hazards, reduced value of the coastal zone, alteration or diminishment of the coastal zones, and/or failure to achieve CZM compliance due to future flooding.	*Direct:* Short-term and long-term, less-than-significant adverse impacts to coastal zone-regulated areas and coastal resources in the Project Area during construction; Long-term, less-than-significant adverse impacts to existing marina access; Long-term, beneficial impacts to public open space, flood hazard areas, and public use due to increased public open spaces and recreational opportunities. *Indirect:* Long-term, beneficial effects to the coastal economy, human health, traffic, and human activities by increasing coastal flood protection.	*Direct:* Same as Alternative 1, except there would be no impacts to marina access, and beneficial effects due to increased public open spaces and recreational opportunities would extend to riparian zones and stormwater management/water quality. *Indirect:* Same as Alternative 1, except beneficial effects would be associated with inland flooding instead of coastal flooding.	*Direct:* Adverse impacts and beneficial effects would be slightly less than Alternative 2 since fewer Proposed Project components would be constructed. *Indirect:* Slightly less than Alternative 2 since Losen Slote pump station C and its force main would not be constructed.
Sustainability / Green Infrastructure	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** impacts from future flooding to drainage patterns that could increase the runoff rate to receiving waters without water quality treatment.	*Direct:* Long-term, beneficial impacts to hydrology due to a decrease in impervious surfaces (a net decrease of 0.8 acre), to communities through increased open space (four new parks and 10.1 acres of public open space, as well as 1.1 acres of created wetlands), to the quality of runoff due to decreased peak runoff rates from drainage enhancements, and to the coastal economy, human health, and human activities from reduced flooding and associated damages. *Indirect:* Long-term, beneficial effects by inducing activities that increase the future potential for green infrastructure construction through demonstrating the performance and community benefits of green infrastructure as part of open space improvements.	*Direct:* Slightly greater than Alternative 1 since there would be a net decrease of 3.4 acres of impervious surfaces, five new parks and 20.0 acres of public open space, 7.2 acres of wetland creation and/or enhancement, and improvements to the quantity, as well as quality, of runoff due to both decreased peak runoff rates and stormwater management through the installation of 41 green infrastructure systems. *Indirect:* Same as Alternative 1.	*Direct:* While there would be a net decrease of 3.7 acres of impervious surfaces under Alternative 3, beneficial impacts would overall be slightly less than Alternative 2 due to the exclusion of two new parks (only 7.6 acres of public open space), only 3.7 acres of wetland creation and/or enhancement, and some decreases in stormwater conveyance capacity since only one pump station and force main would be built for Losen Slote. *Indirect:* Slightly less than Alternative 2 since fewer Proposed Project components would be constructed.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Hazards and Hazardous Materials	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** from future flooding to contaminated sites, the potential introduction or mobilization of contaminants, and/or conflicts with existing or planned remedial investigations.	*Direct:* Short-term, ***potentially significant adverse*** impacts from potentially triggering near-term remediation under the Industrial Site Recovery Act (ISRA) during construction; Long-term, ***potentially significant adverse*** impacts from the disruption or mobilization of previously known hazardous materials encountered during construction; Short-term, less-than-significant adverse impacts from subsurface disturbance of hazardous materials at known or suspected contaminated sites during construction, and to planned remedial activities that could be delayed temporarily; Short-term and long-term, less-than-significant adverse impacts from potential spills (e.g. gasoline and diesel) during construction and operational activities; Long-term beneficial impacts from the removal of potentially contaminated soils during construction (84,900 CY). Under Alternative 1, up to 13 contaminated sites could be directly impacted. *Indirect:* Long-term, ***potentially significant adverse*** impacts from potential creation of volatile organic compound (VOC)/methane preferential pathways, mobilization of contaminant plumes in soil or groundwater, risk of thermal radiation or blast-overpressure damage from one aboveground storage tank (AST), and interference with future remedial investigations; Long-term, beneficial impacts from the protection of contaminated sites from the erosive effects of coastal flooding. Under Alternative 1, up to 11 contaminated sites could be indirectly impacted.	*Direct:* Same as Alternative 1, including the short- and long-term, ***potentially significant adverse*** impacts, except there are 20 contaminated sites that potentially could be impacted directly by Alternative 2, 32,300 CY of potentially contaminated soil would be exported, and long-term, beneficial impacts could also be realized from the capping of potentially contaminated soil by Alternative 2 components. *Indirect:* Same as Alternative 1, including the long-term, ***potentially significant adverse*** impacts, except there are 20 contaminated sites that potentially could be impacted indirectly by Alternative 2, and beneficial impacts would be realized from reduced erosive effects of inland flooding instead of coastal flooding. Additionally, there would be long-term, less-than-significant adverse impacts from localized increases in water velocity that could cause scour and mobilize contaminated sediments in East Riser Ditch and Losen Slote.	*Direct:* There are 19 contaminated sites that potentially could be impacted directly by Alternative 3, but adverse impacts (including the short- and long-term, ***potentially significant adverse*** impacts) and benefits would be slightly less than Alternative 2 since there would be less ground-disturbing activities, and only 28,000 CY of potentially contaminated soil would be exported. *Indirect:* There are 19 contaminated sites that potentially could be impacted indirectly by Alternative 3, but adverse impacts (including the long-term, ***potentially significant adverse*** impacts) and benefits would be slightly less than Alternative 2 since there would be less ground-disturbing activities (for example, a lower risk of scouring the Losen Slote channel because the Losen Slote C pump station and its force main would not be constructed).
Mineral and Energy Resources	*Direct:* No direct impacts. *Indirect:* ***Potentially significant adverse*** effects from future flooding to energy resources due to the increase of long-term risks to identifiable hazards, increases in consumer prices, a minimal diminishment of these resources in the Project Area, and/or short-term decreases in their supply, availability, or capacity.	*Direct:* Short-term, less-than-significant adverse impacts to the supply, availability, capacity, or costs of mineral and energy resources during construction. *Indirect:* Long-term, beneficial effects from increased coastal flood protection, which would reduce damages to energy resources; benefit their supply, availability, capacity, and cost; and commensurately reduce the need for reconstruction and rebuilding of facilities damaged by flood events, thereby reducing potential future need/use of mineral resources.	*Direct:* Slightly less than Alternative 1 since the amounts of mineral and energy resources required for construction are less for most materials. *Indirect:* Same as Alternative 1, except beneficial effects would stem from increased inland flood protection.	*Direct:* Slightly less than Alternative 2 since fewer Proposed Project components would be constructed, and fewer mineral and energy resources would be required. *Indirect:* Slightly less than Alternative 2 since the Losen Slote pump station C and its force main would not be constructed.

Resource Area	No Action Alternative	Alternative 1: Structural Flood Reduction	Alternative 2: Stormwater Drainage Improvement	Alternative 3: Hybrid
Agricultural Resources and Prime Farmland	*Direct:* No direct impacts. *Indirect:* Less-than-significant adverse impacts from the long-term risk of community and residential gardens to identifiable hazards and/or the prohibition of the use of and access to community and residential gardens for future agricultural use due to future flooding.	*Direct:* No direct impacts. *Indirect:* Long-term, beneficial effects on residential and community gardens due to increased coastal flood protection.	*Direct:* No direct impacts (Same as Alternative 1). *Indirect:* Same as Alternative 1, except beneficial effects would stem from increased inland flood protection and stormwater drainage improvements.	*Direct:* No direct impacts (Same as Alternatives 1 and 2). *Indirect:* Slightly less than Alternative 2 since there would be fewer stormwater drainage improvements.

3.0 Affected Environment

3.1 Introduction

This section provides a detailed characterization of the components of the environment, or technical resource areas, which could potentially be affected by the Proposed Project. The information in this section provides the basis for the assessment of impacts from the Proposed Project’s three Build Alternatives and No Action Alternative; the impact analysis is presented in **Section 4.0**.

Each subsection details the baseline environmental conditions within the Project Area and is organized, as appropriate, by municipality in the following order: the Borough of Little Ferry, the Borough of Moonachie, the Borough of Carlstadt, the Borough of Teterboro, and the Township of South Hackensack. Each subsection also identifies applicable Federal, State, and local laws and regulations that pertain to the technical resource areas considered in the analysis along with the methodologies used to gather and assemble the existing conditions data.

When necessary, data gathering for a given technical resource area may extend beyond the Project Area boundary in order to adequately address potential impacts of the Proposed Project. In these instances, the rationale for the larger study area is provided within the relevant subsection. Technical resource areas considered in this section include the following:

- Land Use and Land Use Planning
- Visual Quality/Aesthetics
- Socioeconomics, Community/Populations, and Housing
- Environmental Justice
- Cultural and Historic Resources
- Transportation and Circulation
- Noise and Vibration
- Air Quality and GHG Emissions
- Global Climate Change and Sea Level Change
- Recreation
- Utilities and Service Systems
- Public Services
- Biological Resources
- Geology and Soils
- Hydrology and Flooding
- Water Resources, Water Quality, and WOUS
- Coastal Zone Management
- Sustainability/Green Infrastructure
- Hazards and Hazardous Materials
- Mineral and Energy Resources
- Agricultural Resources and Prime Farmlands

3.2 Land Use and Land Use Planning

3.2.1 Introduction

Land use is a description of how land is occupied and utilized; it refers to the activities that occur on land and within the structures that occupy it. Land use can be separated into two primary categories: natural and human modified. Natural land use includes woodlands, rangeland, grasslands, wetlands, and other open or undeveloped areas. Human-modified land use includes residential, commercial, industrial, communications and utilities, agricultural, institutional, recreational, and generally other areas developed from a natural land cover condition. These basic types of land use can be further broken down where appropriate (e.g., single-family residential, two-family residential, or multi-family residential; retail commercial, office commercial, or warehouse commercial).

Land use is regulated by management plans, policies, regulations, and ordinances (i.e., zoning) that determine the type and extent of land use allowable in specific areas and protect specially designated or environmenertally sensitive areas. A municipality's zoning ordinance controls the use, density, and bulk (i.e., the size of the building in relation to the size of the lot) of development within the municipality. A zoning ordinance is divided into two parts: zoning text and zoning maps. The text establishes zoning districts and sets forth the regulations governing land use and development in each district. The maps depict the location of the zoning districts. The three basic types of zoning districts are: residential, commercial, and industrial. As with land use, these basic categories can be further broken down (e.g., lower, medium, or higher-density residential; neighborhood, highway, or office commercial; or light or heavy industrial).

3.2.2 Regulatory Context

Land use in New Jersey is regulated at the municipal level in accordance with the State Constitution and the New Jersey Municipal Land Use Law (MLUL; New Jersey Statutes Annotated [NJSA] 40:55 *et seq.*). Land use and zoning policies generally are under the jurisdiction of local governments, with some regional involvement (e.g., the NJSEA) and State involvement through the New Jersey State Development and Redevelopment Plan, herein also referred to as the State Plan (New Jersey State Planning Commission 2001). Implementation and enforcement of the regulations governing these policies are the responsibility of local government entities, such as planning departments, zoning boards, code enforcement agencies, county legislatures, and city councils.

New Jersey adopted its State Plan in 2001 in response to the mandates of the New Jersey Legislature contained in the New Jersey State Planning Act (NJSA 52:18A-196 *et seq.*). The State Plan, including its State Plan Policy Map, is used to guide municipal, county, and regional planning; State agency functional planning; and infrastructure investment decisions. The 2001 State Plan delineates five Planning Areas based on natural and built characteristics and sets forth the State's vision for future development within these areas. The five areas include the Metropolitan Planning Area (PA1), Suburban Planning Area (PA2), Fringe Planning Area (PA3), Rural Planning Area (PA4), and Environmentally Sensitive Planning Area (PA5) (New Jersey State Planning Commission 2001). Additional planning areas in the State Plan include: the Rural/Environmentally Sensitive Planning Area (PA4B) and Environmentally Sensitive/Barrier Islands Planning Area (PA5B) (New Jersey State Planning Commission 2001).

The five municipalities within the Project Area, with the exception of those areas in the Meadowlands District, are located within the Metropolitan Planning Area (PA1), which is an area that usually has an obvious tie to a major metropolitan center, such as the New York Metropolitan Area (New Jersey State Planning Commission 2001). The State Plan does not apply to those areas in the Meadowlands District, which are under the jurisdiction of the NJSEA. **Table 3.2-1** shows the percentage of each municipality that lies within the Meadowlands District. The five municipalities, along with Bergen County, also have individual master plans and zoning ordinances.

As noted above, municipal land use and zoning authorities in areas within the Meadowlands District do not apply under the State Plan, and are instead within the purview of the NJSEA. The Hackensack Meadowlands Reclamation and Development Act (NJSA 13:17-1 *et seq.*), effective January 13, 1969, recognized the need for orderly and comprehensive development of the Meadowlands District (NJSEA 2004). The Act created the Hackensack Meadowlands Development Commission (HMDC), which was renamed the NJMC prior to the Hackensack Meadowlands Agency Consolidation Act in 2015. The subsequent 2015 Act consolidated the NJMC into the NJSEA, a State agency with control over the multi-jurisdictional Meadowlands District. For the purposes of this document, the Meadowlands District's zoning regulations under (New Jersey Administrative Code [NJAC] 19:4) are used as the primary reference for zoning regulations and nomenclature. Since the five municipalities in the Project Area are not completely located within the Meadowlands District (**Table 3.2-1**), references to the existing municipal zoning designations in the Project Area, and which Meadowlands District zoning designation(s) they are approximately equivalent to, are discussed in **Sections 3.2.3.1** through **3.2.3.6**, the municipal zoning sections.

Table 3.2-1: Land Acreage of Project Area Municipalities within Meadowlands District

Municipality	Total Acres	In Meadowlands District	
		Acres	Percent
Little Ferry	1,033	428	41%
Moonachie	1,034	827	80%
Carlstadt	2,784	2,315	83%
Teterboro	734	492	67%
South Hackensack	508	86	17%
Total	**6,093**	**4,148**	**68%**

Source: (NJSEA 2004)

Land use compatibility is regulated in areas around civilian airports and military airfields. No military airfields occur in the vicinity of the Project Area. However, due to the presence of Teterboro Airport within the Project Area, the Proposed Project would be subject to both FAA and HUD regulations related to land use and airspace restrictions. HUD assisted projects must comply with 24 CFR Part 51, Subpart D, *Siting of HUD Assisted Projects in Runway Clear Zones at Civil Airports and Clear Zones and Accident Potential Zones at Military Airfields*. Proposed projects and activities within 2,500 feet of a civilian airport involving new construction, land use changes, acquisition of undeveloped land, or facilities that would be frequently used or occupied by people require a land use compatibility assessment. Further, HUD assistance may not be used for these types of projects if they are located within the runway protection zone[17] (RPZ) of a civilian airport per 24 CFR § 51.303. FAA provides additional guidance on what constitutes compatible land use, how to evaluate proposed land uses, and who to consult with prior to project implementation.[18] In addition, notice to FAA is required for proposed construction activities with the potential to impact the navigational airspace at a site (i.e., 200 feet or more above the ground level) in accordance with 14 CFR Part 77. More detailed information concerning Federal, State, and local regulatory requirements associated with the Proposed Project can be found in **Appendix B**.

[17] RPZs or clear zones are a trapezoidal area immediately beyond the end of a runway that serves to enhance the protection of people and property on the ground in the event an aircraft lands or crashes beyond the runway end. The standards are established by FAA regulations. The term in 24 CFR Part 51, *Runway Clear Zones*, was redefined in FAA's Airport Design AC 150/5300-13 to refer to RPZs for civil airports.

[18] *Hazardous Wildlife Attractants on or Near Airports* (FAA AC No. 150/5200-33B dated August 28, 2007), *Interim Guidance on Land Uses Within a Runway Protection Zone* (FAA Memorandum dated September 27, 2012), and *Airport Design* (FAA AC No. 150/5300-13A dated September 28, 2012).

3.2.3 Existing Conditions

3.2.3.1 Existing Planning Documents for the Project Area

The maps and planning documents listed below were used to compile information about current land uses and zoning within the Project Area. In addition, NJSEA provided geographic information system (GIS) datasets for analysis. Data gathered were verified through field visits and windshield surveys conducted in July 2016. The master plans and other relevant planning documents include:

- New Jersey Meadowlands Commission Master Plan (NJSEA [previously known as the NJMC] Master Plan) (NJSEA 2004);
- New Jersey's State Development and Redevelopment Plan (New Jersey State Planning Commission 2001);
- Bergen County Master Plan (Bergen County Planning Board 2011a);
- Bergen County Multi-Jurisdictional All-Hazards Mitigation Plan (Bergen County Office of Emergency Management 2015);
- Little Ferry Master Plan, first adopted in 1964, and subsequent Re-examination Reports (Borough of Little Ferry Planning Board 1964, Borough of Little Ferry Planning Board 1978, Borough of Little Ferry Planning Board 1985, Borough of Little Ferry Planning Board 1990, Borough of Little Ferry Planning Board 1995, Little Ferry Land Use Board 2013, Borough of Little Ferry Planning Board 2003);
- Little Ferry Land Use Plan (Borough of Little Ferry Planning Board 1984);
- Strategic Recovery Planning Report, The Borough of Little Ferry (Borough of Little Ferry 2014);
- Moonachie Master Plan and Proposed Zoning Regulations, first adopted in 1960, and subsequent Re-examination Reports (Borough of Moonachie Planning Board 1960, Borough of Moonachie Planning Board 1982, Borough of Moonachie Planning Board 1988, Borough of Moonachie Planning Board 1994, Borough of Moonachie Planning Board 2000, Borough of Moonachie Planning Board 2007);
- Moonachie Land Use Plan (Borough of Moonachie Planning Board 1978);
- Carlstadt Master Plan, first adopted in 1978, and subsequent Re-examination Reports (Borough of Carlstadt Planning Board 1978, Borough of Carlstadt Planning Board 1999, Borough of Carlstadt Planning Board 2006, Borough of Carlstadt Planning Board 2013);
- Teterboro Master Plans (Borough of Teterboro Planning Board 1988, Borough of Teterboro Planning Board 2000, Borough of Teterboro Planning Board 2006);
- NJSEA (previously the NJMC) Teterboro/Industrial Avenue Redevelopment Plan (NJSEA 2009);
- South Hackensack Master Plan, first adopted in 1979, and Re-examination Reports (Township of South Hackensack 1979, Township of South Hackensack 1982, Township of South Hackensack 2008); and
- South Hackensack Land Use Plan (Township of South Hackensack 2001).

3.2.3.2 Bergen County

Bergen County, located in the northeastern portion of New Jersey, is the most densely populated county in the State (Bergen County Planning Board 2011a). Bergen County is composed of a variety of land uses; **Table 3.2-2** shows the percentage of each land use within Bergen County.

Table 3.2-2: Distribution of Land Uses in Bergen County

Land Use	Percentage in Bergen County
Residential	43%
Open Space	16%
Rights of Way for Water, Utilities, and Roads	16%
Commercial	8%
Public/Quasi-Public	7%
Office and Industrial	4%
Undeveloped/Vacant	5%
Other	1%
Total	**100%**

Areas in the northern portion of the county have lower-density residential uses, some retail centers, and corporate office parks. The southern portion of the county has more compact, mixed-use land uses compared to the other portions of the county, as well as a greater concentration of industrial and warehouse commercial use parcels. The Meadowlands District, located in the southwestern portion of the county, is characterized by large tracts of wetlands and other public/quasi-public uses. Land use along the western and northeastern portions of the county is woodlands.

Bergen County is part of the New York Metropolitan Area, and has been developed in conjunction with New York City. As a result, the county has very little developable land remaining; new development typically occurs as redevelopment or infill within existing developed areas that are either vacant or underutilized (Bergen County Planning Board 2011a). Over the last few decades, the waterfront area along the Hudson River in the southern portion of the county has experienced rapid redevelopment and infill as the area has grown to accommodate an increase in population. Some of the land that was originally used by industry along the Hudson River has been redeveloped into luxury condominium, retail, and service-oriented commercial uses. Similar to riverfront areas, this trend is apparent along rail corridors, such as the Northern Branch Rail Line, Passaic-Bergen Line, and Bus Rapid Transit Corridors (Bergen County Planning Board 2011a).

3.2.3.3 Meadowlands District

Similar to Bergen County as a whole, the Meadowlands District experienced extensive development in the 20th century. With the development of both a robust road and railroad network in the region, cheap, developable land nearby became a desirable location for the construction of warehouses and distribution industries; these land uses still occupy much of the Project Area. This commercial boom led to significant growth in population and employment. Most of the natural upland areas within the Meadowlands District, including within the five municipalities of the Project Area, are already developed; people also have made numerous attempts throughout history to convert the wetland areas into developable lands (i.e., reclamation).

In recent years, however, NJSEA initiated a number of redevelopment projects in the Meadowlands District that moved away from traditional patterns of urban sprawl and reclamation of wetland areas (see **Section 5.0**). The NJSEA Master Plan initiated a shift toward sustainability and smart growth. The plan includes redevelopment/infill for new development, an increased focus on mass transit to accommodate the dense population, and preservation of open space (particularly the remaining wetlands and other natural areas) (NJSEA 2004). As stated earlier, a large portion of the Project Area is wetland under a conservation easement or restriction that must be permanently preserved in its natural state. Areas under a conservation easement or restriction must prohibit all regulated activities as described in the Freshwater Wetlands Protection Act Rules (NJAC 7:7A-2.2 and 2.6), and any other activities that inhibit the natural succession of vegetation unless specifically authorized.

Under the Meadowlands District's zoning regulations (NJAC 19:4), there are 18 zoning designations and one Redevelopment Area classification within the Meadowlands District. Fourteen of those designations, described below, apply to lands within the Project Area.

Environmental Conservation

The environmental conservation (EC) zone includes areas that are ecologically significant wetlands, open waters, and adjacent uplands. Permitted uses in the zone include restoration activities, water access features, and scientific equipment. These uses aim to encourage scientific and educational study regarding wetland ecology. Special exception uses, such as communication towers, marinas, or structures needed to conduct a restoration activity, are permitted assuming the use does not impair the environmental quality of the zone.

Recreation

There are two recreation zone designations under the Meadowlands District's zoning regulations that occur in the Project Area: (1) parks and recreation (PA) and (2) waterfront recreation (WR). The PA zone includes areas that provide public open space and recreational facilities. Allowable activities in the PA zone include parks and recreation facilities. The WR zone includes areas that accommodate marinas and other water-oriented commercial and recreational facilities, such as boat rental facilities or waterfront parks. Prohibited uses in the WR zone include any uses that exclude public access to the Hackensack River or adversely affect the visual aesthetics of the waterway.

Residential

There are two residential zone designations under the Meadowlands District's zoning regulations that occur in the Project Area: (1) low density residential (LDR) and (2) planned residential (PR). The LDR zone includes single-family, two-family, and townhome dwellings. In an area zoned LDR, there may also be community residences and shelters, daycare facilities, and schools. The PR zone includes high-density neighborhoods and multi-family dwellings (i.e., apartment complexes and condominiums). In areas zoned PR, there may be offices, restaurants, and health care facilities.

Commercial

There are two commercial zone designations under the Meadowlands District's zoning regulations that occur in the Project Area: (1) neighborhood commercial (NC) and (2) commercial park (CP). The NC zone allows for uses that serve the neighboring communities, such as banks, retail stores, and houses of worship. The CP zone allows for commercial services in pedestrian-friendly compact centers, such as shopping centers. Note that these example uses are not limited per zone, and commercial zones, through a special exception, may have uses that are not generally allowable.

Transportation

Transportation zone designations under the Meadowlands District's zoning regulations that occur in the Project Area include any roads, highways, rails, or other rights-of-way. Aviation facilities (AF) is also a specific designation under the Meadowlands District's zoning regulations, and includes any land used for an airport or in support of airport operations, such as car rental facilities, helistops, or taxi services.

Industrial

There are two Industrial zone designations under the Meadowlands District's zoning regulations that occur in the Project Area: (1) light industrial A (LI-A) and (2) light industrial B (LI-B). The LI-A zone allows for industrial and distribution uses congregated on a large lot, such as automobile sales, research and development facilities, and warehouses. The LI-B zone is similar to the LI-A zone, but the uses are not located on a large lot. Industrial and commercial zones often support similar uses and are often in close proximity to each other.

Public Utilities

Public utility (PU) zones are areas that support public utilities and intermodal uses, such as electric power facilitates, intermodal facilities, railroad yards, and special exception recycling facilities.

Redevelopment Areas

The properties zoned as redevelopment areas (RA) have been deemed to be "in need of redevelopment" by the NJSEA in accordance with specific regulatory criteria listed in NJAC 19:3-5. Each redevelopment area is regulated by a redevelopment plan specific to the conditions of the area and is intended to encourage development to bring the subject properties back into productive use.

3.2.3.4 Project Area – Overview

The Project Area includes approximately 5,405 acres to the west of the Hackensack River. The Project Area is composed of both relatively dense suburban development and large natural areas. The approximate percentages for broad land use categories in the Project Area are presented in **Table 1.2-1**.

As shown in **Figure 3.2-1**, land use in the Project Area can be divided into four general regions. The northwest quadrant of the Project Area, including the Boroughs of Teterboro and Moonachie, is dominated by the Teterboro Airport and some industrial areas. The northeast quadrant, including portions of the Boroughs of Little Ferry and Moonachie and the Township of South Hackensack, is comprised primarily of residential and commercial land use. As described in **Section 3.4.3.1**, approximately 22,400 people reside within the Project Area (US Census Bureau 2014). The southeast quadrant, including portions of the Boroughs of Carlstadt and Little Ferry and the Township of South Hackensack, consists of large wetland complexes, including the MRI Wetland Mitigation Banks and the Richard P. Kane Natural Areas and Wetland Mitigation Bank. The southwest quadrant, including portions of the Boroughs of Carlstadt and Moonachie, consist mostly of industrial land use.

More detailed descriptions of land use and zoning within each municipality are provided in the following sections.

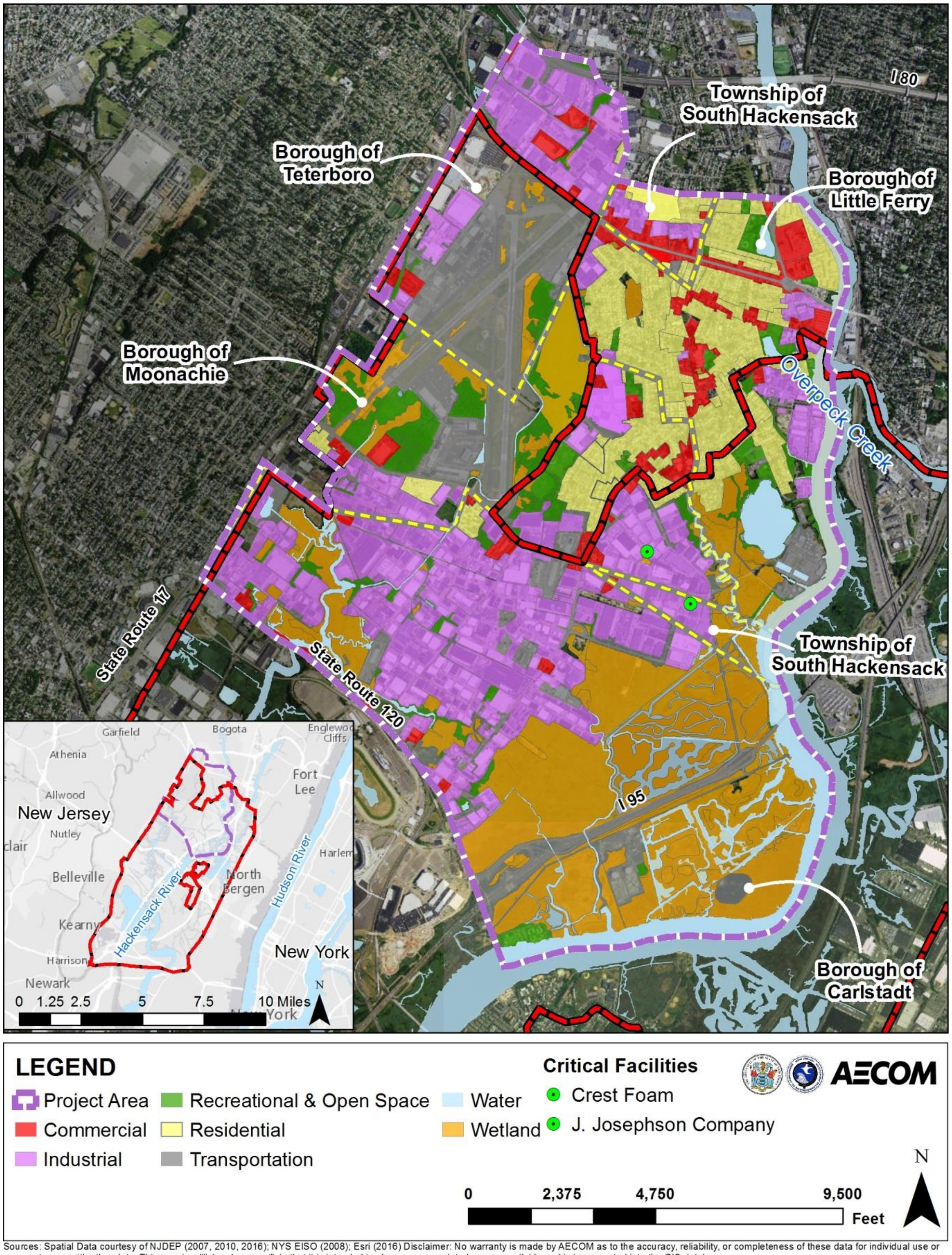


Figure 3.2-1: Land Uses within the Project Area

3.2.3.5 Borough of Little Ferry

Land Use

The entirety of the Borough of Little Ferry lies within the Project Area, but only the southern portion of the Borough lies within the Meadowlands District (**Figure 3.2-2**). Overall, Little Ferry includes 1,033 acres, of which 428 acres (41 percent) are within the Meadowlands District. The Borough of Little Ferry is almost fully developed; remaining developable parcels are small, typically less than 1 acre each (**Figure 3.2-2**). **Table 3.2-3** shows the percentage of each land use in the Borough of Little Ferry.

Table 3.2-3: Distribution of Land Uses in the Borough of Little Ferry

Land Use	Percentage Within Borough	Specific Uses Within Borough	Present in Meadowlands District?
Residential	40%	Multiple-unit dwellings (high-density), single-unit dwellings (medium- and rural-density)	Yes
Water	16%	Artificial and natural lakes, tidal waters, streams	Yes
Commercial	13%	Services, retail, other urban or built-up land	Yes
Wetlands	12%	Deciduous and herbaceous wetlands, coastal wetlands, marshes, mud flats	Yes
Industrial	9%	Industrial facilities and complexes	Yes
Recreational & Open Space	4%	Woodland, fields, parks	Yes
Transportation	4%	Roads, utilities, bridges	Yes
Public/Quasi-Public	2%	Schools, cemeteries	Yes

Development within the Borough of Little Ferry has been historically affected by the local high water table, drainage problems, and a general lack of developable vacant land (Borough of Little Ferry 2014). Most of the residential development within the Borough is located south of US Route 46 and along the main thoroughfares of Bergen County Routes 40, 503, S43. US Route 46, which traverses east-west across the Borough, has a large concentration of commercial uses. Most of these uses consist of car sales facilities, car wash establishments, car rental agencies, service stations, and other automobile-related establishments. There are also other general commercial establishments, such as motels, florists, fast food restaurants, diners, banks, tool shops, and other highway-related business establishments. A second concentration of smaller commercial and mixed commercial and residential uses is present along Main Street, including offices, taverns, wholesale kitchen furnishings, and neighborhood convenience stores. The largest commercial use concentration is the Valley Fair Shopping Center, located at 260 Bergen Turnpike.

Industrial uses in the Borough of Little Ferry are concentrated along the Hackensack River and include general equipment yards, storage facilities, metal fabricating establishments, petroleum tank farms, and other industrial uses. Industrial uses are also located south of US Route 46 bordering the river and along Industrial Avenue and Gates Road. Two manufacturing plants located along Industrial Avenue, both under the ownership of Scientific Design Company, Inc., are considered critical facilities[19] in the Borough of Little Ferry (Bergen County Office of Emergency Management 2015). The southern portion of the Borough is dominated by wetlands and includes some commercial uses on higher ground. Recreational land uses are present north of Lakeview Avenue and along Pickens, Rose, and Crescent Streets.

Zoning

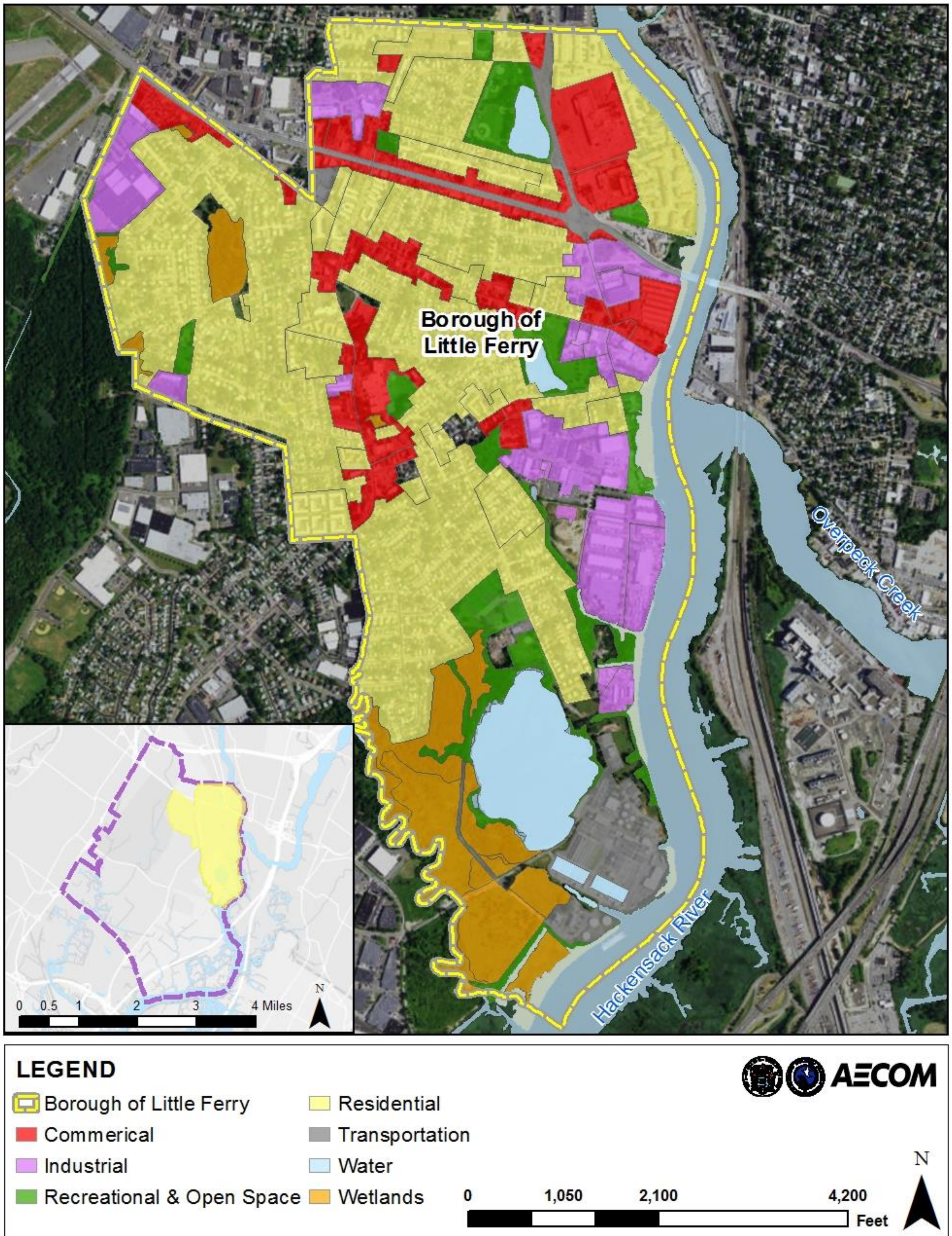
Based on a review of the Borough of Little Ferry zoning map (**Figure 3.2-3**), zoning within the Meadowlands District (southern) portion of the Borough is a mix of environmental conservation, industrial, residential, recreation, public utilities, and redevelopment areas. **Table 3.2-4** lists the zoning designations in the Meadowlands District portion of Little Ferry and, if applicable, any specific designations that are present under each type. Since a portion of the Borough of Little Ferry is located outside of the Meadowlands District, municipal zoning designations of approximate equivalence to the Meadowlands District zoning designations are also listed in **Table 3.2-4**.

Table 3.2-4: Zoning Designations within the Borough of Little Ferry

Zoning Designation	Specific Zoning Designations Within Meadowlands District	Approximately Equivalent Municipal Zoning Designations Within Borough[1]
Environmental Conservation	EC	Not Applicable (N/A)[2]
Industrial	LI-B	Light Industrial (IL) (approximately equivalent to LI-A and LI-B)
Residential	LDR, PR	Multi-Family Residential (RM) (approximately equivalent to PR)
Recreation	PA	N/A[2]
Commercial	NC	Highway and Regional Business Zone (BH) (approximately equivalent to CP, but is associated with a highway location or operation) and Neighborhood Business (approximately equivalent to NC)
Public Utilities	PU	N/A[2]
Redevelopment Area	RA	N/A[2]

1. Source: Code of the Borough of Little Ferry, Chapter XXXV: Land Use Regulations, Article 100: Zoning
2. N/A = Zoning designation is not present in the Meadowlands District or non-Meadowlands District portion of the borough (whichever applicable).

[19] Critical facility determinations in this document are in accordance with those in the Bergen County Multi-Jurisdictional All-Hazards Mitigation Plan, which was approved by FEMA on April 13, 2015.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.2-2: Land Uses within the Borough of Little Ferry

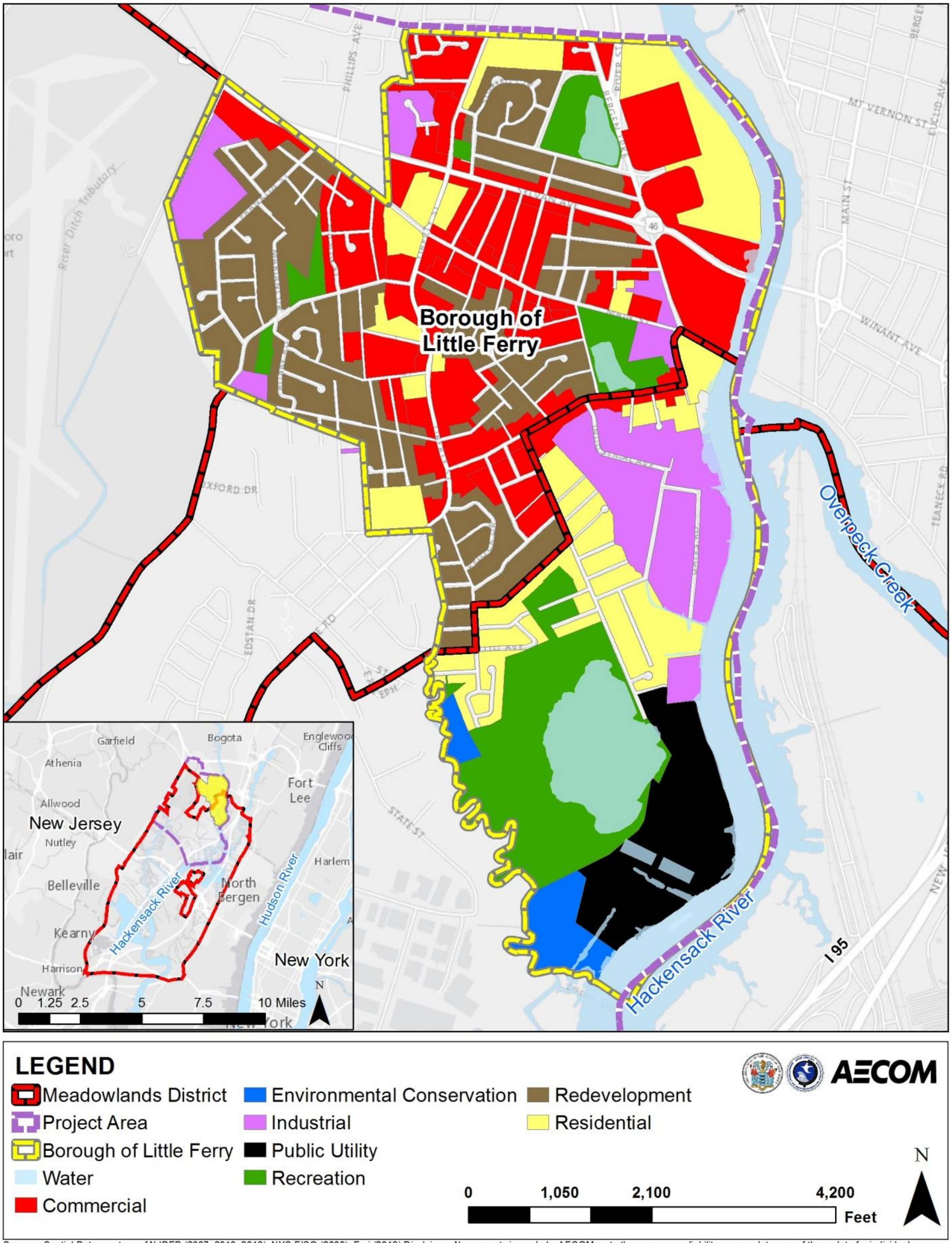


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Figure 3.2-3: Zoning Designations within the Borough of Little Ferry

3.2.3.6 Borough of Moonachie

Land Use

The Borough of Moonachie includes 1,034 acres, of which 827 acres (80 percent) are within the Meadowlands District (**Figure 3.2-4**). The Borough of Moonachie is mostly developed with little vacant land available for new development (Borough of Moonachie Planning Board 1988). **Table 3.2-5** shows the percentage of each land use in the borough.

Table 3.2-5: Distribution of Land Uses in the Borough of Moonachie

Land Use	Percentage Within Borough	Specific Uses Within Borough	Present in Meadowlands District?
Industrial	28%	Industrial facilities and complexes	Yes
Residential	21%	Multiple-unit dwellings (high-density), single-unit dwellings (medium- and low-density)	Yes
Wetlands	15%	Deciduous and herbaceous wetlands, artificial and modified wetlands, coastal wetlands, mud flats, marshes	Yes
Transportation	13%	Airport facilities, railroad, roads	Yes
Commercial	13%	Services, retail, other urban or built-up land	Yes
Water	8%	Artificial lakes, stormwater basins, streams, tidal waters	Yes
Recreational & Open Space	4%	Woodlands, fields, parks, playgrounds	Yes

Mathematical inconsistencies due to rounding.

A portion of Teterboro Airport is located within the Borough of Moonachie; east of the airport are wetlands and some transportation-related land uses. The PANYNJ has constructed a series of public parks and playgrounds along Redneck Avenue, including John Tucci, John Stevens, and Albert Pomponio Fields. There is a large Federal Express facility located just north of these playgrounds. Most of the residential land uses occur east of the airport property along Joseph Street, Jackson Place, Broad Street, and Edstan Drive. The Liberty Bell apartment complex is one of the larger residential land uses along Moonachie Road. The Metropolitan and Vanguard Associates Mobile Home Parks are also located along Moonachie Avenue. Some smaller commercial uses with retail establishments are located in the vicinity of the residential areas. Land on either side of Commercial Avenue is dotted with large office complexes and some Industrial uses. Other parcels with predominantly industrial uses occur along Empire Boulevard, Moonachie Road, and State Street, such as a parcel off of Moonachie Road that is used by Crest Foam, a foam manufacturing plant and a critical facility[20] in the Borough of Moonachie (Bergen County Office of Emergency Management 2015).

Zoning

Based on a review of the Borough of Moonachie zoning map (**Figure 3.2-5**), transportation zones comprise the largest zoning district within the borough. Large parcels set aside for Industrial uses are present along Moonachie Avenue, Moonachie Road, and continue along Empire Boulevard. Two parcels zoned for mobile homes are located along Moonachie Avenue and Caesar Place. There are some low density residential zones along State Street and on both sides of Lincoln Place. **Table 3.2-6** lists the zoning designations in the Meadowlands District and, if applicable, any specific designations that are present under that type. Since a portion of the Borough of Moonachie is located outside of the Meadowlands District, municipal zoning designations of approximate equivalence to the Meadowlands District zoning designations are also listed in **Table 3.2-6**.

Table 3.2-6: Zoning Designations in the Borough of Moonachie

Zoning Designation	Specific Zoning Designations Within Meadowlands District	Approximately Equivalent Municipal Zoning Designations Within Borough[1]
Environmental Conservation	EC	N/A[2]
Transportation	AF	N/A[2]
Industrial	LI-A and LI-B	Manufacturing (M) (approximately equivalent to LI-A and LI-B)
Residential	LDR	One-Family Residential (R-1), Two-Family Residential (R-2), and Mobile Home Park (MHP) (all approximately equivalent to LDR)
Commercial	N/A[2]	General Business (B-1) and Limited Business (B-2) (approximately equivalent to NC and CP)

1. Source: Revised General Ordinances of the Borough of Moonachie, Chapter XXII: Zoning
2. N/A = Zoning designation is not present in the Meadowlands District or non-Meadowlands District portion of the borough (whichever applicable).

[20] A critical facility is defined as a structure, service, or facility that is particularly vulnerable to flooding due to its potential to cause harm, damage, or disruption to community persons, properties, or activities if it is destroyed or impaired.

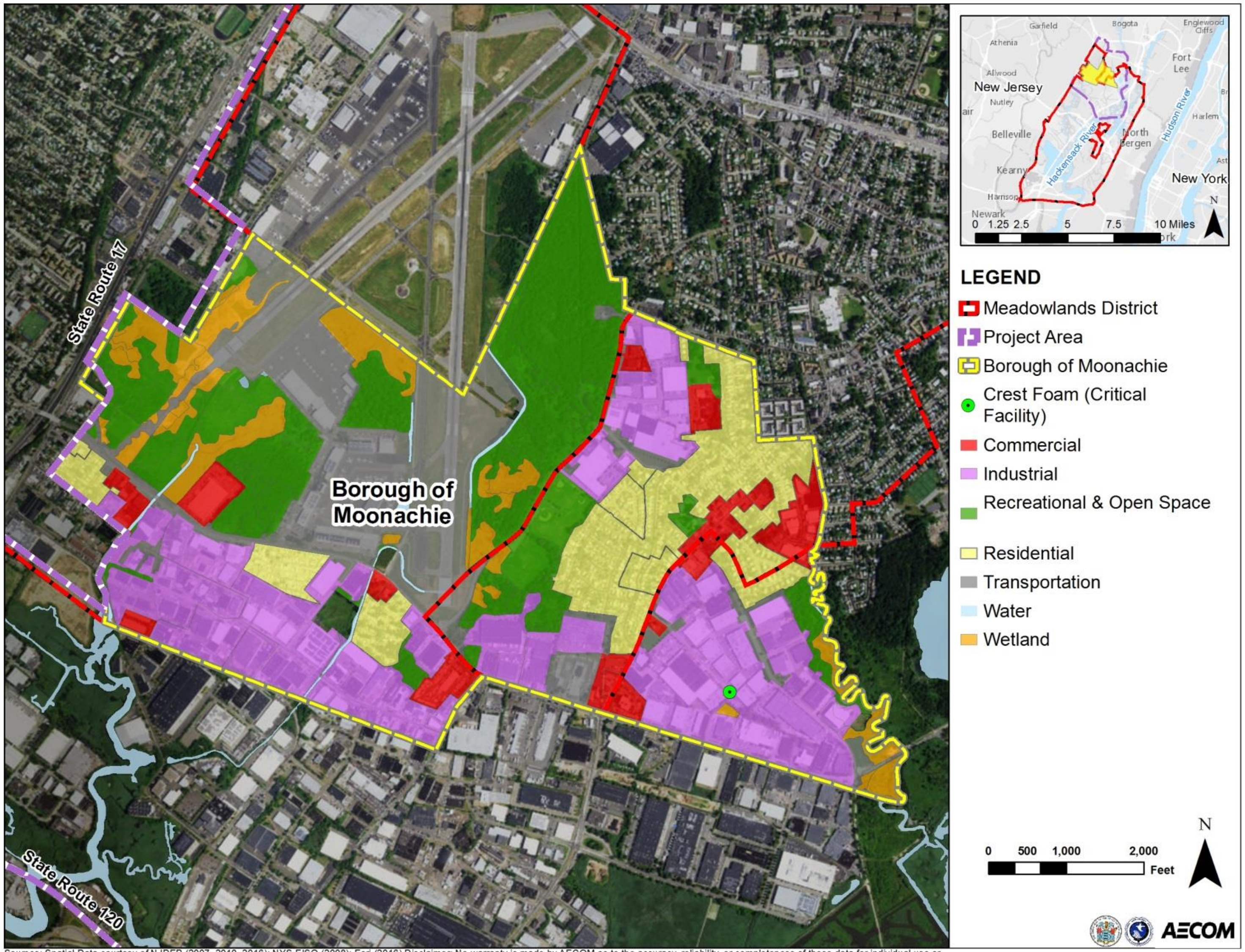

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Figure 3.2-4: Land Uses within the Borough of Moonachie

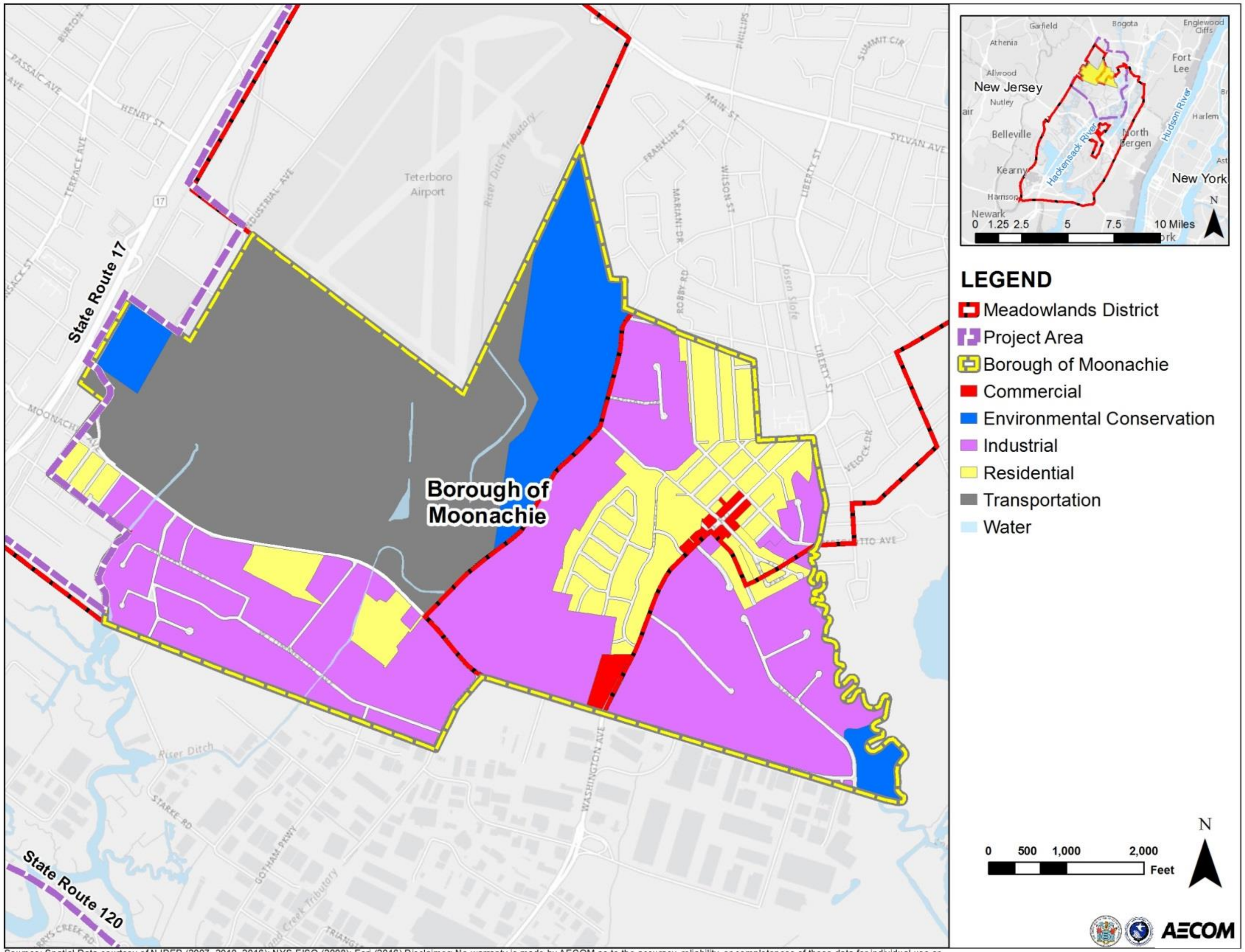

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Figure 3.2-5: Zoning Designations within the Borough of Moonachie

3.2.3.7 Borough of Carlstadt

Land Use

The Borough of Carlstadt includes 2,784 acres, of which 2,315 acres (83 percent) are within the Meadowlands District (**Figure 3.2-6**). **Table 3.2-7** shows the percentage of each land use in the Borough of Carlstadt.

Table 3.2-7: Distribution of Land Uses in the Borough of Carlstadt

Land Use	Percentage Within Borough	Specific Uses Within Borough	Present in Meadowlands District?
Wetlands	33%	Deciduous and herbaceous wetlands, artificial wetlands, coastal wetlands, marshes, mud flats	Yes
Industrial	32%	Industrial facilities and complexes	Yes
Water	18%	Artificial and natural lakes, streams, tidal waters	Yes
Transportation	11%	Bridges, roads, highways, transportation corridors, railroads, rights-of-way	Yes
Commercial	4%	Services, retail, hotels, other urban or built-up land	Yes
Recreational & Open Space	2%	Woodlands, shrubland, fields, parks	Yes

Land parcels between Bergen County Route 503 and State Route 17 are generally industrial and transportation related (Borough of Carlstadt Planning Board 1999). Wetlands and marshes occur north of State Route 120 (also known as Paterson Plank Road). Along Paterson Plank Road, there are several industrial and commercial (retail/office) establishments and some wetlands areas. A hotel (Holiday Inn) is located at the intersection of Paterson Plank Road and 16th Street (InterContinental Hotels Group 2016). Primary land uses along Bergen County Route 503 include commercial uses, such as gas stations, fast food restaurants, and a large electric substation.

Zoning

Based on a review of the Borough of Carlstadt zoning map (**Figure 3.2-7**), portions of the Borough between State Route 17 and Washington Avenue are zoned as industrial and redevelopment. Nearly all of the land east of Washington Avenue is within the Environmental Conservation zone. **Table 3.2-8** lists the zoning designations in the Meadowlands District and, if applicable, any specific designations that are present under that type. Since a portion of the Borough of Carlstadt is located outside of the Meadowlands District, municipal zoning designations of approximate equivalence to the Meadowlands District zoning designations are also listed in **Table 3.2-8**.

Table 3.2-8: Zoning Designations in the Borough of Carlstadt

Zoning Designation	Specific Zoning Designations Within Meadowlands District	Approximately Equivalent Municipal Zoning Designations Within Borough[1]
Environmental Conservation	EC	N/A[2]
Industrial	LI-A and LI-B	N/A[2]
Recreation	WR	N/A[2]
Redevelopment Area	RA	N/A[2]
Commercial	N/A[2]	Commercial Zone (approximately equivalent to NC or CP)

1. Source: Revised General Ordinances of the Borough of Carlstadt, Chapter XXI: Zoning
2. N/A = Zoning designation is not present in the Meadowlands District or non-Meadowlands District portion of the borough (whichever applicable).

3.2.3.8 Borough of Teterboro

Land Use

The Borough of Teterboro includes 734 acres, of which 492 acres (67 percent) are within the Meadowlands District (**Figure 3.2-8**). Teterboro Airport, located just south of US Route 46, is a large land use in the Borough of Teterboro, occupying 26 percent of the land area (**Figure 3.2-8**). **Table 3.2-9** shows the percentage of each land use within the borough.

Table 3.2-9: Distribution of Land Uses in the Borough of Teterboro

Land Use	Percentage Within Borough	Specific Uses Within Borough	Present in Meadowlands District?
Industrial	30%	Industrial facilities and complexes	Yes
Transportation	26%	Airport facilities, roads, railroads	Yes (primarily, Teterboro Airport)
Commercial	25%	Services, retail, museum, colleges, other urban or built-up land	Yes
Wetlands	11%	Deciduous and herbaceous wetlands, artificial and modified wetlands	Yes
Recreational & Open Space	2%	Woodland, shrubland	Yes
Residential	<1%	Single-unit dwellings (medium-density)	No
Water	<1%	Streams	Yes

Bordering the airport on the west is Industrial Avenue, which is lined with some large industrial and commercial uses. Teterboro Landing, located at the intersection of Industrial Avenue and US Route 46, is an ongoing redevelopment project encompassing 55 acres with retail stores such as Costco, Walmart, and other commercial uses. Some notable land uses north of US Route 46 include the Jersey College Nursing School, Municipal Court, Bergen College Technical School, and a Bank of America center. Some residential uses are located along James E. Hanson Way and Huyler Street. The Aviation Hall of Fame and Museum is another major land use located within the Teterboro Airport complex.

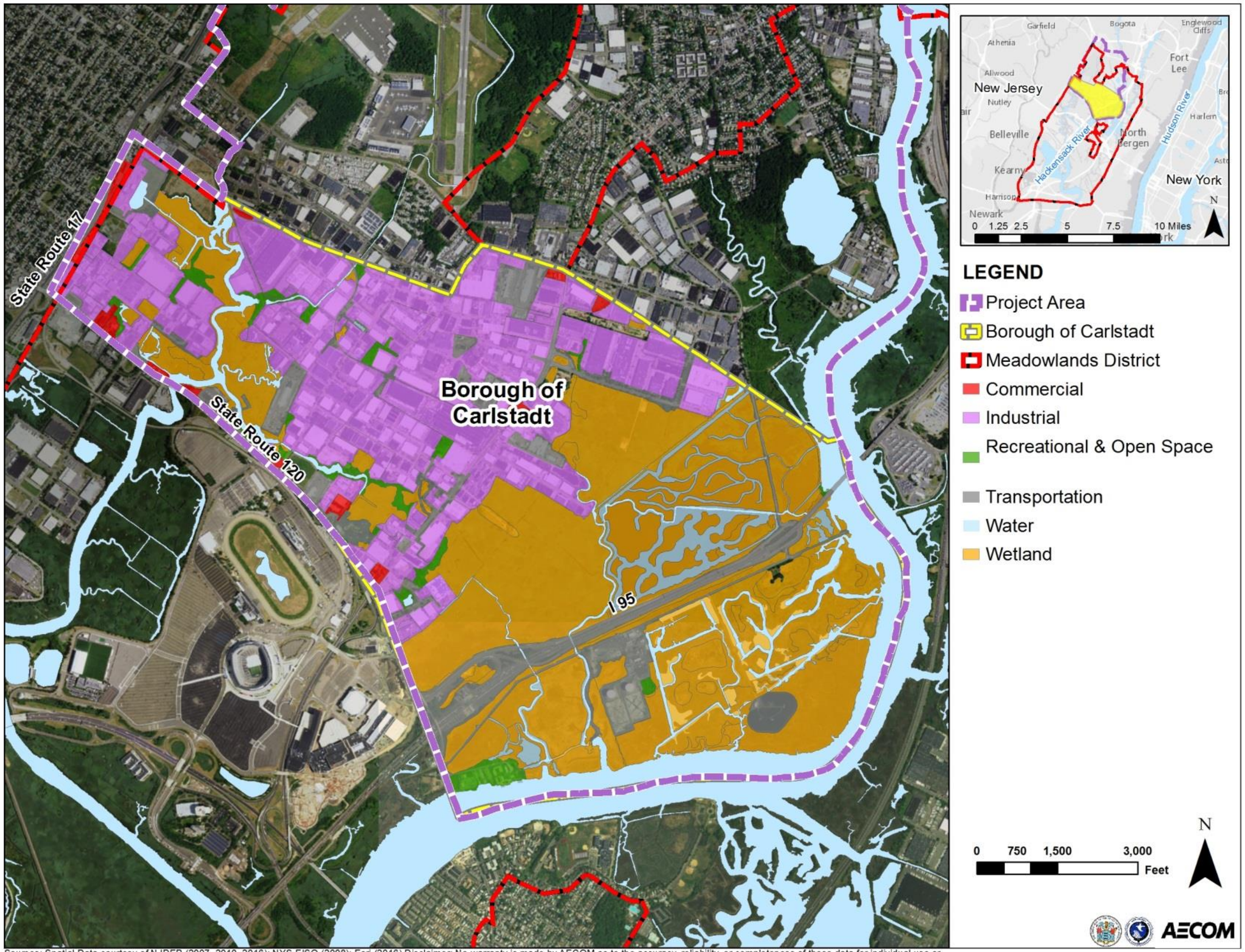
Zoning

Zoning within the Borough of Teterboro (**Figure 3.2-9**) is primarily transportation-related and industrial zones. A limited number of parcels zoned for residential use are located along James E. Hanson Way and US Route 46, with some areas zoned for Redevelopment along State Route 17. **Table 3.2-10** lists the zoning designations in the Meadowlands District and, if applicable, any specific designations that are present under that type. Since a portion of the Borough of Teterboro is located outside of the Meadowlands District, municipal zoning designations of approximate equivalence to the Meadowlands District zoning designations are also listed in **Table 3.2-10**.

Table 3.2-10: Zoning Designations in the Borough of Teterboro

Zoning Designation	Specific Zoning Designations Within Meadowlands District	Approximately Equivalent Municipal Zoning Designations Within Borough[1]
Transportation	AF	N/A[2]
Industrial	LI-B	Light Industrial and Distribution Zone (I) (approximately equivalent to LI-A and LI-B)
Redevelopment Area	RA	Redevelopment Area (approximately equivalent to RA)

1. Source: Zoning Ordinance of the Borough of Teterboro, 1978
2. N/A = Zoning designation is not present in the Meadowlands District or non-Meadowlands District portion of the Borough (whichever applicable).



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.2-6: Land Uses within the Borough of Carlstadt

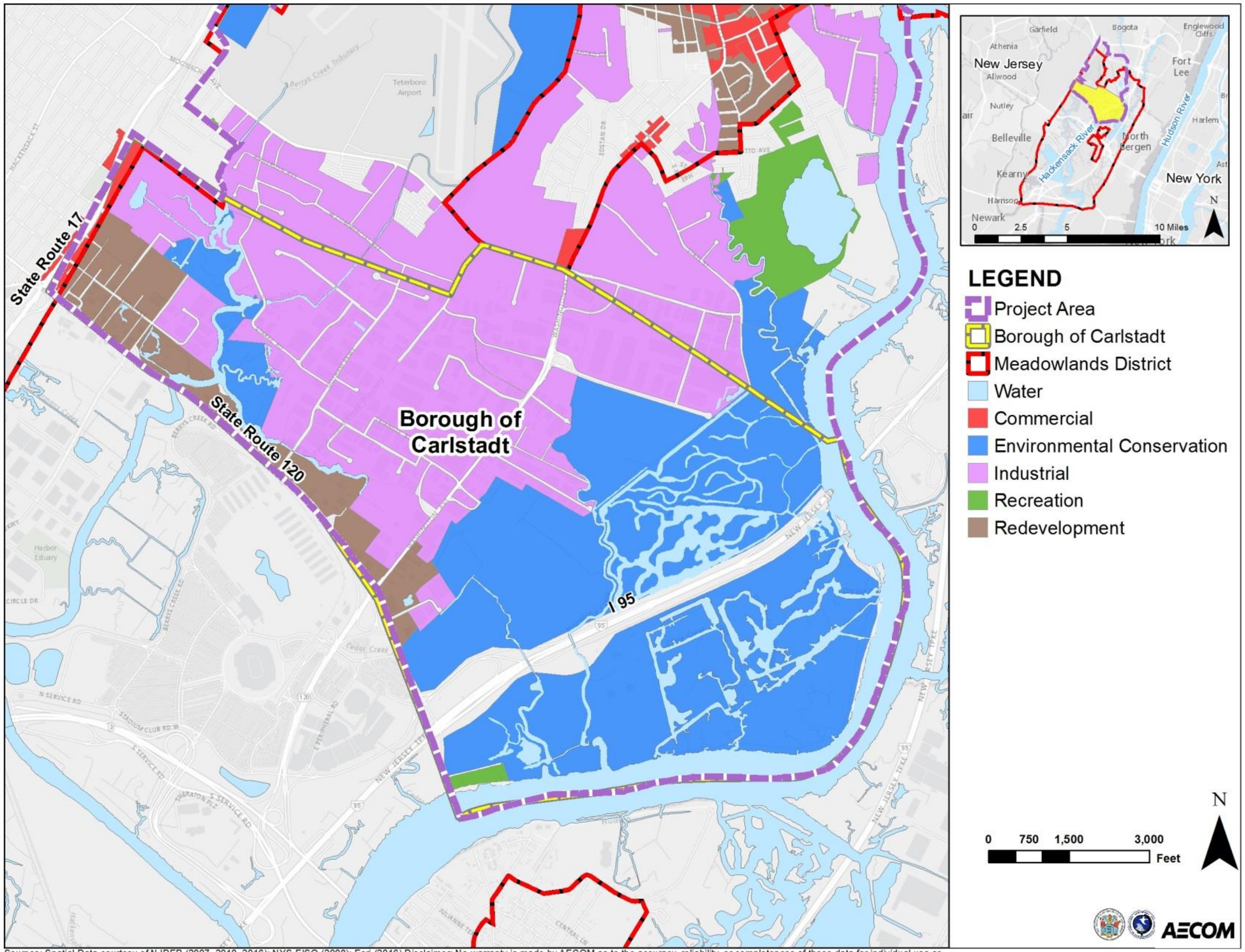


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Figure 3.2-7: Zoning Designations within the Borough of Carlstadt

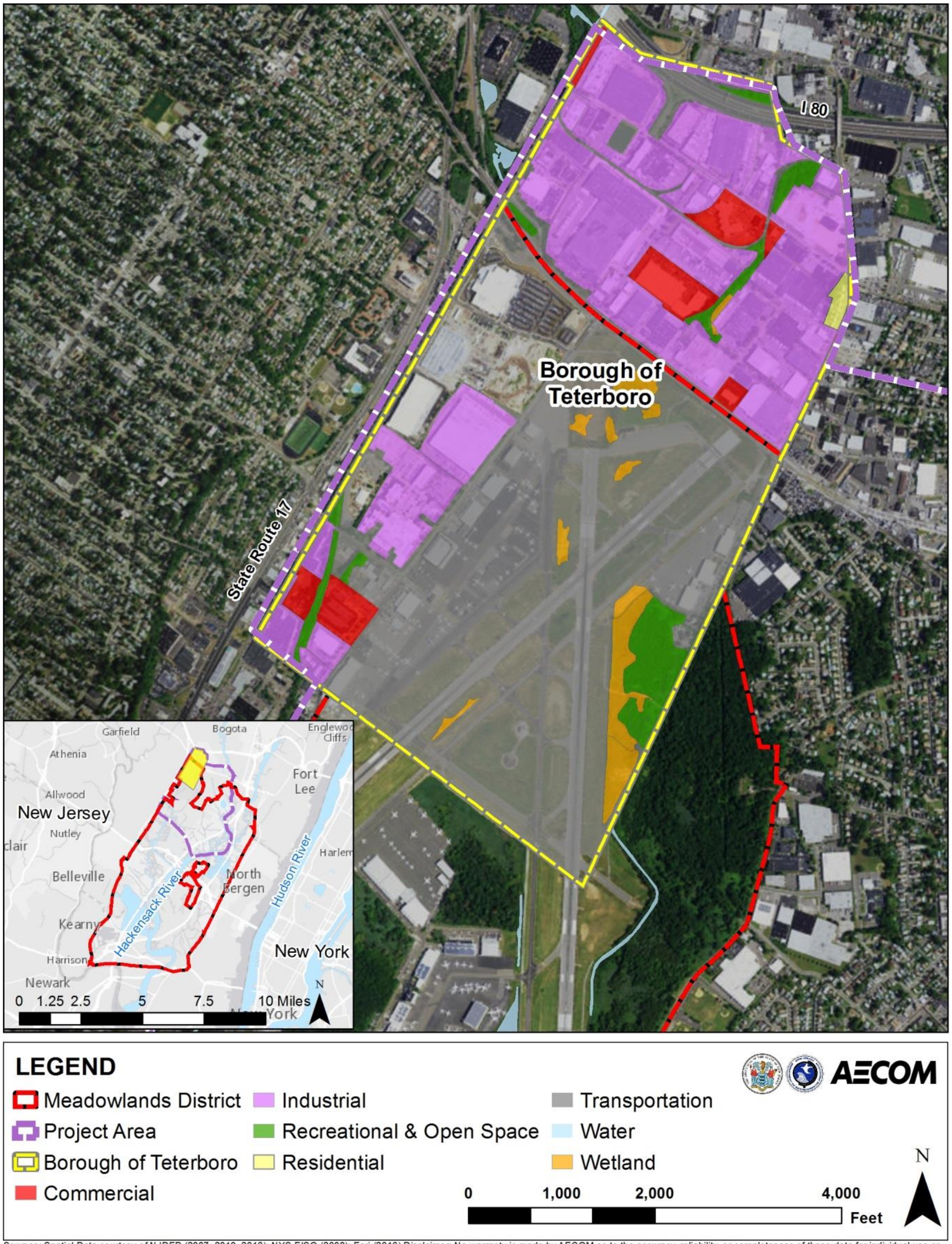

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Figure 3.2-8: Land Uses within the Borough of Teterboro

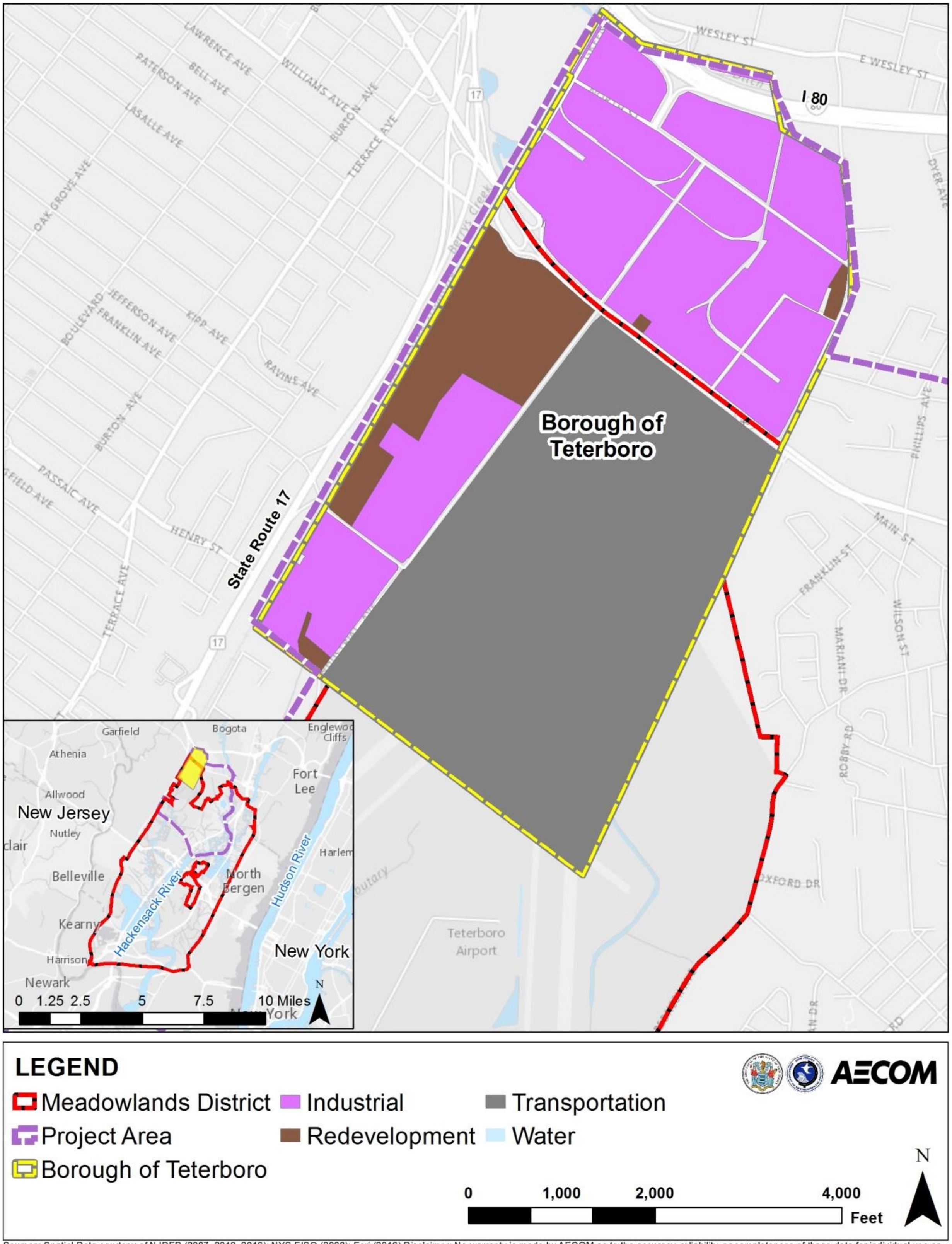

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Figure 3.2-9: Zoning Designations within the Borough of Teterboro

3.2.3.9 Township of South Hackensack

With an area of approximately 0.75 square mile, the Township of South Hackensack is the smallest jurisdiction within Bergen County. Two separate portions of the Township of South Hackensack, comprising 74 acres, are present within the Project Area: one is approximately between US Route 46 and East Grove Street (northern portion; not within the Meadowlands District) and one is bordered by the Hackensack River to the east (southern portion; within the Meadowlands District) (**Figure 3.2-10**). Overall, residential land uses comprise nearly half the total land area within these 74 acres. **Table 3.2-11** shows the percentage of each land use within the Township of South Hackensack in the Project Area.

Table 3.2-11: Percentage of Land Uses in the Township of South Hackensack

Land use	Percentage Within Township	Specific Uses Within Township	Present in Meadowlands District?
Residential	48%	Multiple-unit dwellings (high-density), single-unit dwellings (medium-density)	No
Industrial	23%	Industrial facilities and complexes	Yes
Water	15%	Tidal waters	Yes
Commercial	6%	Services, retail, hotels, other urban or built-up land	Yes
Wetlands	5%	Tidal wetlands, coastal wetlands, marshes, mud flats	Yes
Public/Quasi-Public	2%	Cemeteries	No
Transportation	1%	Roads	Yes
Recreation and Open Space	<1%	Fields	No

Mathematical inconsistencies due to rounding.

Commercial uses north of US Route 46 include hotels, retail stores, automobile service stations, car washes, and fast food restaurants. Residential areas are present in the vicinity of East Grove Street. Most of the parcels south of Empire Boulevard are industrial facilities, such as J. Josephson, Inc., a plastic manufacturing plant located at 35 Horizon Boulevard that is a critical facility in the Township of South Hackensack (Bergen County Office of Emergency Management 2015). Land uses between the Hackensack River and State Street in the Township are wetlands or water.

Zoning

The northern portion of the Township of South Hackensack is primarily zoned residential and commercial. The southern portion is primarily zoned industrial, environmental conservation, and water (**Figure 3.2-11**).

Table 3.2-12 lists the zoning designations in the Meadowlands District and, if applicable, any specific designations that are present under that type. Since one of the Township areas is located outside of the Meadowlands District, municipal zoning designations of approximate equivalence to the Meadowlands District zoning designations are also listed in **Table 3.2-12**.

Table 3.2-12: Zoning Designations in the Township of South Hackensack

Zoning Designation	Specific Zoning Designations Within Meadowlands District	Approximately Equivalent Municipal Zoning Designations Within Township[1]
Environmental Conservation	EC	N/A[2]
Industrial	LI-A	N/A[2]
Commercial	N/A[2]	Commercial Zone (B) (approximately equivalent to NC or CP)
Residential	N/A[2]	One- and Two-Family Residential (A) (approximately equivalent to LDR) and Senior Citizen Multi-Family Residential (SCR) (approximately equivalent to PR)
Mixed	N/A[2]	Mixed (M) (approximately equivalent to a mixture of Commercial, Industrial, and Residential zoning)

1. Source: Code of the Township of South Hackensack, Chapter 208: Zoning
2. N/A = Zoning designation is not present in the Meadowlands District or non-Meadowlands District portion of the Borough (whichever applicable).

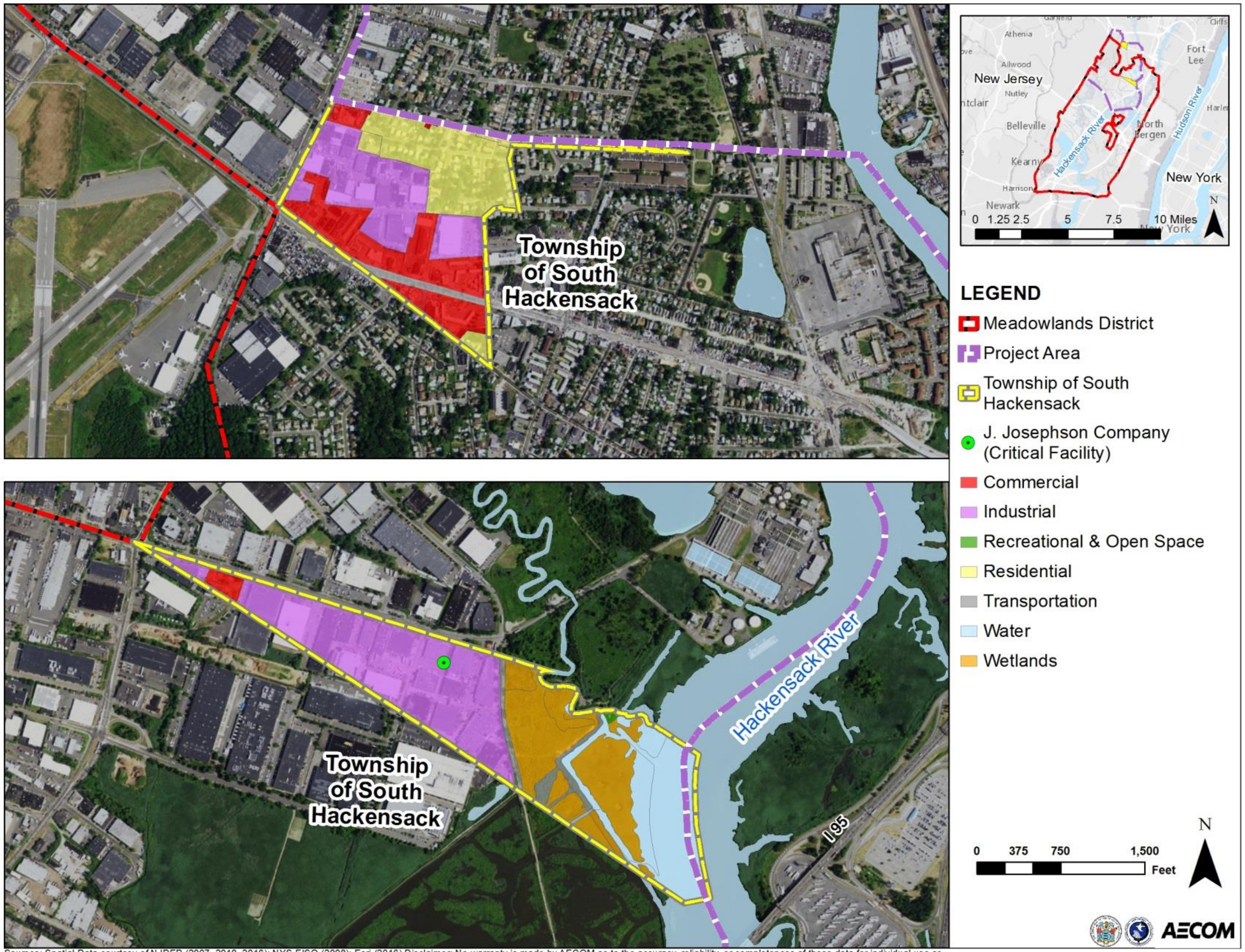

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Figure 3.2-10: Land Uses within the Township of South Hackensack

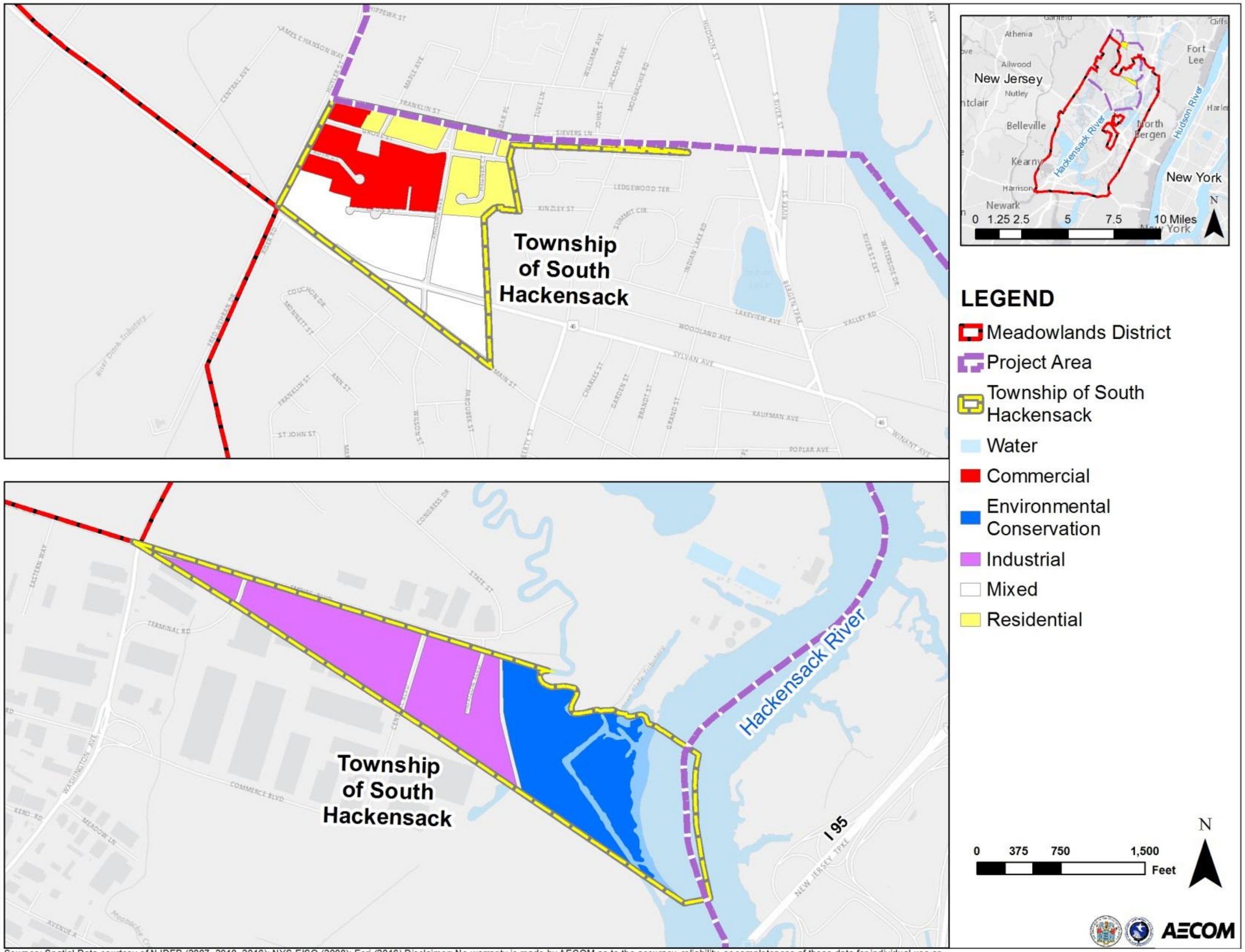

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Figure 3.2-11: Zoning Designations within the Township of South Hackensack

3.3 Visual Quality/Aesthetics

3.3.1 Introduction

This section identifies the existing visual quality, local aesthetics, and visual resources of the Project Area and its vicinity, providing a baseline for determining potential changes to those aesthetic conditions due to implementation of the Proposed Project. As such, this analysis evaluates the existing visual quality and character of the Project Area. Within **Section 4.3**, the data presented here are comparatively evaluated using a standardized evaluation methodology to establish the potential level of change to visual resources and ultimately the level of potential effect of the Proposed Project.

Visual and aesthetic resources influence the human experience of a landscape. Features such as mountain ranges, city skylines, ocean views, wetlands, rivers, and constructed landmarks (e.g., bridges, memorials, or statues) are considered visual and aesthetic resources. For some, cityscapes are valued visual resources; for others, views of natural areas are more valued. While many aspects of visual resources are subjective, assessing the existing aesthetics and visual quality of a landscape or Project Area provides a baseline for a meaningful effects analysis.

3.3.2 Regulatory Context

NEPA requires the consideration of visual resources when analyzing the potential effects of a Proposed Project. In response to NEPA, several Federal agencies have created guidelines for assessing visual resources specific to their projects; however, HUD has not created specific visual assessment guidelines. Therefore, in order to standardize the assessment of visual resources, the Federal Highway Administration (FHWA) guidelines were chosen as the basis for this analysis (FHWA 2015). The FHWA guidelines were used due to the linear nature of the Proposed Project elements.

In addition to Federal regulations, State and local regulations and guidelines related to visual resources may be relevant. There are over 200 comprehensive master plans prepared and adopted by counties, cities, municipalities, and towns in New Jersey, many of which include consideration of visual resources, scenic easements, and telecommunication regulations (Rutgers University Libraries 2013).

Table 3.3-1 outlines the State of New Jersey and local visual resource regulations and guidelines that are applicable to the Project Area. As a review of these data will show, most of these are general guidelines to ensure retention or enhancement of the general visual character of the area. More detailed information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

Table 3.3-1: State and Local Regulations and Guidelines Applicable to Visual Resources

Regulation/Guideline	Summary of Regulation/Guideline
The New Jersey State Development and Redevelopment Plan, Statewide Policy #19 (New Jersey State Planning Commission 2001)	Statewide Policy #19 addresses how design should factor into planning initiatives in the State of New Jersey, including creating "…spatially defined, visually appealing and functionally efficient places in ways that establish an identity…."
NJSEA (previously known as the NJMC) Master Plan, Chapter 4 §§ 19:4-1, 19:4-5, 19:4-8, and 19:4-10 (NJSEA 2004)	Chapter 4 of NJSEA's Master Plan outlines the zoning regulations of the Meadowlands District. One of the purposes of the zoning regulations is "to promote a desirable visual environment through building design and location." To promote this, specific regulations on visual resources include the following: • In the Waterfront Recreation zone, "uses shall be designed to focus on the river as a recreational and visual resource." • Outdoor storage and mechanical equipment should be located so as to minimize the visual impact within and outside a designated work site. • Visual impacts of a proposed billboard should be submitted to NJSEA by a State-licensed professional engineer. • Towers or poles should be installed in a way that minimizes any adverse visual impacts on a public right-of-way. • A brief description of the visual character of a project site and how a proposed project may impact that visual character should be submitted to NJSEA.
The Borough of Little Ferry 2003 Master Plan Reexamination Report (Borough of Little Ferry Planning Board 2003)	This Report encourages visual improvements through design, new signage, and landscaping at key places in the Borough, such as at US Route 46 entrances, Hackensack River waterfront areas, Willow Lake Park, Liberty Street, Main Street, and Washington Avenue.
The Borough of Little Ferry 2013 Reexamination Report of the Master Plan (Borough of Little Ferry Planning Board 2013)	This Report promotes future improvements to US Route 46 to make it more "visually attractive and create a pleasing gateway into the Borough." The Report also restates the 2003 recommendations of improving visual resources and connections between the Hackensack River waterfront areas, Willow Lake Park, Liberty Street, Main Street, and Washington Avenue.
Borough of Moonachie Zoning Regulations Article III § 3-20.7.4 (Borough of Moonachie Planning Board 1960)	Zoning regulations for the Borough of Moonachie mention that all playgrounds, parking lots, and service areas should be screened from the view of adjacent residential lots and streets, and should be landscaped in the character of the surrounding neighborhood.

Regulation/Guideline	Summary of Regulation/Guideline
NJSEA (previously known as the NJMC) Teterboro / Industrial Avenue Redevelopment Plan (NJSEA 2009)	This Plan outlines redevelopment specifications for an approximately 63.2-acre area in the Borough of Teterboro that includes such general guidelines as the following: • Encourage ornamental features (e.g., awnings, flagpoles, signage, etc.) to “enhance the visual environment.” • Provide landscaping to “promote a desirable visual environment…and to mitigate adverse visual impacts.” • Screen mechanical and electrical equipment from public view. • Plant trees to be generally uniform and allow for a “smooth visual transition” between trees of different species. • Design access drives to match the visual character of the area. • Screen the top floors of parking garages from the view of adjacent properties.
Township of South Hackensack 1979 Master Plan (Township of South Hackensack 1979) and **Township of South Hackensack 2001 Land Use Plan** (Township of South Hackensack 2001)	The 1979 Master Plan and the 2001 Land Use Plan state that the Township has an objective to “…promote a desirable visual environment through creative development techniques and good civic design arrangements.”

3.3.3 Existing Conditions

New Jersey is one of the most urbanized and populated states in the country, and Bergen County is the most densely populated county in the State (Bergen County Department of Planning and Economic Development 2004). Due to the presence of nearly 9,000 acres of cultural and recreational land featuring a nationally accredited zoo, five golf courses, 21 parks, two horseback riding areas, and environmental centers, Bergen County ranks high in quality of life indicators (Bergen County Economic Development Corporation 2016).

The portion of Bergen County in which the Project Area is located includes residential land, concentrated within the Borough of Little Ferry, as well as a mix of industrial, commercial, and other uses. Heavy industrial and commercial uses are generally located in the southwestern portion of the Project Area in the Borough of Carlstadt, with additional industrial areas dispersed throughout the Project Area. Wetland areas, including the Richard P. Kane Natural Areas and Wetland Mitigation Bank and the MRI Mitigation Bank, are primarily located in the southeastern portion of the Project Area in the Borough of Carlstadt, with additional wetlands and conservation areas scattered throughout all five Project Area municipalities.

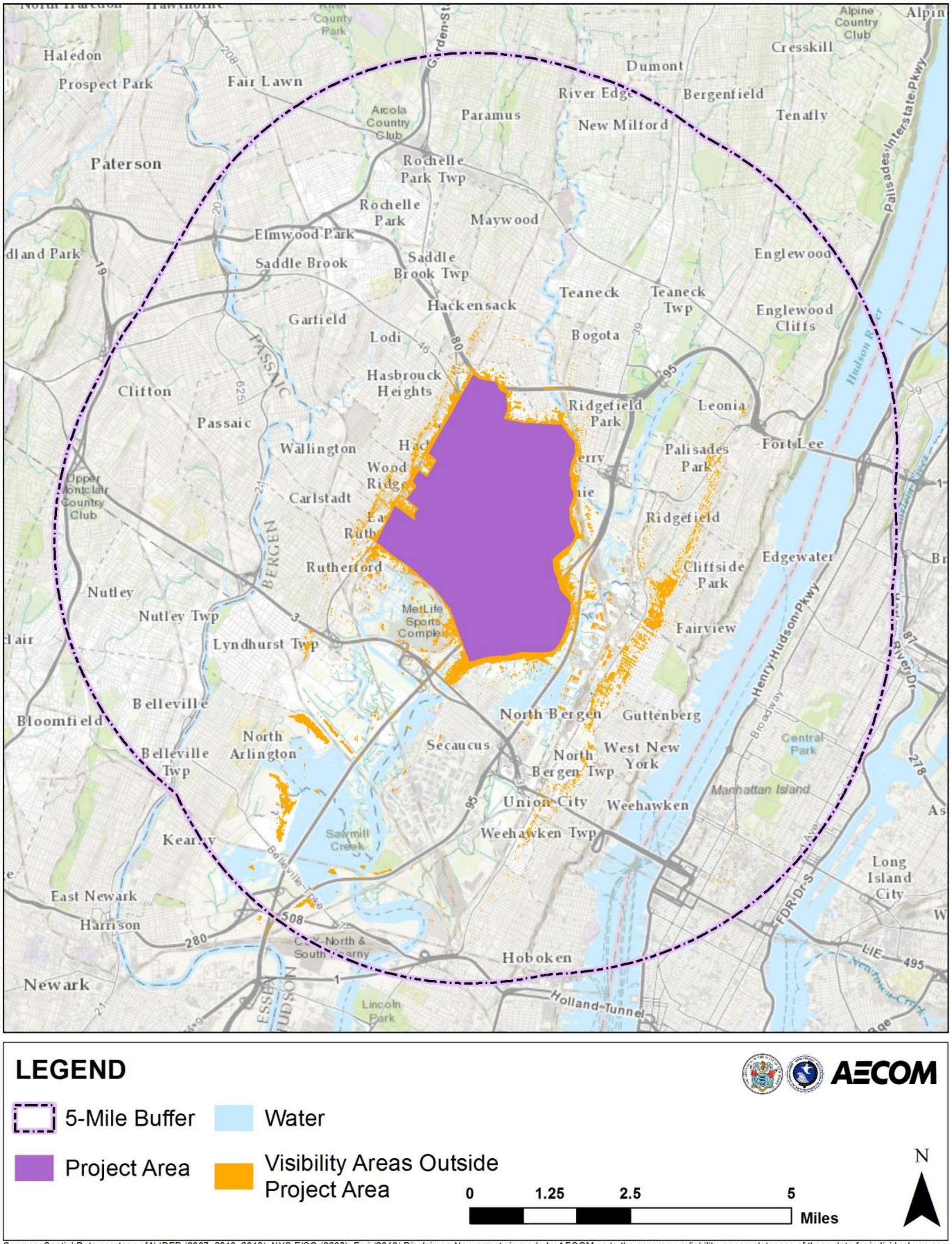
Primary roadways adjacent to and serving the Project Area include State Route 17 to the west, I-80 and US Route 46 to the north, State Route 120 (Paterson Plank Road) to the south, and Interstate 95 (I-95) to the east. The Project Area is bordered on the east by the Hackensack River. Adjacent to the Project Area are the MetLife Stadium, American Dream Mall, and IZOD Center along State Route 120 in the Borough of East Rutherford to the south. The larger regional context surrounding the Project Area consists of the major metropolitan area of Manhattan to the east across the Hackensack and Hudson Rivers.

3.3.3.1 Existing Visual Character

According to standard visual analysis methodologies (see **Section 3.3.2**) the description of visual character is based on defined attributes characterized as neither positive nor negative. Thus, a change in visual character cannot be described as being positive or negative until it is compared with the viewer response to that change.

To begin the assessment process, NJDEP established the Area of Visual Effect for the Proposed Project through the delineation of a project “viewshed.” A viewshed is the surface area visible from a specific location; in this case, that specific location is the Project Area. NJDEP initially considered a standardized Area of Visual Effect of 5 miles around the Project Area to assess existing visual character and the surrounding context (**Figure 3.3-1**). The Project Area is generally flat, so views from within the Project Area are limited to proximate features as well as more distant and higher features, such as the ridge along Hackensack Street to the west, I-95 and the upper floors of buildings of Manhattan to the east, and I-80 and US Route 46 to the north. From outside of the Project Area, views of the Project Area are limited to these higher structural or topographic positions.

Potential viewers outside of the Project Area with visibility of the Project Area were determined based on 5-meter Light Detection and Ranging (LiDAR) data. As illustrated in **Figure 3.3-1**, visibility of the Project Area extends to the ridge to the west, east to the western shore of the Hudson River, south into Hudson County, and along the edges of the Project Area boundary to the north. Viewers within the 5-mile viewshed have the potential to be affected by changes to visual quality and character within the Project Area.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.3-1: Visual Context within a 5-Mile Buffer

Within the Project Area, visual character varies somewhat by location, but generally is typical of an area with residential and industrial/commercial land uses, separated by local surface streets, recreational areas, and, in some cases, wetlands. Landscape units are a subset of the viewshed and are characterized as consistent patterns of visual elements within a landscape (**Figure 3.3-2**). The landscape units defined in this section are characterized by areas of similar geographic surroundings, such as those primarily composed of wetlands or residential development. Specific landscape units of the Project Area are further described in **Section 3.3.3.2**.

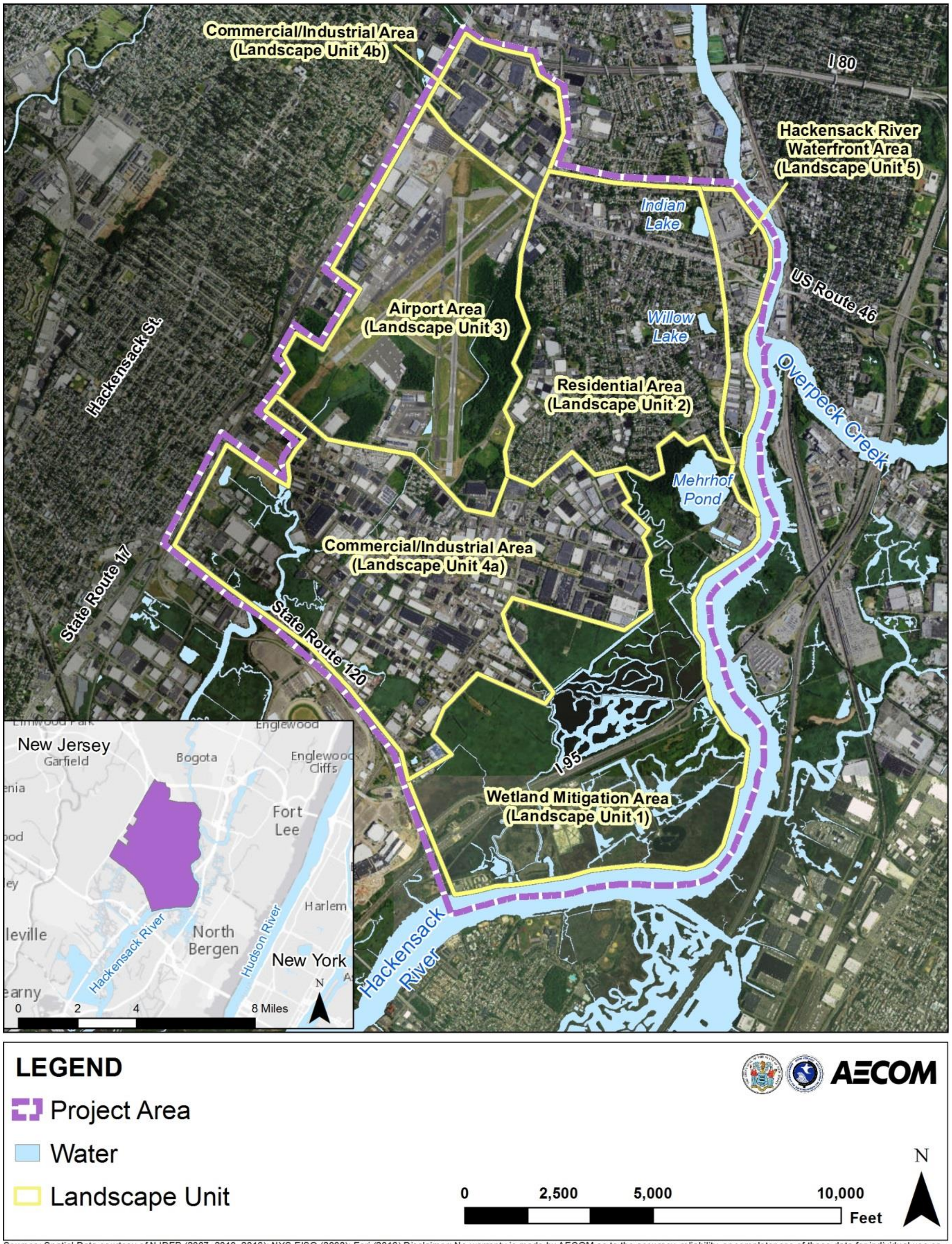
3.3.3.2 Existing Visual Quality

The level of existing visual quality is assessed by evaluating the natural harmony, cultural order, and project coherence of the visual conditions as presently experienced. Visual quality is defined as what viewers like and dislike about the visual character of the Area of Visual Effect. The FHWA guidelines recognize three types of visual perception that determine the visual quality of a scene (landscape unit) (FHWA 2015):

- When viewing the components of a scene's natural environment, viewers inherently evaluate the natural harmony of the existing scene, determining if the composition is harmonious or inharmonious.
- When viewing the components of the cultural environment, viewers evaluate the scene's cultural order, determining if the composition is orderly or disorderly.
- When viewing the project environment, viewers evaluate the coherence of the project components (i.e. the right-of-way), determining if the project's composition is coherent or incoherent.

Much like visual character, visual quality within the Project Area varies widely depending on viewer location. However, there are distinct landscape units within the Project Area where the natural harmony, cultural order, and project coherence of the visual conditions are similar. As such, the Project Area has been divided into five landscape units based on general land use, topography, and vegetation. These units are described below and shown in **Figure 3.3-2**.

- **Landscape Unit 1**, the *wetland mitigation area* in the southeastern portion of the Project Area, includes portions of Carlstadt, Little Ferry, Moonachie, and South Hackensack. This landscape unit consists of wetlands, including the Richard P. Kane Natural Areas and Wetland Mitigation Bank and the MRI Mitigation Bank. This area is adjacent to the Hackensack River and also includes Losen Slote Creek Park, Mehrhof Park, and Mehrhof Pond.
- **Landscape Unit 2**, the *residential area* in the northeastern portion of the Project Area, encompasses portions of the Township of South Hackensack and the Borough of Little Ferry. This unit is comprised primarily of residential development, but also includes recreation-based land uses such as baseball and soccer fields at Indian and Willow Lake Parks and the athletic fields at Washington and Memorial Schools.
- **Landscape Unit 3**, the *airport area* in the northwestern portion of the Project Area, includes the Borough of Teterboro and the northern portion of the Borough of Moonachie. Teterboro Airport encompasses the majority of land in this landscape unit. The Aviation Hall of Fame Museum and the newly developed Teterboro Landing are within the borders of this landscape unit.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.3-2: Landscape Units within the Project Area

- **Landscape Unit 4a/b**, the *commercial/industrial area* in the southwestern portion of the Project Area, and the northern portion of Teterboro, includes Berry's Creek and other tributaries of the Hackensack River. Lands within this landscape unit are dominated by commercial facilities fragmented by natural elements and surface streets. The unit is bordered by State Route 17, State Route 120, and I-80.
- **Landscape Unit 5**, the *Hackensack River waterfront area* along the eastern border of the Project Area, extends the length of Little Ferry. The Hackensack River waterfront comprises the majority of this landscape unit, and includes a variety of additional land use types including commercial storage facilities and residential buildings. Public access to the waterfront is limited and many of the recreational areas in this landscape unit are in need of repair.

3.3.3.3 Viewer Sensitivity

The quality of a visual landscape is largely determined by the extent of the public's interest in and concern for a particular view. For purposes of evaluating the potential level of public interest and concern, *viewer sensitivity* is composed of two elements: *viewer awareness* and *viewer exposure*. These elements combine to form a method of predicting how the public reacts to the visual landscape:

- **Viewer awareness** is a measure of attention, focus, and protection. Viewers for whom a view is routine or lacks focus, making details less noticeable, would be less aware of changes to the view. The protection provided by rules governing a view, either legal or social, also set an expectation for the viewer experience.
- **Viewer exposure** is typically assessed by measuring the number of viewers exposed to the view (extant), duration of the view, and proximity of the viewer. Visual elements are considered higher or lower in importance based on their position relative to the viewer, and the distance from visual elements plays an important role in determining the level of overall exposure. Generally, the closer a resource is to the viewer, the more dominant, and therefore more visually important, it is to the viewer.

3.3.3.4 Viewer Groups

Viewers, or the population affected by the Proposed Project, are separated into two distinct groups: neighbors and travelers. Neighbors are those individuals who are adjacent to the roadway with "views of the road." Travelers are those using the roadway with "views from the road." NJDEP considered four general viewer groups for the evaluation of viewer sensitivity:

- Residential or recreational neighbors, including pedestrians
- Industrial or commercial neighbors
- Commuting travelers
- Shipping travelers
- Pedestrian travelers

Residential and recreational neighbors, including pedestrians on the sidewalks immediately adjacent to and within the Project Area, have direct foreground views of the Project Area. Viewer sensitivity within this group is generally characterized by a long duration of viewer exposure to portions of the Project Area.

Industrial or commercial neighbors would have extended durations of exposure, although this group would typically be less aware of the visual landscape. Commuting and shipping travelers, both within and adjacent to the Project Area, would typically have a routine awareness of visual resources within the Project Area, but their exposure is of short duration and consistent with the expectations of the Project Area. These viewers represent the largest population of affected viewers.

3.3.3.5 Landscape Units

Visual quality/character and the associated viewer exposure and response for each landscape unit are described below. The individual elements of visual quality are combined to describe the landscape composition and natural harmony for each landscape unit.

Landscape Unit 1 – Wetland Mitigation Area

Existing Visual Quality/Character

This landscape unit is representative of the visual setting (**Figure 3.3-3**) experienced by pedestrian viewers, water viewers along the Hackensack River, and vehicular viewers traveling along roads within and adjacent to the southeastern edges of the Project Area. Visual character is defined primarily by wetlands, the Hackensack River, Losen Slote Creek Park, and Mehrhof Pond. Visible in the foreground are existing site features including the Robert Ceberio Environmental Education Pavilion, boat ramps and docks, and storage facilities, surrounded by an abundance of non-native vegetation and trees of various age and type. Views of the Williams Transco liquid natural gas (LNG) storage facility, the Hackensack River, the I-95 overpass, and Manhattan are visible in the middle ground and background views. An existing berm is present along Transco Road, and can be seen in middle ground views by vehicular viewers from elevated roads adjacent to the Project Area and water viewers. However, views are generally short in duration and dominated by wetland views. Views of this berm within the landscape unit are limited to authorized personnel. The foreground and middle ground views are dominated by wetlands within the Project Area, with glimpses of Manhattan in the background view, as well as the American Dream Mall, MetLife Stadium, and IZOD Center in East Rutherford. Wetlands and natural areas appear to be interconnected, creating a connected visual experience. Combined these natural and cultural elements possess a largely consistent natural harmony and cultural order.

Viewer Sensitivity

Viewer exposure at this location is characterized by pedestrian and water viewers visiting the conservation or recreational areas would experience long duration, unobstructed views of the changes to visual quality within Landscape Unit 1; however, a large portion of the wetland mitigation areas have restricted access. Additionally, vehicular viewers would experience short duration views while moving quickly past the Project Area along I-95, State Route 120, and the Hackensack River.

Existing Character: This view of the Project Area wetlands in Landscape Unit 1 represents a typical view of the Project Area from I-95. Middle and foreground views are dominated by the saturated wetland, while views into the background consist of nondescript buildings.

Existing Character: This view faces northeast from River Barge Park and represents a typical view of Landscape Unit 1. The Hackensack River and surrounding wetlands are visible in the foreground, with middle ground views dominated by the Williams Transco pipeline tanks. Background views are encompassed by nondescript buildings.

Existing Character: This view faces east within River Barge Park. Foreground and middle ground views consist of the Robert Ceberio Environmental Education Pavilion and trees of various size and type. No background views are visible from this point.

Existing Character: This view faces northeast from River Barge Park and represents a typical view of the Hackensack River along the southern portion of Landscape Unit 1. Middle and foreground views are filled with a view of the Hackensack River, outlined by the city skyline in the background.

Existing Character: This view along Mehrhof Road represents a typical view along Mehrhof Pond in Landscape Unit 1. Foreground views are dominated by a chain-link fence (that restricts public access) and vegetation. Middle and background views of Mehrhof Pond are generally blocked by vegetation.

Existing Character. This view from Transco Road (no public access) represents a typical view within the wetland mitigation areas in Landscape Unit 1. Foreground and middle ground views are dominated by the saturated wetlands. Background views consist of MetLife Stadium and the American Dream Mall.

Figure 3.3-3: Surrounding Visual Character of Landscape Unit 1

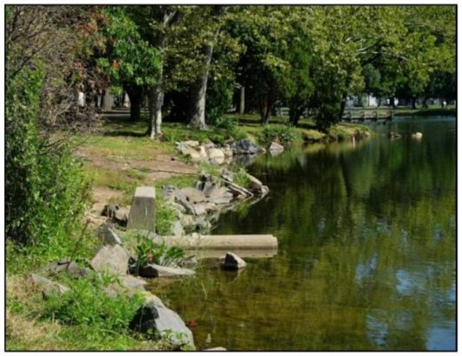
Landscape Unit 2 – Residential Area

Existing Visual Quality/Character

This landscape unit is representative of the visual setting (**Figure 3.3-4**) experienced by pedestrian viewers, and vehicular viewers traveling within and along elevated roads adjacent to the northeastern Project Area boundary. Visual character is defined primarily by residential development throughout the Borough of Little Ferry, as well as smaller recreational uses. Visible in the foreground are the lakeside parks of Indian and Willow Lakes, and one to three story buildings that include residences of similar architectural design, fire and rescue facilities, municipal buildings, and public facilities. Within the center of this landscape unit along Main Street, views are cluttered with utility lines and poles lining the sidewalks, although their presence decreases when moving further into the residential areas. Repetitive visual patterns emerge with only a slight break in these views near Indian and Willow Lake Parks. Adjacent parcels are utilized in varying and inconsistent ways, causing a divided visual experience. Foreground views are cluttered by buildings on small parcels, utility lines, signs, and parked cars in the commercial positions of the landscape unit, but less so in the residential portions. Combined, these elements result in inconsistent natural harmony and cultural order.

Viewer Sensitivity

Pedestrian and vehicular viewers experience primarily foreground views in this landscape unit and would have a high awareness of visual resources within the Project Area. Further, because it is anticipated that vehicular and pedestrian viewers are largely composed of local residents, interest and concern related to visual quality/character and overall *viewer sensitivity* is anticipated to be high. Travelers would generally have short durations of exposure. While pedestrian viewers experience a longer duration in exposure, their views are generally restricted to the immediate foreground view.



Existing Character: This view of Indian Lake Park illustrates a typical view of the Indian Lake shoreline in Landscape Unit 2. Foreground views are dominated by natural vegetation, which block all middle ground and background views. A paved walking path encircles the lake behind the abundant trees.

Existing Character: This view of Indian Lake Park represents a typical view from Lakeview Avenue in Landscape Unit 2. Foreground and middle ground views consist of the lake while indistinguishable buildings are visible in the background.

Existing Character: This view faces east along Main Street in Little Ferry and represents a typical view along the commercial portion of Main Street in Landscape Unit 2. Views are dominated by overhanging utility lines, utility poles, and cars lining the length of the street, and one to three story buildings of various shapes and forms. Middle ground and background views are blocked by the foreground features.

Existing Character: This view along Main Street represents a typical view of Willow Lake Park in Landscape Unit 2. Foreground and middle ground views include park amenities (ball fields, playground), while background views are dominated by vegetation.

Existing Character: This view faces east along Main Street and represents a typical view of the residential portion of Main Street in Landscape Unit 2. The foreground views are less cluttered by utility lines and poles than in the commercial area. Views are dominated by one to three story houses situated close to the roadway. No background views are visible from this point.

Existing Character. This view along Main Street illustrates the typical visual character of the Project Area in Landscape Unit 2. Sidewalks are lined with trees and utility lines. One to three story houses and commercial buildings are visible.

Figure 3.3-4: Surrounding Visual Character of Landscape Unit 2

Landscape Unit 3 – Airport Area

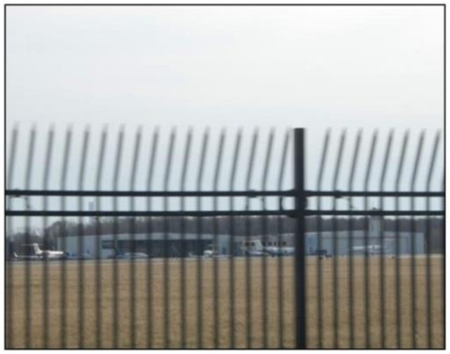
Existing Visual Quality/Character

This landscape unit is representative of the visual setting (**Figure 3.3-5**) experienced by vehicular viewers traveling along roads adjacent to the Project Area and Teterboro Airport, and pedestrians within Teterboro Landing and the ballfields of Redneck Avenue Park. Visual character is defined by the runways, hangars, terminals, and parked and overhead aircraft at Teterboro Airport, including (and largely obstructed by) walls around the airport facility and the shopping and dining facilities in Teterboro Landing. Views of existing site features are only partially obstructed by existing trees within Teterboro Woods along Redneck Avenue. Teterboro Landing, with its internal parking and consolidated signage, enhances the visual diversity of the area, and increases the overall visual quality of this landscape unit. Aside from large aircrafts, the visual setting is largely absent of memorable vistas or features, but Teterboro Woods and Teterboro Landing contribute distinctive visual elements to the area. The existing airport comprises the majority of the landscape; airport related elements, such as runways, terminals, and commercial buildings, share different vertical scales and geometric organizations. Combined, these features result in inconsistent natural harmony and cultural order.

Viewer Sensitivity

Pedestrian viewers are limited to Teterboro Landing and Redneck Avenue Park; thus travelers are the primary viewer group in this landscape unit.

Because vehicular viewers would be composed of both local residents and travelers utilizing Teterboro Airport, concern for changes to visual quality/character and overall *viewer sensitivity* is anticipated to be low to moderate. *Viewer exposure* would be low as viewers along State Route 17, US Route 46, and I-80 experience only short duration, unobstructed foreground views of Landscape Unit 3. Viewer exposure within the Project Area would vary depending on the duration of their exposure to unobstructed foreground and middle ground views.



Existing Character: This view from US Route 46 illustrates the existing visual character of the Project Area in Landscape Unit 3. The Teterboro Airport Hangars dominate background views and are protected by foreground views of black fencing.

Existing Character: This represents a typical view of the noise barrier along Moonachie Ave in Landscape Unit 3. Foreground views are dominated by utility lines and poles, the noise barrier, and fence line. Middle ground and background views of the Teterboro Airport are blocked by these foreground features.

Existing Character: This represents a typical view of Teterboro Airport from US Route 46 along the northern boundary of Landscape Unit 3. Foreground views into the airport are minimally obstructed by fencing, while middle and background views consist of parked aircraft and airport facilities.

Existing Character: This view from the intersection of US Route 46 and Industrial Avenue faces Teterboro Landing, which is located in the northeast portion of Landscape Unit 3. Views are dominated by big-box facilities of national brands. Internal parking and signage creates a less crowded view from surrounding streets.

Existing Character: This view represents a typical view from Redneck Avenue Park in Landscape Unit 3. Foreground views consist solely of grassy fields and park facilities. Middle ground views include a fence lines (including the chain link fence surrounding Teterboro Airport) and utility lines. The natural vegetation (Teterboro Woods) blocks any background views into the airport.

Existing Character: This view from Industrial Avenue faces Teterboro Airport and represents a typical view of Teterboro Woods in Landscape Unit 3. Foreground views are dominated by the chain link fence surrounding the airport and heavy tree growth. The abundance of trees blocks any middle and background views into the airport.

Figure 3.3-5: Surrounding Visual Character of Landscape Unit 3

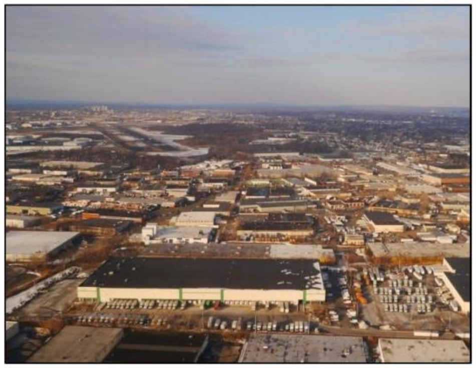
Landscape Unit 4a/b – Commercial/Industrial Area

Existing Visual Quality/Character

This landscape unit is representative of the visual setting (**Figure 3.3-6** and **Figure 3.3-7**) experienced by vehicular viewers traveling within the far northwestern and southwestern portions of the Project Area and along State Route 17, State Route 120, and I-80. Visual character is defined by a wide area comprised primarily of commercial and industrial land uses. The majority of the views in this landscape unit are consistent with large windowless buildings of minimally articulated architecture. Many of these buildings are also elevated above street elevations to prevent flooding. Within this landscape unit, densely packed mobile home parks are located along Moonachie Road, creating crowded views intensified by the low hanging utility lines and an inefficient use of street signage. This landscape unit also includes natural landscape features, including Berry's Creek, East and West Riser Ditch, and other tributaries of the Hackensack River. The existing landscape of commercial and industrial buildings is broken up slightly by smaller areas of recreational and open space. The existing visual setting is largely absent of memorable vistas or features. The existing industrial and commercial buildings tend to vary in size, age, and organization with little visual continuity. Landscape elements tend to be cluttered and crowded due to low hanging utility lines, large signs, parked vehicles on roadways and building exteriors, inward facing buildings, and large trucks on roadways, resulting in a disorderly and inharmonious landscape.

Viewer Sensitivity

This landscape unit has a lack of scenic quality and is viewed primarily by travelers (with pedestrian viewers utilizing the commercial and industrial properties as a secondary viewer group). Viewers' experiences are generally short in duration and of primarily foreground views.



Existing Character: This aerial view faces north towards Teterboro Airport and illustrates the typical visual setting of the Project Area in Landscape Unit 4. Views are dominated by the presence of commercial buildings of various shapes and forms.

Existing Character: This aerial view faces west above the Borough of Carlstadt and illustrates the typical visual setting of the Project Area in Landscape Unit 4. Views are dominated by the presence of commercial buildings bordering the wetlands in Landscape Unit 1.

Existing Character: This view represents a typical view along Washington Avenue within Landscape Unit 4. Views are dominated and cluttered by four lanes of traffic with multiple vehicles and delivery trucks , a concrete median, low hanging utility lines, and large signs and billboards.

Existing Character: This represents a typical view from Commercial Avenue in Landscape Unit 4. Views consist of inward facing one to three story buildings of various shapes and forms, cluttered by overhanging utility lines and cars parked along both the road and buildings.

Existing Character: This view from Veteran's Boulevard faces east and toward Landscape Unit 1. This view represents a rare view within Landscape Unit 4 of the nearby wetlands and city skyline. Typical views do not often offer middle ground or background views.

Existing Character: This view along Veteran's Boulevard provides an example of the flood protection measures (berm and wall) currently constructed around some of the businesses within Landscape Unit 4. All middle and background views are blocked by commercial facilities.

Figure 3.3-6: Surrounding Visual Character of Landscape Unit 4a/b

Existing Character: This view represents a typical view along Moonachie Road near the mobile home parks within Landscape Unit 4. Views are dominated by low hanging utility lines, densely packed mobile homes, and large buildings in the distance.

Existing Character: This view represents a typical view within the mobile home park along Moonachie Road in Landscape Unit 4. Densely packed mobile homes, utility lines, and parked cars restrict middle ground and background views.

Existing Character: This view along Paterson Plank Road (State Route 120) illustrates the typical visual setting in the southern most portion of Landscape Unit 4. Views are crowded with utility lines and antenna rays.

Existing Character: This view along Paterson Plank Road (State Route 120) illustrates the typical visual setting in the southern portion of Landscape Unit 4. Views are dominated by utility lines and antenna rays, creating a crowded and distracted view for vehicular viewers.

Existing Character: This view from Commercial Avenue represents a rare view within Landscape Unit 4 of the adjacent wetlands. Foreground and middle ground views are dominated by Berry's Creek and an abundance of non-native vegetation. Background views of elevated commercial and business facilities are barely discernible.

Existing Character: This view from Commercial Avenue represents a typical view of West Riser Ditch in Landscape Unit 4, which consists of a very narrow riparian buffer. Middle ground views through the trees are comprised of commercial buildings, blocking all background views.

Figure 3.3-7: Surrounding Visual Character of Landscape Unit 4a/b

Landscape Unit 5 – Hackensack River Waterfront Area

Existing Visual Quality/Character

This landscape unit is representative of the visual setting experienced by pedestrian viewers, water viewers, and vehicular viewers along the Hackensack River waterfront in the far northeastern portion of the Project Area (**Figure 3.3-8**). Visual character is defined by residential and recreational properties, as well as abandoned facilities along the shoreline in the Borough of Little Ferry. The existing landscape of the Hackensack River waterfront is fragmented by these land use types, with minimal direct access from the Project Area to the waterfront by the general public. Views into this landscape unit from the surrounding streets consist of commercial and storage facilities immediately adjacent to the river; however, middle ground views of power plant towers and background views of the city skyline may distract viewers from the Project Area. The existing visual setting has few memorable vistas and features, with potentially distinct views blocked by power plant towers and piles of commercial supplies. The existing properties and land uses along the Hackensack River waterfront have minimal organization and visual continuity. Landscape elements are comprised of different scales, forms, and materials, creating a lack of natural harmony and cultural order.

Viewer Sensitivity

Although viewers are likely to be composed largely of local residents, *viewer sensitivity* is anticipated to be low due to the overall low scenic quality of this landscape unit. Viewers' experiences are generally short in duration and of primarily foreground views. Further, based on field reconnaissance, vehicular and pedestrian traffic is generally minimal in this portion of the Project Area.

Existing Character: This view faces southwest along US Route 46 and provides a typical view of the Project Area in Landscape Unit 5 from US Route 46. Foreground views are dominated by the Hackensack River and commercial and storage facilities immediately along the shoreline. In the background, K Town is visible amidst an abundance of trees.

Existing Character: This view faces west from Bergen Turnpike (where it dead ends at the Hackensack River), and represents a typical view of the Project Area in Landscape Unit 5. The overall view is crowded with low hanging utility lines and poles, parked cars, and buildings set close to the roadway.

Existing Character: This view faces southeast from Bergen Turnpike (where it dead ends at the Hackensack River) and represents a rare view of the Hackensack River from Landscape Unit 5. Foreground views are dominated by the Hackensack River with visible background views of the city skyline. Middle ground views of power plant towers and other commercial facilities and materials dominate the overall view.

Existing Character: This view from Riverside Avenue represents a rare view of the Hackensack River from Landscape Unit 5. Foreground views consist of the river, dock poles, and wildlife. Middle ground and background views are dominated by industrial activities and major roadways.

Existing Character: This view from Riverside Avenue represents a typical view of the residential areas in Landscape Unit 5. Middle ground and background views are completely blocked by the waterfront properties in the foreground. Tree presence is sparse.

Existing Character: This view from River Street Extension represents a typical view within the Waterside Village properties in Landscape Unit 5.

Figure 3.3-8: Surrounding Visual Character of Landscape Unit 5

3.4 Socioeconomics, Community/Populations, and Housing

3.4.1 Introduction

Socioeconomics is defined as the basic attributes and resources associated with the human environment, particularly population and economic activity. Human population is affected by regional birth and death rates, as well as net migration. Economic activity typically comprises employment, personal income, and industrial growth. Impacts on these two fundamental socioeconomic indicators can also influence other components such as housing availability and public services provision.

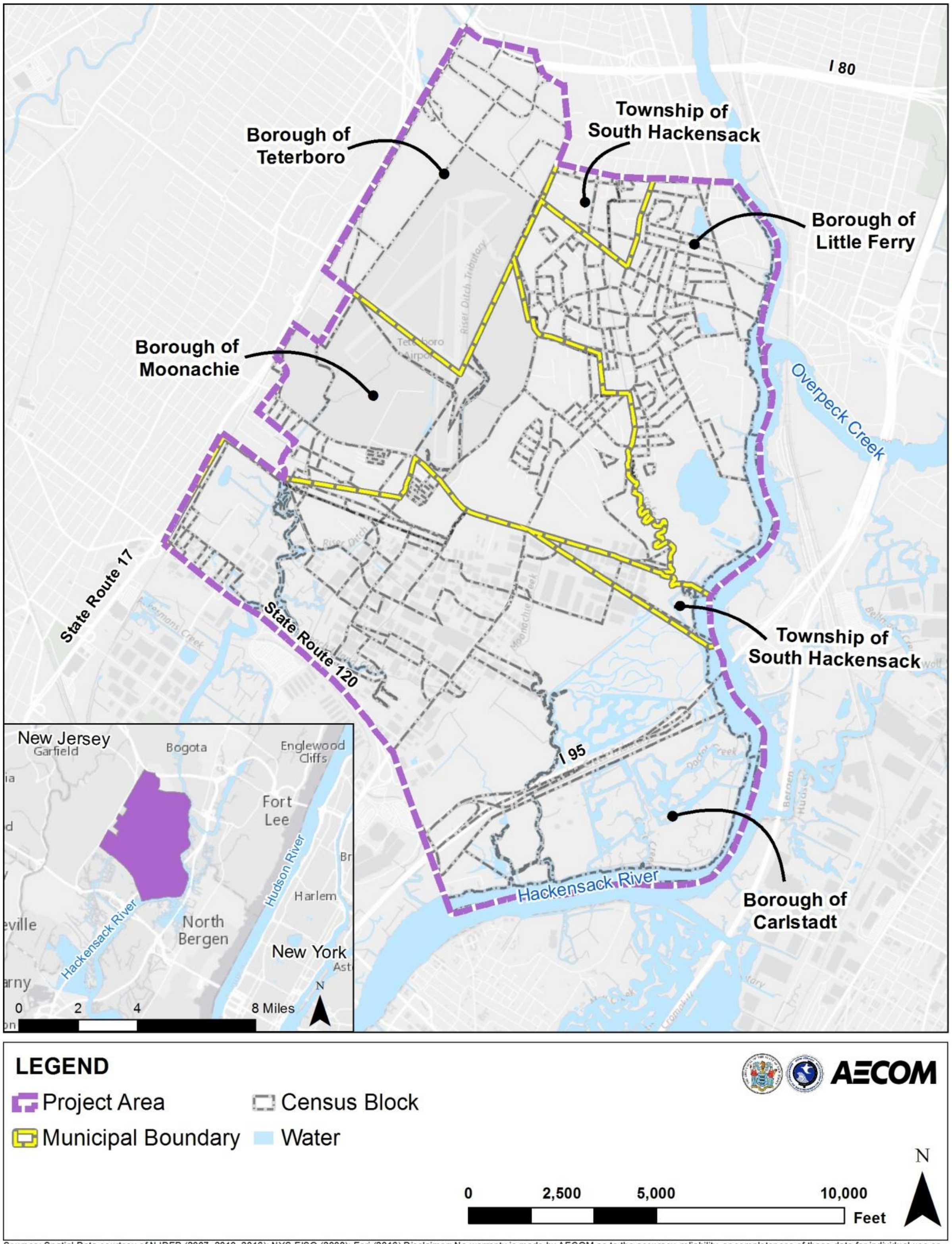
This section identifies and describes the socioeconomic environment surrounding the Project Area. The demographic and economic characteristics and trends are presented at an individual municipal level and compared to Bergen County as well as the State of New Jersey. Economic conditions are described by using the available statistics for income and poverty, labor force and industry, housing, and journey-to-work. Demographic conditions are described based on available statistics for population, age, and race or ethnicity. It should be noted that the US Census Bureau recognizes two ethnicities when collecting demographic data: (1) Hispanic or Latino and (2) Non-Hispanic or Latino (US Census Bureau 2013). The numbers and percentages of Hispanic or Latino persons described below comprise any persons who identify themselves as a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish origin, regardless of race (e.g., Hispanic White persons, Hispanic Black persons, etc.).

Baseline socioeconomics data were compiled from the US Census Bureau using the 2010 to 2014 American Community Survey dataset (US Census Bureau 2014). The American Community Survey data are collected from sample populations every year to allow for up-to-date statistics for use by Federal, State, and local entities. The 2010 to 2014 five-year estimates represent data collected from different population subgroups over a period of time, most recently in 2014. The following resources also provided baseline socioeconomic information: *Bergen County At A Glance* (Bergen County Department of Planning and Engineering 2016); *Vision Bergen: The Visioning Component of the Bergen County Master Plan* (Bergen County Planning Board 2011b); the NJSEA Master Plan (NJSEA 2004); the official website of Bergen County (Bergen County 2016a); as well as the New Jersey State Data Center (Department of Labor and Workforce Development 2016). For this analysis, the study area is defined as the Project Area. **Figure 3.4-1** and **Figure 3.4-2** show the census blocks and census tracts that make up the Project Area, respectively.

3.4.2 Regulatory Context

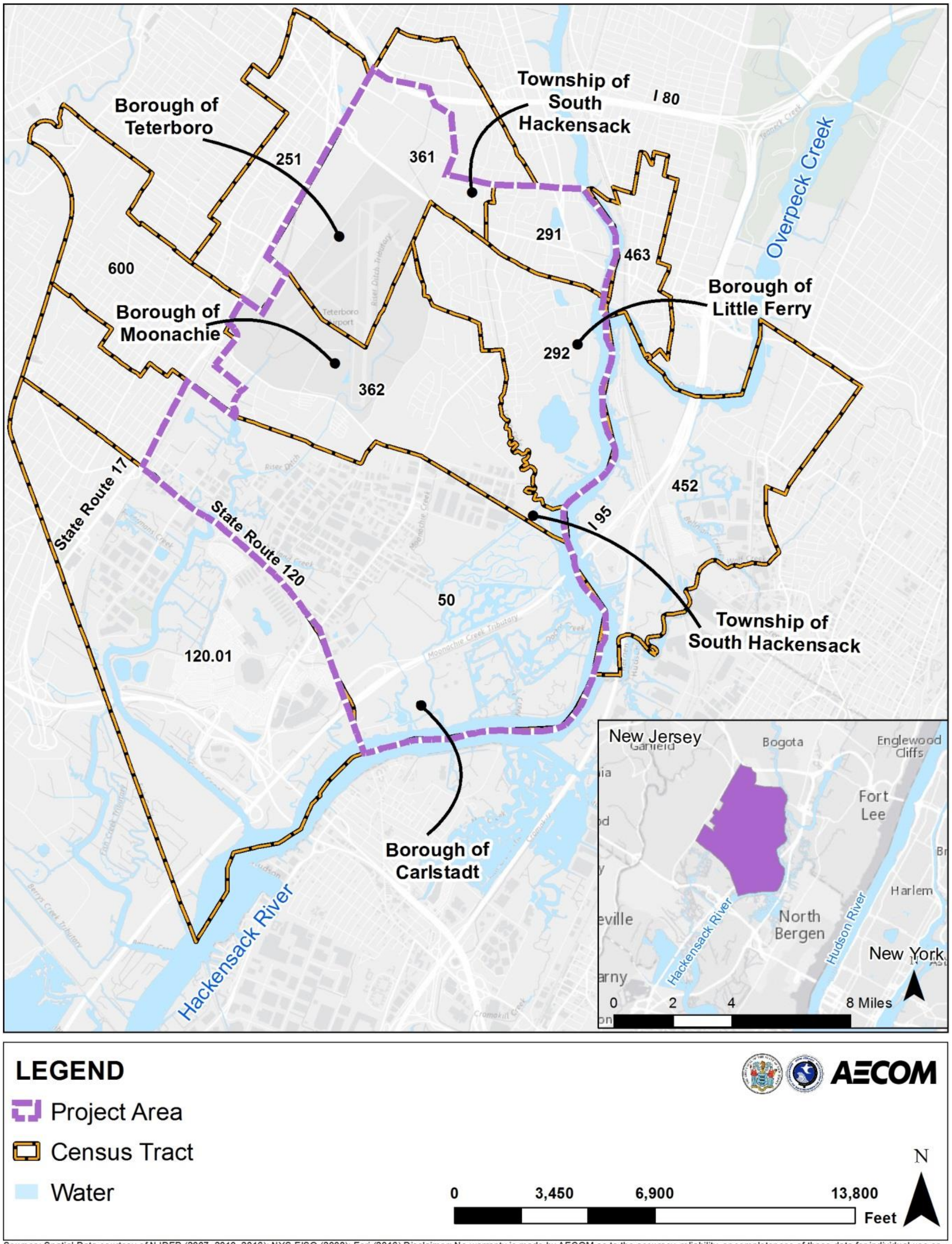
NEPA requires consideration of socioeconomics in NEPA analysis. Specifically, Section 102(A) of NEPA requires Federal agencies to “insure the integrated use of the natural and social sciences…in planning and in decision making” (42 USC § 4332(A)).

Furthermore, HUD set forth additional requirements for CDBG-DR grantees in 2014 that require RBD projects to “examine potential displacement of residents, businesses, and other entities due to potentially increasing costs of rent and property ownership in the years following the completion of the RBD Project (e.g., gentrification) and to consider mitigation for the impacts of such displacement” (VI.2.b; p.62186). More detailed information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.4-1: Census Blocks within the Project Area



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.4-2: Census Tracts within the Project Area

3.4.3 Existing Conditions

The following sections include detailed descriptions, in text and tables, of various socioeconomic indicators for the Project Area at municipal, county, and State levels. The socioeconomic indicators presented include demographics (race and ethnicity), age, income and poverty status, labor force and industry, housing, and journey-to-work information.

3.4.3.1 Demographics

In 1990, a total of 7,730,188 people lived in the State of New Jersey, of which 825,380 people lived in Bergen County (Department of Labor and Workforce Development 2016). Between 1990 and 2014, the population of New Jersey increased by approximately 15 percent (1,144,186 residents), and the population of Bergen County increased by approximately 12 percent (95,076 residents). **Table 3.4-1** shows the overall demographic trends from 1990 to 2014 at the municipal, county, and State levels.

In 2014, populations ranged between 10,773 and 56 individuals within the five municipalities as follows (from most to least): Borough of Little Ferry (10,773), Borough of Carlstadt (6,189), Borough of Moonachie (2,741), Township of South Hackensack (2,652), and Borough of Teterboro (56). The Boroughs of Carlstadt and Little Ferry and the Township of South Hackensack all exhibited moderate population growth (8 to 26 percent), compared to the Borough of Teterboro, which grew by 155 percent. In contrast, the Borough of Moonachie had 3 percent fewer residents in 2014 than in 1990 (Department of Labor and Workforce Development 2016, US Census Bureau 2014).

Table 3.4-1: Demographic Trends from 1990 to 2014

Area	1990 Population	2014 Population	Percent Change (%)
New Jersey	7,730,188	8,874,374	15
Bergen County	825,380	920,456	12
Borough of Carlstadt	5,570	6,189	11
Borough of Little Ferry	9,989	10,773	8
Borough of Moonachie	2,817	2,741	-3
Borough of Teterboro	22	56	155
Township of South Hackensack*	2,106	2,652	26

*Includes all three entities of the Township of South Hackensack
Source: (Department of Labor and Workforce Development 2016, US Census Bureau 2014)

The percent of the total population by race or ethnicity at the municipality, county, and State levels are presented in **Table 3.4-2** and **Table 3.4-3**. Whites composed the greatest percentage of the total population within the State of New Jersey, Bergen County, and the five municipalities within the Project Area, ranging from 89 percent in the Borough of Teterboro to 59 percent in the Borough of Little Ferry. With the exception of the Borough of Little Ferry (59 percent), White populations were higher in the municipalities in comparison to Bergen County (71 percent) and the State of New Jersey (69 percent).

Table 3.4-2: Distribution of Population by Race at the State, County, and Municipal Level in 2014

Race	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
White Alone	68.7%	71.2%	79.4%	58.5%	84.0%	89.3%	68.7%
Black or African American Alone	13.5%	5.7%	0.4%	4.1%	0.7%	0.0%	6.9%
American Indian and Alaska Native Alone	0.2%	0.2%	0.4%	0.9%	0.0%	0.0%	0.0%
Asian Alone	8.8%	15.2%	10.7%	29.3%	7.9%	0.0%	4.0%
Native Hawaiian and Other Pacific Islander Alone	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Some other race Alone	6.3%	5.5%	7.5%	4.9%	5.8%	5.4%	15.2%
Two or more races	2.5%	2.2%	1.6%	2.2%	1.6%	5.4%	5.2%
Total Population Count	**8,874,374**	**920,456**	**6,189**	**10,773**	**2,741**	**56**	**2,652**

Values are percentages and for the entirety of each borough
*Includes all three entities of the Township of South Hackensack
Source: (US Census Bureau 2014)

Table 3.4-3: Distribution of Population by Ethnicity at the State, County, and Municipal Level in 2014

Ethnicity	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
Hispanic or Latino^	18.6%	17.4%	23.0%	22.3%	27.0%	39.3%	34.2%
Non-Hispanic or Latino	81.4%	82.6%	77.0%	77.7%	73.0%	60.7%	65.8%
Total Population Count	**8,874,374**	**920,456**	**6,189**	**10,773**	**2,741**	**56**	**2,652**

Values are percentages and for the entirety of each borough
*Includes all three entities of the Township of South Hackensack
^Hispanic or Latino of any race, including Hispanic White, Hispanic Black, etc.
Source: (US Census Bureau 2014)

In each municipality except the Borough of Teterboro, Asians are the second largest race. For example, in the Borough of Little Ferry, Asians comprised 29 percent of the total population in 2014, compared to just 15 percent of the population in Bergen County. In contrast, the Borough of Teterboro had no reported Asian population in 2014. Blacks or African Americans were the third largest race in the Project Area. In the Township of South Hackensack, Blacks or African Americans made up 7 percent of the total population in 2014, which was the largest proportion of this demographic in the Project Area. The Boroughs of Carlstadt and Moonachie had Black or African American populations of less than 1 percent, and the Borough of Teterboro had no reported Black or African American population in 2014 (US Census Bureau 2014).

The population of the Hispanic or Latino ethnicity in New Jersey and Bergen County was 19 and 17 percent in 2014, respectively. All of the Project Area municipalities had Hispanic and Latino populations greater than both the State of New Jersey and Bergen County, ranging from 39 percent in the Borough of Teterboro to 22 percent in the Borough of Little Ferry (US Census Bureau 2014).

3.4.3.2 Age Characteristics

As indicated in **Table 3.4-4**, the State of New Jersey, Bergen County, and the five municipalities in the Project Area all exhibited relatively comparable group cohort patterns in 2014. Approximately 45 percent of the total population within the Project Area municipalities was in the 35 to 64 years age group. The Borough of Teterboro and the Township of South Hackensack had 4 and 8 percent of their populations within the 15 to 24 years age group respectively, which was lower compared to the remainder of the Project Area municipalities and Bergen County (US Census Bureau 2014).

Table 3.4-4: Distribution of Population by Age at the State, County, and Municipal Level in 2014

Age (in years)	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
Less than 5 years	6.0%	5.4%	2.9%	5.8%	4.9%	8.9%	5.3%
5 to 14 years	12.9%	13.0%	11.8%	9.5%	10.1%	8.9%	11.0%
15 to 24 years	12.9%	11.9%	15.3%	12.6%	9.6%	3.6%	8.2%
25 to 34 years	12.8%	11.7%	16.5%	12.7%	10.7%	16.1%	19.8%
35 to 64 years	41.4%	42.9%	40.6%	47.6%	47.5%	48.2%	40.6%
65 years and older	14.0%	15.5%	13.0%	11.8%	17.1%	14.3%	15.1%
Total Population Count	**8,874,374**	**920,456**	**6,189**	**10,773**	**2,741**	**56**	**2,652**

*Includes all three entities of the Township of South Hackensack
Percent totals are greater or less than 100% due to rounding
Source: (US Census Bureau 2014)

In 2014, the population of children less than 5 years in the State of New Jersey and Bergen County were 6 and 5 percent, respectively. The highest percentage of children less than 5 years in age in the Project Area occurred in the Borough of Teterboro (9 percent) and was lowest in the Borough of Carlstadt (3 percent) (US Census Bureau 2014).

The population of seniors (individuals 65 years and older) in Bergen County and the State of New Jersey were 16 and 14 percent, respectively. Within the Project Area, only the Borough of Moonachie had a population of seniors greater than Bergen County at 17 percent. With the exception of the Borough of Moonachie, the population of seniors in the Project Area ranged from 12 percent in the Borough of Little Ferry to 15 percent in the Township of South Hackensack (US Census Bureau 2014).

3.4.3.3 Protection of Children

Because children may suffer disproportionately from environmental health risks and safety risks, EO 13045 (*Protection of Children from Environmental Health Risks and Safety Risks*) was issued with the intent to prioritize identification and assessment of environmental health risks and safety risks that may affect children and to ensure Federal agencies' policies, programs, activities, and standards address environmental and safety risks to children.

As shown in **Table 3.4-5**, the percentage of the population under age 18 was approximately 23 percent and 22 percent in the State of New Jersey and Bergen County, respectively. In general, the percentage of the population under 18 is lower in the Project Area than in the State and County as a whole, with percentages ranging from 17.6 percent in the Borough of Teterboro to 20.6 percent in the Township of South Hackensack (US Census Bureau 2014). Therefore, there is potential for children to be present in the Project Area.

Table 3.4-5: Total Population Versus Population Under Age 18 in 2014

	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
Total Population	8,874,374	920,456	6,189	10,773	2,741	56	2,652
Population Under 18	2,036,084	203,322	1,152	2,131	489	10	545
% Population Under 18	22.9%	22.1%	18.6%	19.8%	17.8%	17.6%	20.6%

*Includes all three entities of the Township of South Hackensack
Source: (US Census Bureau 2014)

3.4.3.4 Income and Poverty

According to the 2010 to 2014 American Community Survey data presented in **Table 3.4-6**, the median household income in the State of New Jersey ($72,062) was lower than Bergen County ($83,686). Median household incomes of municipalities in the Project Area were all lower than Bergen County with values ranging from $71,847 in the Borough of Carlstadt to $53,125 in the Borough of Teterboro. Per capita income exhibited similar patterns as illustrated for median household income. Per capita income was $36,359 in New Jersey and $43,194 in Bergen County; it ranged from $33,534 in the Borough of Carlstadt to $30,617 in the Township of South Hackensack (US Census Bureau 2014).

Table 3.4-6: Income and Poverty at the State, County, and Municipal Level in 2014

Income and Poverty	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
Median household income in the last 12 months (in 2014, Inflation-adjusted)	$72,062	$83,686	$71,847	$63,810	$63,438	$53,125	$66,042
Per capita income	$36,359	$43,194	$33,534	$33,286	$30,837	$31,621	$30,617
Percent below poverty level	10.7%	7.5%	6.8%	8.0%	6.6%	16.1%	8.2%

*Includes all three entities of the Township of South Hackensack
Source: (US Census Bureau 2014)

The percentage of persons living below the poverty level was 11 percent in the State of New Jersey and 8 percent in Bergen County in 2014. The majority of the municipalities in the Project Area had similar poverty levels as compared to Bergen County, except for the Borough of Teterboro, where 16 percent of the population was living below the poverty level.

HUD defines gentrification as “the process by which a neighborhood occupied by lower-income households undergoes revitalization or reinvestment through the arrival of upper-income households” (HUD 1979). When determining whether the process of gentrification has occurred within a study area, the surrounding region is typically used for comparison purposes. The county levels are generally used to establish a threshold for this comparison (USEPA 2016n). For this analysis, the study area is defined as the five census tracts that comprise the Project Area (**Figure 3.4-2**), and Bergen County data are used to establish the surrounding region’s threshold. Baseline socioeconomic data for this section were compiled from the US Census Bureau using the 2006 to 2010 and the 2010 to 2014 American Community Survey datasets (US Census Bureau 2010a, US Census Bureau 2014).

To assess whether the process of gentrification has the potential to occur or is occurring within the Project Area, a similar methodology to that described in *Displacement or Succession? Residential Mobility in Gentrifying Neighborhoods* (Freeman 2005) and in *Gentrification in America Report* (Maciag 2015) was applied. This methodology is two-fold: determining if a census tract is eligible to gentrify, and determining if gentrification is occurring. Each of the five census tracts within the Project Area was evaluated to determine their eligibility to gentrify. A census tract is eligible to gentrify if it meets the following criteria: (1) the census tract has a population of at least 500 residents, (2) the census tract’s median household income is in the bottom 40th percentile when compared to all tracts within Bergen County, and (3) the census tract’s median home value is in the bottom 40th percentile when compared to all tracts within Bergen County. For those census tracts identified as eligible to gentrify (i.e., meeting all three criteria listed above), additional criteria are considered to determine if gentrification was occurring. A census tract is determined to have gentrified over a period of time if it meets the following criteria: (1) an increase in a census tract’s educational attainment (as measured by the percentage of residents age 25 and over holding bachelor's degrees) is in the top 33rd percentile of all tracts within Bergen County[21], (2) a census tract's median home value increased when adjusted for inflation, and (3) the percentage increase in a census tract's inflation-adjusted median home value is in the top 33rd percentile of all census tracts within Bergen County.

Based on 2006 to 2010 and 2010 to 2014 American Community Survey data (US Census Bureau 2010a, US Census Bureau 2014), all five census tracts in the Project Area have a population of at least 500 residents, which meets the first criteria. The bottom 40th percentile of median household incomes for all census tracts in Bergen County was $74,777 in 2014. All five census tracts in the Project Area had median household income values below this value in 2014 and, therefore, meet the second criteria for eligibility. The bottom 40th percentile of the median home value of all census tracts in Bergen County was $380,500 in 2014. Median home values in 2014 for census tracts 50 and 361 were $383,100 and $408,800, respectively (US Census Bureau 2014). Therefore, census tracts 50 and 361 were deemed ineligible to gentrify. However, median home values in census tracts 291, 292, and 362 were below $380,500 in 2014. Therefore, these census tracts were determined to be eligible to gentrify and were carried forward for additional analysis.

Based on 2006 to 2010 and 2010 to 2014 American Community Survey data, census tracts 291 and 362 did not experience in increase in educational attainment; therefore, they are not experiencing gentrification. Census tract 292 did show an increase in educational attainment. This increase was from 16.1 percent in 2010 to 18.1 percent attainment in 2014 (US Census Bureau 2010a, US Census Bureau 2014). However, the top 33rd percentile for increased educational attainment for all tracts within Bergen County was 33.8 percent. Therefore, the increase was not large enough to meet the gentrification criteria. In summary, while census tracts 291, 292, and 362 were determined to be eligible to gentrify, no census tracts in the Project Area are currently experiencing gentrification.

3.4.3.5 Labor Force Characteristics of Residents within the Project Area

As indicated in **Table 3.4-7**, over half of the population of New Jersey, Bergen County, and the five municipalities in the Project Area were both in the labor force and employed in 2014. The total labor force population includes individuals 16 years and over. The unemployment rate in Bergen County was 5 percent in 2014. The Borough of Little Ferry and the Township of South Hackensack had unemployment levels similar to Bergen County at 5 percent, while the remaining Boroughs had higher unemployment rates, ranging from 7 percent (Boroughs of Carlstadt and Moonachie) to 9 percent (Borough of Teterboro) (US Census Bureau 2014).

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[21] While some research examining gentrification has focused on changes in household income as opposed to changes in educational attainment, "income fluctuates throughout time, whereas among young adults educational attainment levels are relatively stable" (Freeman 2005). Further, "a measure of gentrification relying on income might overlook neighborhoods experiencing an influx of highly educated but poorly paid professionals, whereas a measure based on education would be less likely to miss this type of change" (Freeman 2005). It is for these reasons that educational attainment as opposed to household income was used in determining whether gentrification has occurred in the Project Area.

Table 3.4-7: Labor Status at the State, County, and Municipal Level in 2014

Labor Category	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
In Labor Force	66.3%	65.6%	68.1%	71.1%	63.2%	69.6%	67.2%
Employed	59.8%	60.8%	61.5%	66.3%	56.1%	60.9%	62.5%
Unemployed	6.4%	4.8%	6.6%	4.8%	7.0%	8.7%	4.7%
Total Population Count (population 16 years of age and older)	**7,080,181**	**741,961**	**5,253**	**9,022**	**2,313**	**46**	**2,189**

*Includes all three entities of the Township of South Hackensack
Percent totals are greater or less than 100% due to rounding
Source: (US Census Bureau 2014)

In the State of New Jersey, 60 percent of the total labor force population (16 years of age and over) was employed in 2014, compared to 61 percent in Bergen County. Specifically, employment by industry sector was examined to characterize the employment profile of the residents within the Project Area and surrounding region. As presented in **Table 3.4-8**, the educational services, health care, and social assistance sector employed the largest percentage of the workforce across all areas, according to 2010 to 2014 American Community Survey data. Employment in this sector ranged from 27 percent in the Township of South Hackensack to 18 percent in the Borough of Carlstadt. In the Borough of Teterboro, the percentage of those employed in the educational services sector was 21 percent, identical to that of those employed in the public administration sector (21 percent). Also in the Borough of Teterboro, manufacturing, transportation/warehousing/utilities, and finance (including insurance, real estate, rental, and leasing), had identical employment rates of 4 percent. Employment by industry sector was lowest in the agriculture (including forestry, fishing, hunting, and mining) and information sectors (US Census Bureau 2014).

Table 3.4-8: Summary of Employment by Industry at the State, County, and Municipal Level in 2014

Industry	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
Agriculture, forestry, fishing and hunting, and mining	0.3%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Const-ruction	5.6%	5.2%	3.6%	6.0%	5.1%	0.0%	7.7%
Manufac-turing	8.7%	8.7%	13.3%	9.3%	11.8%	3.6%	15.0%

Industry	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
Wholesale Trade	3.4%	4.5%	2.6%	7.3%	4.3%	0.0%	1.9%
Retail Trade	11.2%	10.9%	12.1%	13.5%	9.6%	17.9%	14.8%
Transportation, warehouse-ing, and utilities	5.7%	4.8%	10.3%	6.1%	10.2%	3.6%	5.3%
Information	2.9%	3.4%	1.7%	3.2%	2.7%	0.0%	1.7%
Finance and insurance, real estate, and rental and leasing	8.6%	9.3%	9.5%	5.6%	4.8%	3.6%	2.8%
Professional and scientific management and administrative and waste management services	12.8%	13.7%	11.7%	10.8%	16.3%	0.0%	11.0%
Educational services, health care, and social assistance	23.7%	24.0%	17.8%	21.9%	20.4%	21.4%	26.7%
Arts, entertainment, and recreation, and accommodation and food services	8.3%	7.4%	9.7%	7.2%	8.7%	10.7%	5.6%
Other, except public administration	4.5%	4.8%	3.6%	7.6%	3.9%	17.9%	2.1%

Industry	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
Public administra-tion	4.4%	3.1%	4.2%	1.4%	2.1%	21.4%	5.3%
Total Population Count (civilian employed population 16 years and over)	**4,235,089**	**451,145**	**3,229**	**5,983**	**1,298**	**28**	**1,369**

*Includes all three entities of the Township of South Hackensack
Percent totals are greater or less than 100% due to rounding
Source: (US Census Bureau 2014)

3.4.3.6 Employment and Business Characteristics within the Project Area

This section includes information on the major industries and businesses within the Project Area, including the number of individuals employed (regardless of their place of residence), the type of services provided, the number and size of businesses, and their estimated sales values. Employment and business data for the Project Area were obtained from GIS Planning's ZoomProspector Enterprise web-based tool. This application maintains comprehensive demographic, industry, and geographic data for various cities, communities, and regions (GIS Planning 2017). GIS Planning obtains its data from several vendors, including, but not limited to, InfoGroup and Applied Geographic Solutions.

In 2016, a total of 20,133 individuals were employed by businesses within the Project Area. The number of employees within the five municipalities from highest to lowest was as follows: Borough of Moonachie (6,527 employees), Borough of Teterboro (5,169 employees), Borough of Little Ferry (3,999 employees), Borough of Carlstadt (3,668 employees), and Township of South Hackensack (770 employees) (GIS Planning 2017).[22]

Information on the number of individuals employed by businesses within the Project Area and Bergen County by major industry type in 2016 is presented in **Table 3.4-9**. Of the major industry types, services[23] (23.7 percent), retail trade (22.1 percent), and manufacturing (18 percent) businesses employed the largest percentage of individuals in the Project Area, ranging from a total of 62.5 percent in the Borough of Teterboro to 70.6 percent in the Township of South Hackensack. In Bergen County, the top three industry types are the same; they employ approximately 73.6 percent of individuals employed by businesses in the

[22] This web-based tool allowed for data to be obtained at the Project Area level. Values for the Borough of Carlstadt and Township of South Hackensack represent the values within the Project Area and not the municipalities as a whole.

[23] The Services industry, denoted by Standard Industrial Classification codes 70-89, includes hotels, rooming houses, camps, and other lodging places; personal services; business services; automotive repair services and parking; miscellaneous repair services; motion pictures; amusement and recreation services; health services; legal services; educational services; social services; museums, art galleries, and botanical and zoological gardens; membership organizations; engineering, accounting, research, management, and related services; private households; and miscellaneous services.

county. However, the distribution of these jobs is different in comparison to the Project Area, with more individuals employed in the service industry and fewer employed in the manufacturing industry (GIS Planning 2017).

Information on the total number of business establishments by size within the Project Area and Bergen County is presented in **Table 3.4-10**. Approximately 1,510 business establishments had employees in the Project Area in 2016, with one-third of them occurring in the Borough of Little Ferry. Of these business establishments, 84.7 percent of them employed fewer than 20 employees within the Project Area. Further, only 5 business establishments in the Project Area employed more than 250 individuals. Similarly, approximately 91.3 percent of the 52,777 business establishments in Bergen County employed fewer than 20 individuals and only 0.3 percent employed more than 250 individuals (GIS Planning 2017).

Table 3.4-9: Summary of Major Industries within the Project Area and Bergen County in 2016

	Bergen County		Borough of Carlstadt		Borough of Little Ferry		Borough of Moonachie		Borough of Teterboro		Township of South Hackensack*	
Industry	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Agricultural, Forestry, Fishing	4,454	0.8%	13	0.4%	21	0.5%	15	0.2%	11	0.2%	13	1.7%
Mining	105	0.0%	6	0.2%	0	0.0%	6	0.1%	0	0.0%	0	0.0%
Construction	18,787	3.4%	124	3.4%	150	3.8%	202	3.1%	134	2.6%	21	2.7%
Manufacturing	46,240	8.7%	669	18.2%	617	15.4%	1,256	19.2%	1,008	19.5%	79	10.3%
Transportation and Communications	22,804	4.3%	525	14.3%	295	7.4%	659	10.1%	510	9.9%	41	5.3%
Wholesale Trade	31,577	5.9%	579	15.8%	342	8.6%	1,097	16.8%	1,083	21.0%	18	2.3%
Retail Trade	124,587	23.4%	810	22.1%	935	23.4%	1,458	22.3%	1,043	20.2%	198	25.7%
Finance, Insurance, and Real Estate	37,749	7.1%	34	0.9%	222	5.6%	74	1.1%	107	2.1%	57	7.4%
Services	220,817	41.5%	845	23.0%	953	23.8%	1,528	23.4%	1,178	22.8%	266	34.6%
Public Administration	19,850	3.7%	37	1.0%	407	10.1%	123	1.9%	64	1.2%	70	9.1%
Unclassified	4,884	0.9%	26	0.7%	57	1.4%	109	1.7%	30	0.6%	7	0.9%
Total Employees	**531,854**		**3,668**		**3,999**		**6,527**		**5,169**		**770**	

Source: (GIS Planning 2017)
*The values provided for the Township of South Hackensack are for the northern portion between the Boroughs of Teterboro and Little Ferry. No employee data output was generated for the southern portion of the Township within the Project by the GIS Planning application.

Table 3.4-10: Summary of Total Business Establishments by Size in 2016

	Bergen County		Borough of Carlstadt		Borough of Little Ferry		Borough of Moonachie		Borough of Teterboro		Township of South Hackensack*	
Size	**Total**	**Percent**	**Total**	**Percent**	**Total**	**Percent**	**Total**	**Percent**	**Total**	**Percent**	**Total**	**Percent**
1-4 employees	34,223	64.8%	68	31.9%	340	66.9%	140	36.2%	126	39.6%	56	66.7%
5-9 employees	9,380	17.8%	69	32.4%	90	17.7%	101	26.1%	84	26.4%	12	14.3%
10-19 employees	4,615	8.7%	29	13.6%	40	7.9%	60	15.5%	56	17.6%	9	10.7%
20-49 employees	2,866	5.4%	27	12.7%	23	4.5%	46	11.9%	31	9.8%	3	3.6%
50-99 employees	971	1.8%	11	5.2%	8	1.6%	26	6.7%	10	3.1%	3	3.6%
100-249 employees	542	1.0%	8	3.8%	7	1.4%	12	3.1%	9	2.8%	1	1.2%
250+ employees	180	0.4%	1	0.5%	0	0.0%	1	0.3%	3	0.9%	0	0.0%
Total Establishments	**52,777**		**213**		**508**		**387**		**318**		**84**	

Source: (GIS Planning 2017)

* The values provided for the Township of South Hackensack are for the northern portion between the Boroughs of Teterboro and Little Ferry. No employee data output was generated for the southern portion of the Township within the Project by the GIS Planning application.

Information on the top three employers within the Project Area by total number of employees is presented in **Table 3.4-11**. Symrise Inc., a wholesaler company in the Borough of Teterboro, employed approximately 500 employees in 2016, and represents the largest employer in the Project Area. The second largest employer, a wholesaler company named General Trading Co, employed approximately 350 employees in the Borough of Carlstadt in 2016. The three businesses in the Borough of Carlstadt with the most employees represent the 2nd, 4th, and 5th largest businesses by number of employees in the Project Area. The 3rd largest business, a transportation and warehousing company named Jet Aviation Holdings USA Inc. with 300 employees is located in the Borough of Moonachie (GIS Planning 2017).

Total estimated sales for all businesses within the Project Area were approximately $4.2 billion in 2016. Sales by municipality in 2016 from highest to lowest were as follows: Borough of Carlstadt ($1.97 billion), Borough of Moonachie ($1.38 billion), Borough of Little Ferry ($479.4 million), Township of South Hackensack ($195.6 million), and Borough of Teterboro ($183.5 million) (GIS Planning 2017).

Table 3.4-11: Top Three Employers within the Project Area by Number of Employees in 2016

Municipality	Name of Business		Business Type	Number of Estimated Employees
Borough of Little Ferry	**1**	Dassault Falcon Jet Corp	Manufacturing – Electronics, Furniture, Machinery, Metal, Transportation, Misc.	200
	2	Doka USA Ltd	Manufacturing – Electronics, Furniture, Machinery, Metal, Transportation, Misc.	160
	3	Unisource Distribution Div.	Manufacturing – Chemical, Fuel, Paper, Plastic, Wood	120
Borough of Moonachie	**1**	Jet Aviation Holdings USA Inc.	Transportation and Warehousing: Private and Public Transportation, Oil and Gas Pipelines, Sightseeing	300
	2	Meridian Air Charter	Retail: Home, Food, Automobiles, Personal Care	160
	3	LPS Industries Inc.	Manufacturing – Electronics, Furniture, Machinery, Metal, Transportation, Misc.	150
Borough of Carlstadt	**1**	General Trading Co	Wholesalers	350
	2	Thumann's The Deli Best	Accommodation and Food Services	260
	3	Unimac Graphics	Manufacturing – Chemical, Fuel, Paper, Plastic, Wood	250

Municipality		Name of Business	Business Type	Number of Estimated Employees
Borough of Teterboro	**1**	Symrise Inc.	Wholesalers	500
	2	A & E Stores	Retail: Home, Food, Automobiles, Personal Care	200
	3	Gym Source NE; Bergen County Technical Schools	Retail: Hobby, Media, General Merchandise; Education	100
Township of South Hackensack*	**1**	A & E Stores	Retail: Home, Food, Automobiles, Personal Care	200
	2	Boswell Engineering Co	Professional, Scientific, and Technical Services	199
	3	Datamation Systems	Wholesalers	60

Source: (GIS Planning 2017)
*The values provided for the Township of South Hackensack are for the northern portion between the Boroughs of Teterboro and Little Ferry. No employee data output was generated for the southern portion of the Township within the Project Area by the GIS Planning application.

3.4.3.7 Housing

Based on 2010 to 2014 American Community Survey data, there were 3,188,498 occupied housing units out of a total of 3,572,138 in the State of New Jersey (an occupancy rate of 89 percent). In Bergen County, 335,371 housing units were occupied out a total 354,298 (an occupancy rate of 95 percent). Within the Project Area, occupancy rates ranged from 90 percent (Borough of Moonachie) to 100 percent (Borough of Teterboro). The number of vacant housing units was low within the Project Area, ranging from 359 units in the Borough of Little Ferry to 0 units in the Borough of Teterboro. As indicated in **Table 3.4-12**, homeowner vacancy rate was 1 percent in Bergen County, and ranged from 5 percent in the Borough of Moonachie to 0 percent in the Boroughs of Carlstadt and Moonachie and the Township of South Hackensack.

In 2014, median home value was higher in Bergen County ($443,500) in comparison to the five municipalities, which ranged from $343,800 in the Borough of Little Ferry to $406,600 in the Township of South Hackensack. Gross median rent was fairly comparable across New Jersey, Bergen County, and the five municipalities. The largest median rent value was in the Borough of Teterboro ($1,500), which was higher than both New Jersey ($1,188) and Bergen County ($1,340), and the lowest was in the Borough of Moonachie ($953) (US Census Bureau 2014)**. Table 3.4-12** presents census information on housing-related indicators at the municipal, county, and State levels (US Census Bureau 2014).

Table 3.4-12: Housing Information at the Municipal, County, and State Level

Housing Category	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
Occupied Housing Units	3,188,498	335,671	2,147	4,160	1,013	29	973
Vacant Housing Units	383,640	18,627	187	359	114	0	30
Total Housing Units	3,572,138	354,298	2,334	4,519	1,127	29	1,003
Owner-Occupied Units	2,073,915	217,432	1,200	1,773	817	1	476
Renter-Occupied Units	1,114,583	118,239	947	2,387	196	28	497
Homeowner Vacancy Rate	1.7%	1.1%	0.0%	3.6%	5.4%	0.0%	0.0%
Rental Vacancy Rate	6.5%	4.0%	4.3%	5.4%	0.0%	0.0%	1.2%
Median Home Value	$319,900	$443,500	$383,100	$343,800	$344,700	NA	$406,600
Gross Median Rent	$1,188	$1,340	$1,302	$1,309	$953	$1,500	$1,390

*Includes all three entities of the Township of South Hackensack
Housing Occupancy and Housing Tenure values are estimates
NA: No value was provided by the US Census Bureau
Source: (US Census Bureau 2014)

3.4.3.8 Journey-to-Work

Journey-to-work shows the transportation mode used by residents to commute to their place of work. The Project Area's journey-to-work patterns are influenced by different factors, such as Bergen County's proximity to New York City (approximately 26 miles) and other major employment centers such as Newark, New Jersey in Essex County (approximately 20 miles) and Clifton, New Jersey in Passaic County (approximately 13 miles).

As shown in **Table 3.4-13**, the use of a car, truck, or van was the most common means of transportation to work for persons living in the State of New Jersey, Bergen County, and the Project Area. Residents in the Borough of Teterboro exhibited the highest percentage of persons driving alone to work (96 percent) compared to residents in other jurisdictions. Residents in the Borough of Little Ferry utilized public transportation at a higher rate than the rest of the municipalities at 18 percent.

Table 3.4-13: Journey-to-Work Information at the Municipal, County, and State Level

Journey-to-Work Data	New Jersey	Bergen County	Borough of Carlstadt	Borough of Little Ferry	Borough of Moonachie	Borough of Teterboro	Township of South Hackensack*
Car, Truck, or Van	80.2%	77.1%	77.9%	75.9%	89.1%	96.2%	75.4%
Drove Alone	71.9%	69.6%	72.1%	67.2%	80.9%	96.2%	69.3%
Carpooled	8.3%	7.5%	5.8%	8.7%	8.2%	0.0%	6.0%
Public Transportation (excluding taxicab)	10.9%	13.7%	12.2%	18.4%	6.1%	3.8%	7.6%
Worked in State of residence	86.4%	77.0%	82.5%	80.0%	90.3%	96.2%	93.9%
Worked outside State of residence	13.6%	23.0%	17.5%	20.0%	9.7%	3.8%	6.1%
Worked in county of residence	54.1%	55.4%	53.3%	55.2%	60.3%	76.9%	78.9%
Worked outside county of residence	32.3%	21.6%	29.2%	24.8%	30.0%	19.2%	15.0%
No vehicle available	6.7%	4.3%	5.0%	5.4%	1.1%	0.0%	4.9%
1 vehicle available	22.7%	23.0%	20.5%	32.1%	20.3%	15.4%	31.9%
2 vehicles available	40.7%	44.3%	42.5%	40.6%	53.3%	50.0%	45.0%
3 vehicles available	29.9%	28.4%	31.9%	22.0%	25.4%	34.6%	18.2%

*Includes all three entities of the Township of South Hackensack
Percent totals are greater or less than 100% due to rounding
Source: (US Census Bureau 2014)

A larger percentage of residents in the Project Area worked in-State (80 to 96 percent) than compared to Bergen County (77 percent). The Borough of Teterboro and the Township of South Hackensack had the highest percentage of residents working in-State at 96 and 94 percent, respectively. Excluding the Borough of Carlstadt, all of the municipalities in the Project Area had the same or higher percentages of residents working in the county of residence as compared to Bergen County (55 percent). The Borough of Moonachie had the highest percentage of residents working outside of the county of residence (30 percent), followed closely by the Borough of Carlstadt (29 percent). Across Bergen County and the five municipalities, approximately half of the residents had two vehicles in their household, ranging from 53 percent in the Borough of Moonachie to 41 percent in the Borough of Little Ferry (US Census Bureau 2014).

3.5 Environmental Justice

3.5.1 Introduction

As part of the EJ assessment for the Proposed Project, demographic data were examined to assess whether minority, low-income, or LMI persons reside within the Project Area. EJ considerations are determined by comparing demographic and economic characteristics within the Project Area to the same characteristics in the surrounding region (CEQ 1997).

When determining the presence of minority, low-income, and LMI populations within a study area, the surrounding region is typically used for comparison purposes. The county levels are generally used to establish a threshold for this comparison (USEPA 2016n). This approach is consistent with the analysis conducted by Together New Jersey in the Fair Housing & Equity Assessment Report, Northern New Jersey Region which defined “communities of concern” as places that are home to high concentrations of minority, low-income and other disadvantaged populations, that equal or exceed a given threshold (Together North Jersey 2015). For this analysis, the study area is defined as the Project Area (see **Figure 3.5-1**). Bergen County data are used to establish the surrounding region’s threshold for minority, low-income, and LMI populations. These thresholds will be compared to minority, low-income, and LMI populations in the Project Area to identify EJ communities of concern that could be affected by the Proposed Project.

The following information was collected and aggregated to represent the demographic and economic characteristics within the Project Area, Bergen County, and the State of New Jersey.

- **Racial and Ethnic Characteristics** – The 2010 US Census data on race and ethnicity were used to identify the numbers of each race or ethnicity and their locations (US Census Bureau 2010b). The population in each census block within the Project Area and surrounding region was characterized using the following race categories: White, Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, some other race, and two or more races. Populations with a Hispanic or Latino origin are also identified (US Census Bureau 2010b).
- **Percentage of Minority Population** – As defined by the US Census Bureau, the minority population includes all non-White persons, as well as White-Hispanic persons (US Census Bureau 2010b).
- **Low-Income Population** – The percentage of persons living below the poverty level as defined by the US Department of Health and Human Services was used to determine the low-income population in a given census tract. The 2010 to 2014 American Community Survey data on poverty were used to identify the number of persons below poverty and their locations (US Census Bureau 2014).
- **LMI Population** – As defined by the CDBG Program under HUD, “a person is considered to be of low income only if he or she is a member of a household whose income would qualify as ‘very low income’ under the Section 8 Housing Assistance Payments program. Generally, these Section 8 limits are based on 50 percent of area median. Similarly, CDBG moderate income relies on Section 8 ‘lower income’ limits, which are generally tied to 80 percent of area median” (HUD 1984). LMI persons in the Project Area and surrounding region were identified by reviewing the American Community Survey 5-Year 2006-2010 LMI block group level data, provided by HUD(HUD 2016a).

3.5.2 Regulatory Context

EO 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations*), requires Federal agencies, including HUD, to consider how federally assisted projects may have disproportionately high and adverse human health or environmental effects on minority and low-income populations. The basis for EO 12898 is to ensure decisions made by Federal agencies, or those State agencies with delegated Federal programs, comply with Title VI of the Civil Rights Act (1964), Title 42 USC §§ 2000 *et seq*. This law states that: "No person in the United States shall, on the ground of race, color or national origin be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."

EO 12898 also directs HUD to develop a strategy for implementing EJ. HUD's mission to incorporate EJ principles in all its activities includes "equal access to safe and healthy housing for all; mitigating risks to communities in disaster-prone areas; improving access to affordable, quality housing free of hazards to residents' health; and working to achieve inclusive, sustainable communities free from discrimination." HUD developed its "2012 – 2015 Environmental Justice Strategy" (HUD 2015), ultimately posting the final strategy in April 2012. In addition, in October 2014, HUD completed its "Climate Change Adaptation Plan" and included many action items with EJ implications (HUD 2014).

The State of New Jersey also issued EO 96 in February 2004 to demonstrate its commitment toward ensuring that minority and low-income communities are afforded fair treatment and meaningful involvement in the decision-making process regardless of race, color, ethnicity, religion, income, or education. Pursuant to EO 96, all activities conducted throughout the EIS process will abide by the spirit of the EO and ensure the process is open and responsive to any EJ concerns.

Specific to LMI populations and according to HUD, the CDBG program requires that each CDBG-funded activity "must either principally benefit LMI persons, aid in the prevention or elimination of slums or blight, or meet a community development need having a particular urgency" (HUD 2017). Further, with respect to activities that benefit all residents of a given area, at least 51 percent must be LMI (HUD 2017). However, some communities do not have any or have very few areas in which 51 percent of the residents are LMI. For these grantees, CDBG law authorizes an exception criterion. Section 105(c)(2)(A)(ii) is implemented in the CDBG regulations at 24 CFR 570.208(a)(1)(ii), which identifies the methodology to calculate a grantee's "exception" threshold. For Bergen County, the LMI exception threshold for area benefit activities is 39.57 percent (HUD 2017).

3.5.3 Existing Conditions

3.5.3.1 Minority Populations

To identify the number and percentage of minority populations within the Project Area, population data were gathered at the census block level from the 2010 US Census (US Census Bureau 2010b). **Table 3.5-1** presents race and ethnicity related data within the State, county, and Project Area at the census block level, while **Table 3.5-2** provides this data for each municipality within the Project Area.

As presented in **Table 3.5-1** below, the percentage of minority persons in the Project Area (46.3 percent) exceeds the percentage of minority persons in Bergen County (37.5 percent) and the State (40.7 percent). Asians comprise the single largest minority category across all jurisdictions. The percentage of Hispanic or Latino persons within the Project Area (20.2 percent) also exceeds the percentage exhibited within the county (16.1 percent) and the State (17.7 percent) overall (US Census Bureau 2010b).

Table 3.5-1: Distribution of Population by Race and Ethnicity within the Project Area in 2010

Race	Project Area		Bergen County		New Jersey	
	Number	Percent	Number	Percent	Number	Percent
Non-Hispanic or Non-Latino White	10,543	53.7%	566,053	62.5%	5,214,878	59.3%
Hispanic or Latino White	2,608	13.3%	84,650	9.4%	814,370	9.3%
Black or African-American Alone	662	3.4%	52,473	5.8%	1,204,826	13.7%
American Indian and Alaska Native Alone	57	0.3%	2,061	0.2%	29,026	0.3%
Asian Alone	3,644	18.6%	131,329	14.5%	725,726	8.3%
Native Hawaiian and Other Pacific Islander Alone	6	0.0%	229	0.0%	3,043	0.0%
Some Other Race Alone	1,429	7.3%	45,611	5.0%	559,722	6.4%
Two or More Races	667	3.4%	22,710	2.5%	240,303	2.7%
Total Population	**19,616**	**100.0%**	**905,116**	**100.0%**	**8,791,894**	**100.0%**
Minority Population	**9,073**	**46.3%**	**339,063**	**37.5%**	**3,577,016**	**40.7%**
Hispanic or Latino*	3,969	20.2%	145,281	16.1%	1,555,144	17.7%

*Includes persons with a Hispanic or Latino origin of any race, including Hispanic White.
Source: (US Census Bureau 2010b)

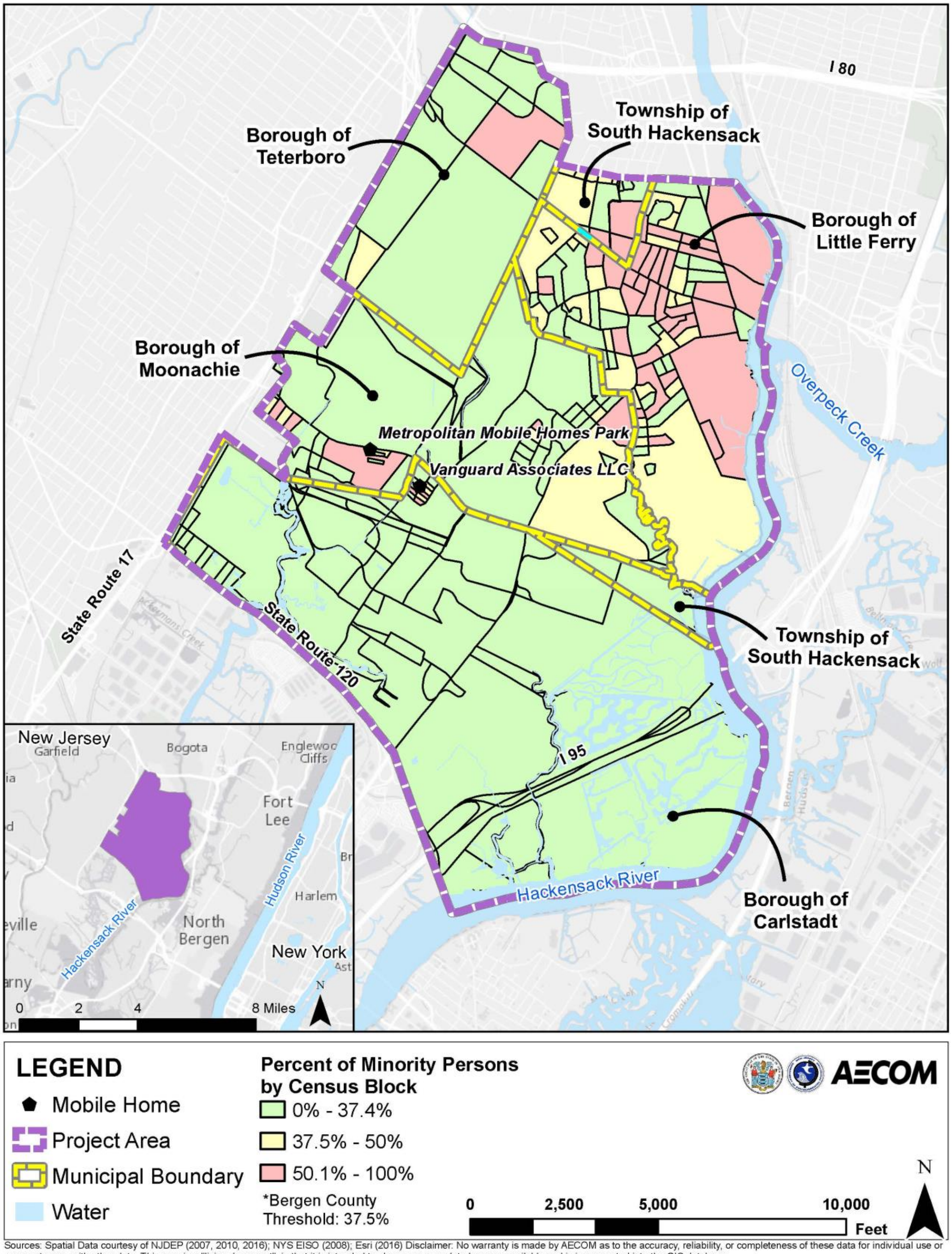
As presented in **Table 3.5-2**, the Borough of Little Ferry has the highest percentage of minority persons (52.4 percent). The Township of South Hackensack has the second highest percentage of minority persons (45.9 percent), followed by the Boroughs of Teterboro (44.2 percent) and Moonachie (36.3 percent), respectively. The Borough of Carlstadt has the lowest percentage of minority persons at 35.7 percent. The threshold for minority populations is Bergen County at 37.5 percent. The Boroughs of Little Ferry, Moonachie, and the Township of South Hackensack are communities of concern for minority populations, as they exceed the 37.5 percent threshold of Bergen County.

To better understand the distribution of minority persons within the Project Area, the locations and percentages of minority persons by census block were calculated and mapped. Using GIS, the aerial extent of the population within each census block was calculated, and the population was assumed to be evenly distributed within each block. For example, if 50 percent of the area within each census block was inside the study area boundary, then 50 percent of the population of the census block was used for calculation purposes. As shown in **Figure 3.5-1**, there are several census blocks with a higher percentage of minority persons, compared to Bergen County as a whole (37.5 percent), located within the Boroughs of Little Ferry and Moonachie. In addition, two census blocks in the Borough of Teterboro also exhibit a higher percentage of minority persons than the Bergen County average. As such, all census blocks with minority populations of 37.5 percent or more would be considered EJ communities of concern within the Project Area. For additional, more specific information regarding the percentage of minority persons in each block group and block where the Bergen County threshold of 37.5 percent was exceeded, refer to **Appendix D**.

Table 3.5-2: Populations by Race and Ethnicity within the Project Area

Race	Borough of Carlstadt		Borough of Little Ferry		Borough of Moonachie		Borough of Teterboro		Township of South Hackensack	
2010 US Census	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
White	322	75.2%	6,524	61.1%	4,497	76.7%	693	70.1%	1,115	67.4%
Non - Hispanic or Non-Latino White	275	64.3%	5,087	47.6%	3,734	63.7%	552	55.8%	895	54.1%
Hispanic or Latino White	47	11.0%	1,437	13.5%	763	13.0%	141	14.3%	220	13.3%
Non-White	106	24.8%	4,158	38.9%	1,365	23.3%	296	29.9%	540	32.6%
Black or African American Alone	6	1.4%	437	4.1%	76	1.3%	62	6.3%	81	4.9%
American Indian and Alaska Native Alone	1	0.2%	31	0.3%	15	0.3%	10	1.0%	0	0.0%
Asian Alone	45	10.5%	2,535	23.7%	704	12.0%	71	7.2%	289	17.5%
Native Hawaiian and Other Pacific Islander Alone	0	0.0%	6	0.1%	0	0.0%	0	0.0%	0	0.0%
Some Other Race Alone	51	11.9%	762	7.1%	377	6.4%	125	12.6%	114	6.9%
Two or More Races	3	0.7%	387	3.6%	193	3.3%	28	2.8%	56	3.4%
Total Population	**428**	**100.0%**	**10,682**	**100.0%**	**5,862**	**100.0%**	**989**	**100.0%**	**1,655**	**100.0%**
Minority Population	**153**	**35.7%**	**5,595**	**52.4%**	**2,128**	**36.3%**	**437**	**44.2%**	**760**	**45.9%**
Hispanic or Latino*	173	40.4%	2,318	21.7%	876	14.9%	238	24.1%	364	22.0%

*Includes persons with a Hispanic or Latino origin of any race, including Hispanic White.
Source: (US Census Bureau 2010b)



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.5-1: Percent of Minority Persons by Census Block within the Project Area

3.5.3.2 Low-Income Population

Poverty rate level data at the census tract level were obtained from the 2010 to 2014 American Community Survey to identify low-income populations within the Project Area and surrounding region (US Census Bureau 2014). Poverty rates within the five municipalities according to the 2010 to 2014 American Community Survey from highest to lowest are as follows: Borough of Teterboro (16.1 percent), Township of South Hackensack (8.2 percent), Borough of Little Ferry (8.0 percent), Borough of Carlstadt (6.8 percent), and Borough of Moonachie (6.6 percent). The threshold for persons below the poverty line in Bergen County is 7.5 percent. Therefore, the Boroughs of Teterboro and Little Ferry and the Township of South Hackensack are EJ communities of concern for low-income populations, as they exceed the 7.5 percent threshold of Bergen County.

To better understand the distribution of low-income populations within these municipalities, poverty data were examined and mapped at the census tract level. **Table 3.5-3** includes the number of individuals and the percentage of the population below the poverty level within the five census tracts and at the Project Area, county, and State level. Poverty levels within census tract 292 (9.4 percent) and census track 361 (8.3 percent) exceed the Bergen County threshold (7.5 percent); therefore, these census tracts would be considered EJ communities of concern. As illustrated in **Figure 3.5-2**, these census tracts occur within the Boroughs of Little Ferry and Teterboro and a portion of the Township of South Hackensack, which corresponds with the findings above. The remaining census tracts within the Project Area are below the county level threshold and would not be considered communities of concern based on poverty levels.

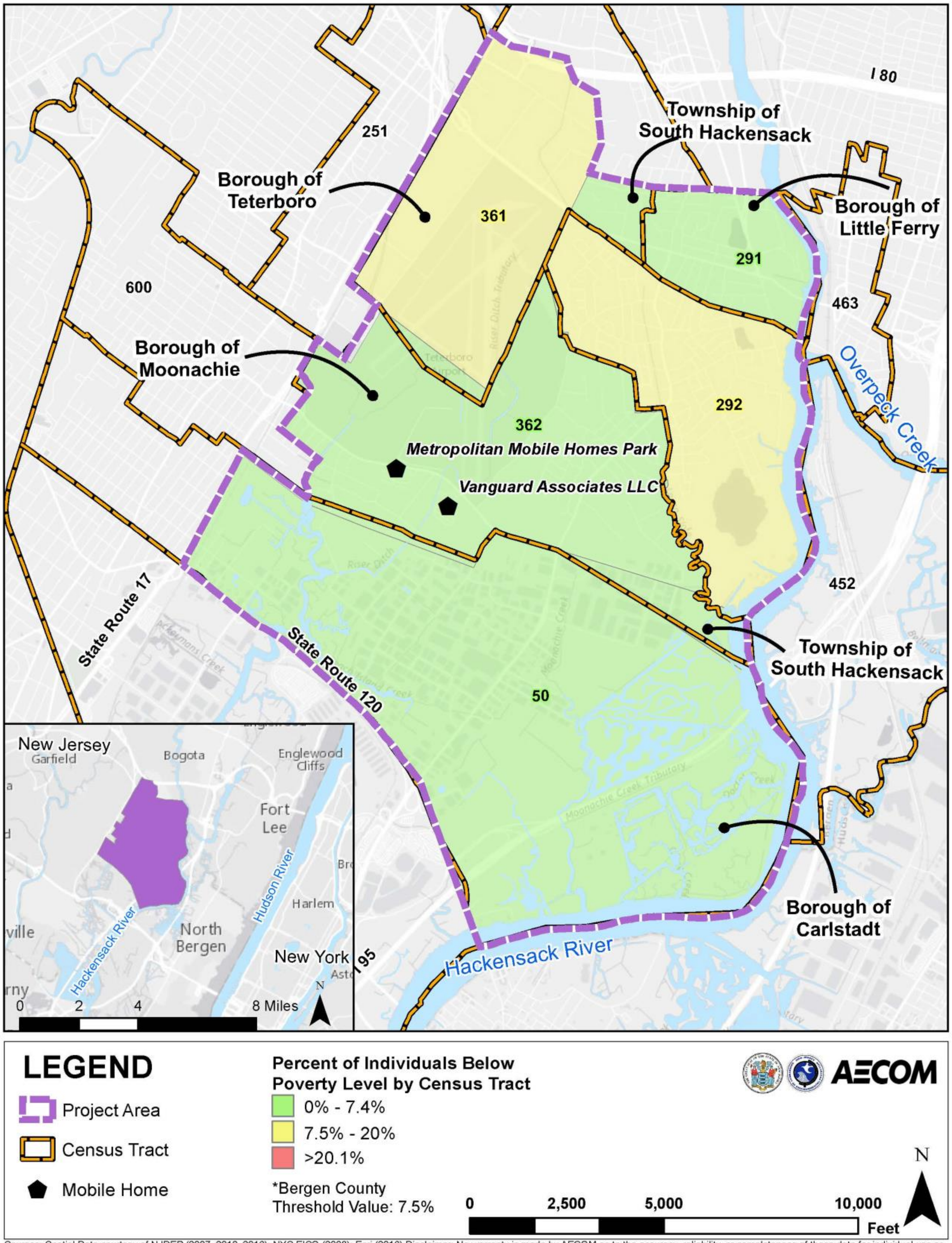
Table 3.5-3: Low-Income Populations within the Project Area, Bergen County, and New Jersey

Area	Number of Individuals Below Poverty	Total Population*	Percent of Total Population Below Poverty
Census Tract 50	421	6,189	6.8%
Census Tract 291	307	4,873	6.3%
Census Tract 292	554	5,869	9.4%
Census Tract 361	219	2,622	8.3%
Census Tract 362	181	2,725	6.6%
Project Area	**1,682**	**22,278**	**7.5%**
Bergen County	68,104	920,456	7.5%
New Jersey	934,665	8,874,374	10.7%

*Boundaries of some of the census tracts (e.g., 361) extend beyond the limits of the Project Area, see **Figure 3.4-2**.
Source: (US Census Bureau 2014)

3.5.3.3 LMI Populations

One of the primary objectives of the HUD CDBG Program is to provide benefits to LMI persons within the Project Area. LMI information was derived from special data tabulations provided by HUD (HUD 2016a). LMI persons in the Project Area were identified by reviewing the American Community Survey 5-Year 2006-2010 LMI block group level data. These data were downloaded and mapped using GIS. **Table 3.5-4** shows the number and percentage of LMI persons within the Project Area by municipality and for Bergen County overall.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.5-2: Percentage of Individuals Below the Poverty Level by Census Tract in Project Area

Table 3.5-4: Low- and moderate-income Populations within the Project Area

Area	Number of LMI Persons	Percentage of LMI Persons
Borough of Carlstadt	2,185	36.1%
Borough of Little Ferry	4,550	42.9%
Borough of Moonachie	1,085	40.1%
Borough of Teterboro	4	4.2%
Township of South Hackensack*	655	29.0%
Bergen County	**247,910**	**28.0%**

*Includes all three entities of the Township of South Hackensack
Source: (HUD 2016a)

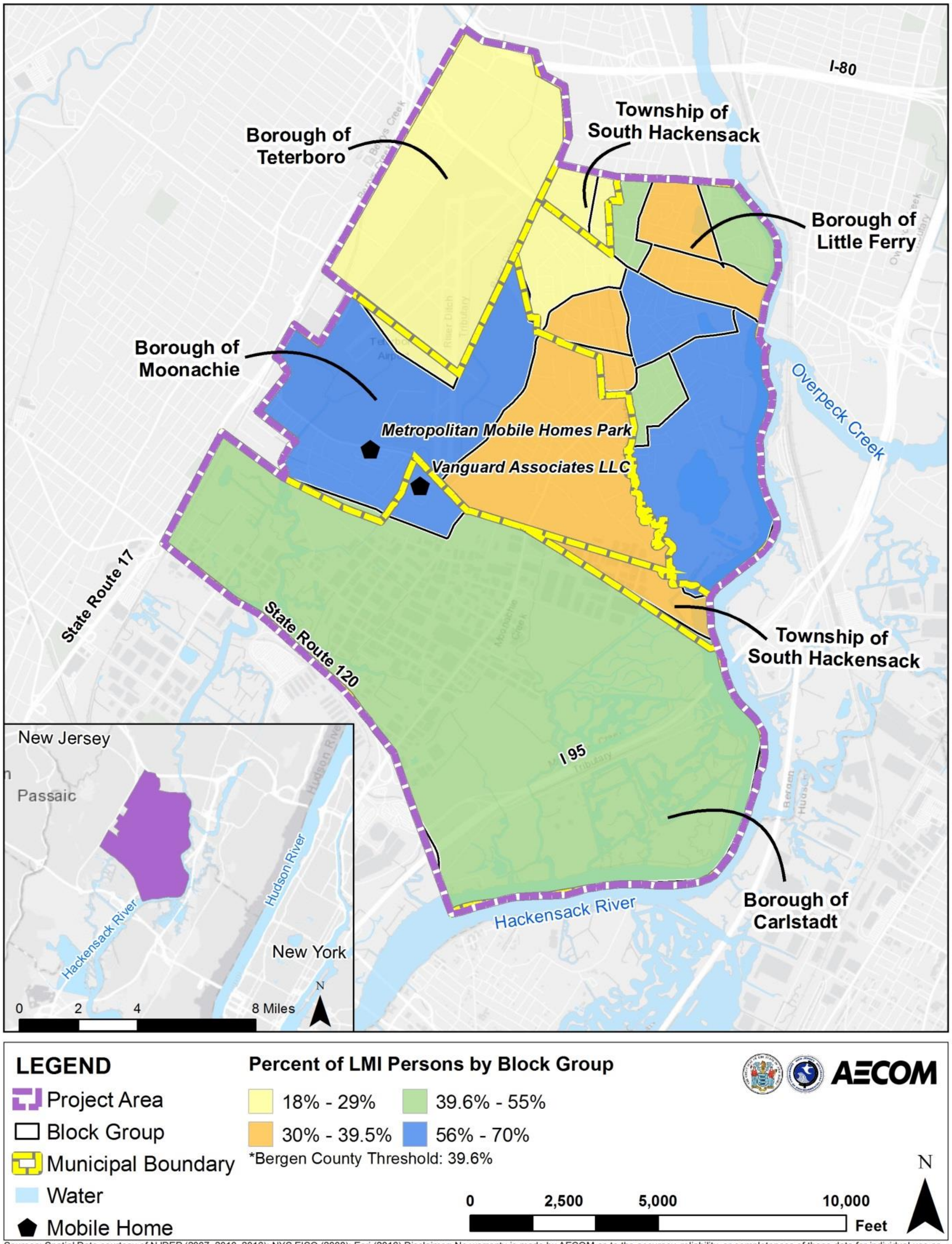
As described in **Section 3.5.2**, the LMI exception threshold for area benefit activities is 39.57 percent (HUD 2017). Of the five municipalities, the Boroughs of Little Ferry and Moonachie would be characterized as EJ communities of concern for LMI populations because the percentage of LMI persons exceeds the exception threshold for Bergen County.

To better understand the distribution of EJ communities of concern within the Project Area, LMI data were examined and mapped at the block group level. A total of 15 block groups occur within the Project Area, and seven of them exceed the Bergen County LMI exception threshold of 39.57 percent, as shown in **Figure 3.5-3**. Further, as illustrated in **Figure 3.5-4**, the highest concentration of LMI persons occurs in the northeast portion of the Project Area, specifically within the Boroughs of Little Ferry and Moonachie, and the Township of South Hackensack. Two block groups in the Borough of Little Ferry have the highest concentration of LMI persons in the whole Project Area.

However, the 15 block groups that comprise the Project Area, when combined, have an overall LMI percentage of 39.9 percent, which exceeds the Bergen County threshold. As such, the entire Project Area meets the LMI exception threshold for area benefit activities (HUD 2017). For additional, more specific information regarding the percentage of LMI persons in each block group, please refer to **Appendix D**.

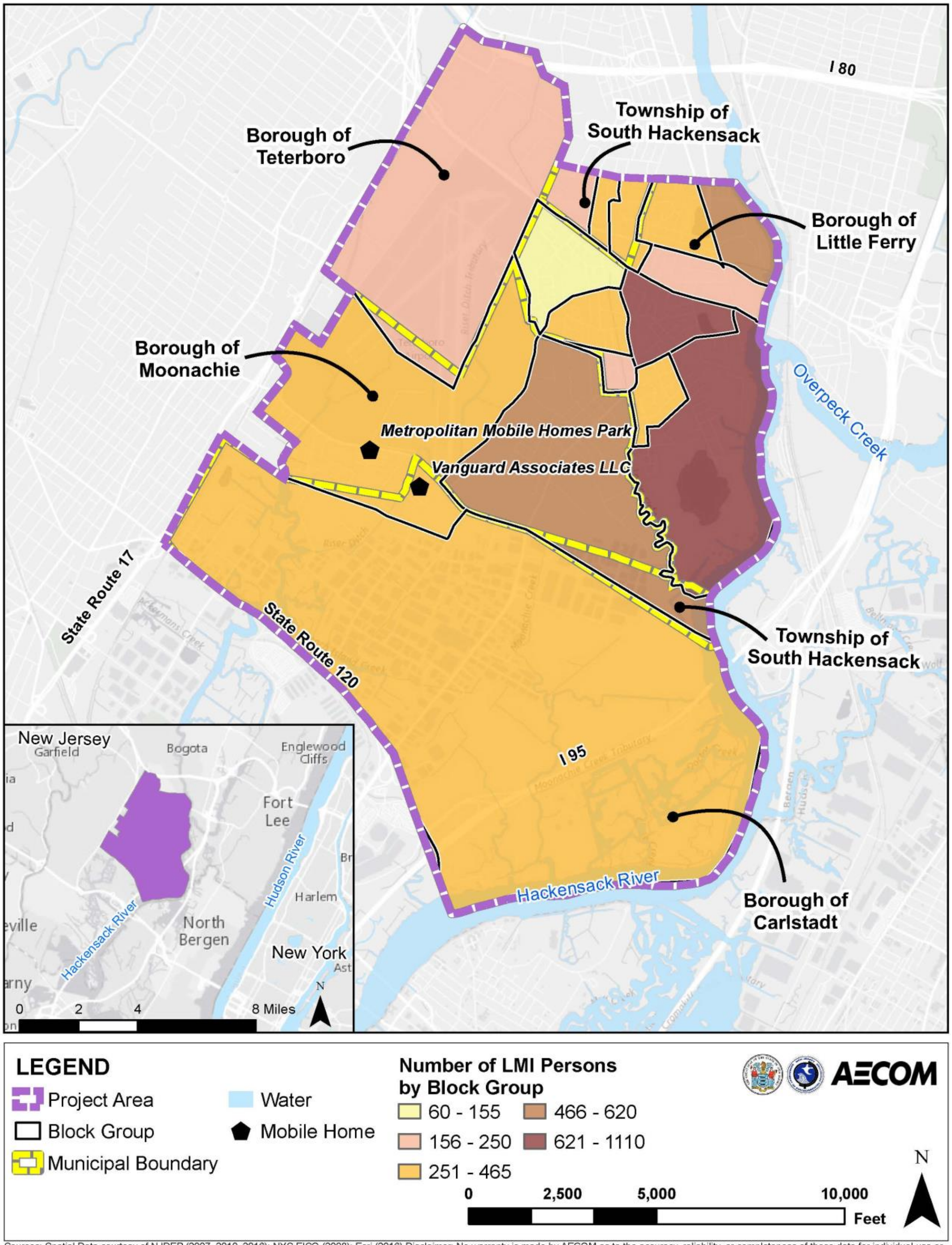
3.5.3.4 Summary

As discussed earlier, EJ communities of concern include places that are home to high concentrations of minority and low-income populations that equal or exceed a given threshold. For this analysis, Bergen County data were used to establish a threshold for comparison to determine communities of concern within the Project Area. Based on this analysis, the entire Project Area is considered an EJ community of concern, given that the percentage of LMI persons in the Project Area is 39.9 percent and exceeds the Bergen County LMI exception threshold of 39.6 percent. The highest concentration of minority populations occurs in the northeast portion of the Project Area, predominantly within the Boroughs of Moonachie, Little Ferry, and the Township of South Hackensack. All areas of the Project Area except the Borough of Teterboro and portions of the Borough of Little Ferry and the Township of South Hackensack have low-income and LMI populations. One location exceeds the Bergen County thresholds for all three EJ indicators: a portion of the Borough of Little Ferry that extends northward to Main Street, westward to Redneck Avenue, and along the municipal boundary of the Borough of Moonachie. **Figure 3.5-5** illustrates the EJ communities of concern in the Project Area.



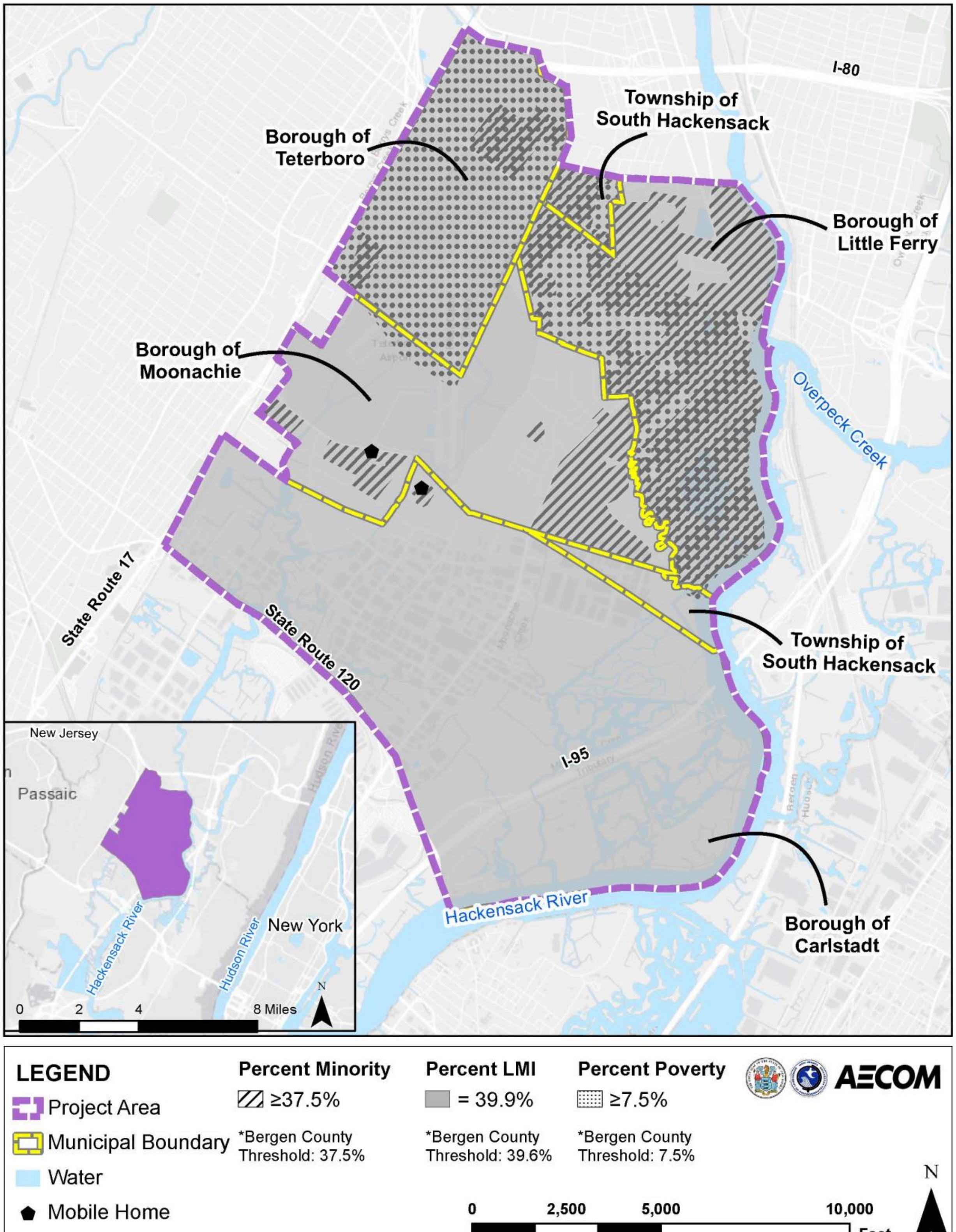
Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.5-3: Percentage of LMI Persons by Block Group



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.5-4: Number of LMI Persons by Block Group



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.5-5: EJ Communities of Concern in the Project Area

3.6 Cultural and Historical Resources

3.6.1 Introduction

Federal and State laws, such as the NEPA, Section 106 of the NHPA, the Freshwater Wetlands Protection Act, and the New Jersey State Development and Redevelopment Plan, require consideration of the effects of a Proposed Project on cultural and historic resources. These resources can consist of archaeological sites, historic buildings, structures, districts, and objects, as defined by the NHPA, as well as collections and associated records as defined by 36 CFR Part 79. Consideration of cultural resources under NEPA includes the necessity to independently comply with the applicable procedures and requirements of other Federal and State laws, regulations, and EOs. Section 106 of the NHPA (54 USC § 306108) requires Federal agencies to consider the effect an undertaking may have on historic properties; its implementing regulations, 36 CFR Part 800, describe the procedures for identifying and evaluating historic properties; assessing the effects of Federal actions on historic properties; and consulting to avoid, reduce, or minimize adverse effects. As part of the Section 106 process, agencies are required to engage consulting parties that include the State Historic Preservation Office (SHPO), appropriate federally recognized Native American tribes, local government, and other authorized individuals and/or organizations with legal, economic, or preservation interest in the proposed undertaking. The Proposed Project is an undertaking as defined by 36 CFR Part 800.3, and is required to comply with Section 106 of the NHPA.

The Section 106 process requires each undertaking to define an APE. The APE includes all land, buildings, and structures that may be affected during the Proposed Project. The APE is defined in 36 CFR § 800.16(d) as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking."

The cultural resource assessment of the Project Area presented here provides information to characterize the archaeological sensitivity and identify archaeological sites and historic properties eligible for or listed on the National Register of Historic Places (NRHP). The NJHPO concurred with the APE for the Proposed Project via letter on March 19, 2018.

For the purposes of this cultural resource sensitivity assessment, a study area of 1 mile beyond the boundaries of the Project Area was established for examination of previous investigations and documented resources. This extension assisted with the development of a broad, inclusive context with regard to potential prehistoric and historic resources that may be present within the Project Area.

Background research was conducted at the New Jersey State Museum (NJSM) and the NJHPO on August 2 and 3, 2016. This effort included an examination of the State and National Registers of Historic Places files and survey map files at the NJHPO, archaeological forms on file at the NJSM, and books, journals, and other reference material. Map research was conducted online using a variety of sources, including: Ancestry.com, the David Rumsey Map Collection, the New Jersey Pine Barrens Historic Map Collection, the Library of Congress American Memory Map Collection, the New York Public Library Digital Gallery, the University of Alabama Map Collection, the National Map: Historical Topographic Map Collection, NOAA's Office of Coast Survey Historical Map & Chart Collection, and the Fairleigh Dickinson University Digital Archives.

The NJDEP has sent consultation letters to the NJHPO, the Archaeological Society of New Jersey, and Native American tribes with potential ancestral ties to the Project Area in order to comply with NEPA, Section 106 of the NHPA, and EO 13175 (*Consultation and Coordination with Indian Tribal Governments*). Consulted tribes included the Absentee-Shawnee Tribe of Indians of Oklahoma, the Delaware Nation, the Delaware Tribe of Indians, the Eastern Shawnee Tribe of Oklahoma, the Shawnee Tribe, and the Stockbridge-Munsee Community Band of Mohicans. Each of these tribes may potentially have a traditional connection to the lands contained within the APE. A copy of the consultation letters and responses received is included in **Appendix A**. In an email on October 27, 2016, the Stockbridge-Munsee Mohican Tribe declined to participate in the Proposed Project because it is outside of their cultural area of interest. On December 15, 2017, the Eastern Shawnee Tribe of Oklahoma responded that the Proposed Project was outside the known historical regional areas of their tribe, but that they should be notified if any archaeological sites or objects are discovered. On January 3, 2018, the Shawnee Tribe responded that they had no concerns regarding the Proposed Project at that time, but that they should be notified if any archaeological materials are encountered. Finally, on January 29, 2018, the Delaware Nation responded that it is primarily concerned with maintaining adequate buffers around known cultural sites, protecting/promoting indigenous plants, and being notified in the event of a discovery. No other responses have been received to date. Consultation with NJHPO regarding potential impacts to cultural resources remains ongoing (see **Section 4.6** and **Appendix A**).

3.6.2 Regulatory Context

Notable regulations and guidelines applicable to cultural resources within the Project Area are provided below. For more information on laws and regulations that pertain to the Proposed Project, see **Appendix B**.

Federal Plans, Regulations, Executive Orders, and Laws

- Section 101(b)(4) of NEPA requires Federal agencies to coordinate and plan their actions so as to preserve important historic, cultural, and natural aspects of the country’s national heritage.
- Section 106 of the NHPA and its implementing regulation, 36 CFR 800, require Federal agencies to take into consideration the effects of their undertakings on properties listed on or eligible for listing on the NRHP, as well as to afford the ACHP an opportunity to comment on the undertaking. The current Proposed Project utilizes funding provided by FEMA and HUD, and as such, must demonstrate compliance with Section 106 requirements as part of a federally funded undertaking.
- Sections 1(3) and 2(b) of EO 11593 (*Protection and Enhancement of the Cultural Environment*) instruct Federal agencies to support the preservation of cultural properties by directing them to identify and nominate the NRHP cultural properties under their jurisdiction.
- The Secretary of the Interior’s Standards and Guidelines (36 CFR 61 and 48 FR 44716) establish procedures for approved Federal, State, and tribal historic preservation programs, provide standards and guidelines for managing historic properties, and define the minimum qualifications in education and experience required to perform identification, evaluation, registration, and treatment activities for history, archaeology, architectural history, architecture, and historic architecture.

State Plans, Policies, Regulations, and Laws

- Under the Waterfront Development Act (NJSA 12:5-1 *et seq.*) and Freshwater Wetlands Protection Act (NJSA 13:9B-1 *et seq.*), permits from the NJDEP may be required for the

Proposed Project. The regulations for Waterfront Development and Freshwater Wetlands permits contain provisions for completing cultural resource studies.

- All cultural resource studies and reports will be completed following the NJHPO guidelines for historic architectural surveys (NJHPO 1999) and archaeological surveys (NJHPO 1994, NJHPO 1996, NJHPO 2000, NJHPO 2003). The cultural resource survey and reports will also follow the New Jersey Register of Historic Places Act Rules (NJAC 7:4).
- The State Development and Redevelopment Plan (NJSA 52:18A-200(f)) (New Jersey State Planning Commission 2001) cites Historic Preservation as a policy objective for development and redevelopment in the Metropolitan Planning Area of the Hackensack Meadowlands District (PA-1).

Regional and Local Plans, Policies, Regulations, and Ordinances

Each of the municipalities located in the Project Area have municipal master plans to guide future development. Per the MLUL, which governs planning and zoning throughout New Jersey, a periodic reexamination of a municipality's master plan must occur every six years (Article 11, NJSA C.40:55D-89 *et seq*). In recent reexamination reports by each of the municipalities, historic preservation was prioritized via recommendations of adaptive reuse, rehabilitation, and/or consideration during development and/or redevelopment endeavors. The following reexamination reports formed the basis for this summary analysis:

- Borough of Carlstadt: *Borough of Carlstadt Reexamination Report* (Borough of Carlstadt Planning Board 2006) and *General Reexamination of the Master Plan, Borough of Carlstadt* (Borough of Carlstadt Planning Board 2013);
- Borough of Little Ferry: *Master Plan Reexamination Report, Borough of Little Ferry* (Borough of Little Ferry Planning Board 2003) and *Reexamination Report of the Master Plan, the Borough of Little Ferry* (Borough of Little Ferry Planning Board 2013);
- Township of South Hackensack: *Township of South Hackensack 2008 Master Plan Periodic Reexamination Report* (Township of South Hackensack 2008);
- Borough of Moonachie: *Master Plan Reexamination Report* (Borough of Moonachie Planning Board 2007); and
- Borough of Teterboro: *Periodic Reexamination Report of the Master Plan* (Borough of Teterboro Planning Board 2006).

3.6.3 Existing Conditions

A review of previous cultural resource studies, previously recorded archaeological sites, and historic aboveground properties was conducted within a 1-mile radius of the Project Area. Background information about the prehistory and history of the region also contributed to the assessment of the Project Area for the potential for cultural resources.

3.6.3.1 Prehistoric Context

Prehistoric cultural complexes in northeastern North America are traditionally separated into three broad periods: Paleoindian, Archaic, and Woodland. The **Paleoindian period** (12,000 to 10,000 years before present [BP]) is the earliest time of Native American occupation in the region (Kraft 2001). During this period, sea levels were lower than present levels; therefore, the drainages in the Project Area would not have been tidal and the tidal marshes in the Meadowlands District would not have existed. Paleoindian populations were small nomadic groups that traveled extensively. The highly mobile groups likely traversed large regions of the Hackensack River Basin and surrounding areas. The Port Mobile Site on the western shore of Staten Island is one of the larger Paleoindian sites near the Project Area (Kraft 2001). Nine additional Paleoindian sites are known in the surrounding Newark Basin (URS 2001).

At the start of the **Archaic period**, which lasted from 10,000 to 3,000 years BP, a warming trend led to major environmental transformations, including a rise in sea levels and the appearance of more varied plant and animal populations (Kraft 2001). By the end of the Archaic period, the rising water table contributed to the formation of the tidal marshes in the Project Area (Hunter Research, Inc. 2006). The Archaic period is characterized by an increase in the number of sites, wider variety of artifact types, and larger sites. In the Newark Basin, 163 sites have components dating to the Archaic period (URS 2001). An increase in site density during the Archaic period has been interpreted as an increase in population.

The **Woodland period** (2,700 and 300 years BP) is marked by the introduction of ceramic vessels. Trends toward greater sedentism and increasing subsistence specialization that began during the Archaic continued, and were eventually joined by the introduction of agriculture. By the end of the Woodland period, settlements exhibited a trend toward longer habitation, larger group size, and the creation of small villages near floodplains. In the Newark Basin, 264 sites include components dating to the Woodland period (URS 2001). The largest Late Woodland sites have been found along major rivers, such as the Hudson River, and likely represent base settlements occupied for much of the year. No large Woodland base camp sites have been identified within the Newark Basin (URS 2001). At the end of the Woodland period, European interaction occurred with Native American groups near the Project Area (Stewart 2014). Increased contact with European traders and settlers ultimately resulted in the breakdown of traditional lifeways. Contact-period archaeological sites have been found near the Project Area (Lenik 1989).

3.6.3.2 Historic Context

The earliest European settlement in Bergen County between the Hackensack and Passaic Rivers (south of the City of Hackensack) was limited to fast land above the marshes. In 1641, this settlement consisted of a Dutch trading post on the west bank of the Hackensack River, located at the modern site of the Borough of Little Ferry.

Despite violent conflict with Native American populations, the first land patent on the west side of the Hackensack River was issued to Captain William Sanford in 1668 upon his purchase of 15,000 acres from the East Jersey Proprietors. This parcel encompassed the southern peninsula at the confluence of the Hackensack and Passaic Rivers, south of the current Project Area. The land to the north was granted to John Berry of Barbados, who was given the tract in 1669 by then-governor Philip Carteret. Berry’s tract, which he called New Barbadoes, encompassed all land between the Hackensack and Saddle Rivers for a distance of 6 miles north of Sanford’s land (Harvey 1900) and included the present-day Borough of Teterboro (NJDOT 1987, Hunter Research, Inc. 2006). At the end of the 17th century, Thomas Outwater and others purchased the island of Moonachie, or Berry’s Island, and built a dwelling there in 1718 (Bergen County Office of Cultural and Historic Affairs 1980 - 1981, Matthews 1993).

By the late 17th century, the land north of the marsh was devoted to farming (NJDOT 1987). The Meadowlands District to the south was largely composed of salt marsh and cedar swamps that were subjected to localized efforts to reduce salinity in attempts to create freshwater meadows better suited to growing and harvesting salt hay (Sebold 1992, Hunter Research, Inc. 2006). Transport of people, goods, and salt hay across the marshes and uplands was facilitated by the construction of a few roads;

among the earliest was the Pollifly Road built in the late seventeenth century (present-day Bergen County Route 55), a north-south corridor that ran along the western upland bordering the marshes (Clayton and Nelson 1882). Plank roads constructed of Atlantic white cedar made transportation of people and goods possible across the marshes, and in 1759, John Schuyler built the first of these plank roads between Barbadoes Neck and his copper mine on the Passaic River (Hunter Research, Inc. 2006).

These early corridors connected the widely distributed villages established on the higher, drier ground surrounding and within the marshes. Along the Pollifly Road, from south to north, were the present-day Boroughs of Carlstadt and Moonachie. To the east, on the banks of the Hackensack River, was the present-day Borough of Little Ferry. Dividing the marshes between the Hackensack River and Pollifly Road was Washington Avenue, which ran through the island of Moonachie (Clayton and Nelson 1882). The New York and Paterson Turnpike (present-day State Route 120), which crossed the marsh between Berry's Creek and the island of Moonachie, was surveyed and built between 1816 and 1820 (Van Valen 1900). However, the main transportation improvements in the Meadowlands District were aimed at connecting the interior of New Jersey to the Hudson River waterfront and New York City (Hunter Research, Inc. 2006). To this end, two railroads were built through the Meadowlands District in the 1830s: (1) the New Jersey Railroad from Newark and (2) the Paterson and Hudson River Railroad from East Rutherford. Both connected to the Paulus Hook ferry terminal on the Hudson River (Hunter Research, Inc. 2006). These transportation routes provided the small villages around the Meadowlands District an opportunity for industrial growth and the late 19th century saw the subdivision of the all-encompassing Lodi Township into the smaller, independent villages of Carlstadt (1894), Little Ferry (1894), Moonachie (1910), Teterboro (1917), and South Hackensack (1935).

Borough of Carlstadt. German political refugees established the Borough of Carlstadt in the 1840s, when the German Democratic Land Association organized mass immigration to the US and purchased 140 acres in Lodi Township for their members (Van Valen 1900). Residential and commercial development of Carlstadt was rapid, and by the 1850s the village was well known for German singing societies, beer gardens, and the teaching of German and English in schools (Lurie and Mappen 2004). The first church in the area was the German Presbyterian Church of Carlstadt, built in 1869 (Van Valen 1900). By the early 20th century, the Borough of Carlstadt had several manufacturing industries in operation, producing ladies' shoes, watch cases, and onyx and marble church pulpits (Van Valen 1900).

Borough of Little Ferry. Although Little Ferry was the site of the earliest occupation in the area with the 17th century Dutch trading post, settlement of the general vicinity progressed slowly. A ferry crossing of the Hackensack River was established there in 1659 to permit access to the more extensive development east of the river, and it remained in operation until 1826. In addition to regular service, the ferry aided George Washington's troops in their escape from Fort Lee after the British invasion of New Jersey.

Prior to the 1860s, sparse residential and commercial settlement flanked the four streets (Liberty Street, Washington Avenue, Riverside Avenue, and Bergen Pike) of Little Ferry. However, discovery of large, high quality clay beds in the banks of the Hackensack River during the late 1860s brought profitable and large-scale industry to the borough. During the 1870s, brick-making became a major industry in the Borough of Little Ferry, which, with its clay beds and proximity to the Hackensack River's transportation options, was well positioned to exploit the brick demands of nearby expanding urban centers. Cole and Showers established the area's first brickyards in 1872, although this enterprise was not successful and the business quickly passed first into the hands of John Thume and then to the Mehrhof family in 1877.

The Mehrhof operation was extremely successful, which brought other brick manufacturers to the Borough of Little Ferry, such as James W. Gillies, the Gardner Brothers, Charles Walsh and Edward Smulto, and I. & W. Felter. The Mehrhof Brick Company remained the largest of the brick-making ventures and was located near the eastern boundary of the current Project Area. Up to and throughout the first half of the 20th century, Little Ferry was prominent in the brick-making industry and vestiges of the industry are visible in clay pits-turned-lakes that remain today. The need for manpower to supply the brickworks attracted immigrant workers, who found employment at the clay beds as well as in other local industries. Beginning in the second half of the 19th century, the Borough of Little Ferry was also the home of other clay-based industries such as flower pot manufacturers and industries that exploited local resources such as shell button producers. This latter industry was adopted by individuals as well as by larger producers (Borough of Little Ferry 2016d).

Borough of Moonachie. According to local legend, the name "Moonachie" was taken from Monaghie, a famous Indian Chief (Wesrervelt 1923). The Borough of Moonachie was an abundant agriculture center; its principal role was feeding the Continental Army during the American Revolution (Borough of Moonachie 2016). After World War II, agriculture was largely abandoned in favor of industry, and traditional truck farms and marshlands were removed in order to create space for high rises and industrial centers (Lurie and Mappen 2004).

Borough of Teterboro. In 1920, only 24 people resided in the Borough of Teterboro (Wesrervelt 1923). Prior to incorporation, it was part of a land-development firm headed by Walter Teter. The initial 540 acres that made up the Borough of Teterboro were removed from the Borough of Little Ferry, Borough of Hasbrouck Heights, and the Township of South Hackensack.

By the early 20th century, the Borough of Teterboro was home to the Wittemann-Lewis Aircraft Company, which produced airplanes (Wesrervelt 1923). Today, the Teterboro Airport is the most recognizable feature in the Borough of Teterboro. The PANYNJ has owned the airport since the 1940s. The Borough of Teterboro is also home to the Aviation Hall of Fame and Museum of New Jersey (founded in 1972) and the Aeronautical Education Center (Lurie and Mappen 2004).

Township of South Hackensack. South Hackensack was predominantly purposed as farmland until the 1940s; however during the second half of the 20th century, industrial growth around the Teterboro Airport and the Hackensack River altered the township's landscape (Lurie and Mappen 2004).

3.6.3.3 Meadowlands Archaeological Sites

No archaeological sites have been registered within a 1-mile radius of the Project Area, according to site files at the NJSM. Native American artifacts were found north of the Project Area in the 1960s near I-80, which do not appear to have been registered as an archaeological site with the NJSM (Ensign 1971). A dugout canoe was found in marshland along the Hackensack River (Cross 1941). Archaeological deposits associated within pearl shell button manufacturing activities have been observed in the Borough of Little Ferry (Erik Kiviat, personal communication, September 19, 2016). Mr. Kiviat indicated that button debris was observed in 2006 within the Project Area. The pearl button industry in the Borough of Little Ferry began around 1890 (Aggarwal 2012, Lurie and Mappen 2004).

3.6.3.4 Previously Recorded Historic Aboveground Resources

Shortly after Hurricane Sandy in 2012, a Programmatic Agreement was issued between NJHPO and FEMA (later expanded in 2013 to include NJDEP and NJDCA) that exempted certain Hurricane Sandy affected areas from a Section 106 review of aboveground historic buildings. These areas were identified by NJHPO and FEMA to have no aboveground historic resources and are known as Historic Preservation Exclusion Green Zones (Green Zones). The Green Zones were delineated by NJHPO and

FEMA through windshield surveys and background research of areas where substantial Hurricane Sandy damage would require FEMA funds to remove private property (NJDCA 2016). In Bergen County, Green Zones were identified in the Boroughs of Little Ferry, Moonachie, and Carlstadt (**Figure 3.6-1**).

Based on an examination of the historic sites maps and their associated documentation on file at NJHPO, including eligibility files and municipal and county-wide surveys and the historic properties and historic districts layers available through NJ-GeoWeb, five historic resources have been previously inventoried within the Project Area: the US Route 46 Bascule Bridge, the Outwater Cemetery, the Gethsemane Cemetery, the Moonachie Streetscape, and 69 Bruno Street in the Borough of Moonachie (see **Figure 3.6-1** and **Table 3.6-1**).

Table 3.6-1: Previously Recorded Historic Resources within the Project Area

NJHPO ID	Name	NRHP Status
2962	US Route 46 Bascule Bridge	Eligible
N/A	Outwater Cemetery	Identified
549	Gethsemane Cemetery	Listed
10543	Moonachie Streetscape	Identified
10543	69 Bruno Street	Identified

Source: NJHPO

The US Route 46 Bascule Bridge in the Borough of Little Ferry was designed in 1934 by John Waddell and Shortridge Hardesty, who were known for their innovative bridge designs. The span is one of only two double-leaf bascule spans constructed in the 1930s in Bergen County and is considered eligible for individual listing on the NRHP (KFS 1997).

The 18th century Outwater Cemetery is located in the Borough of Carlstadt, on Washington Avenue. It was inventoried as part of the Washington Avenue widening project in the late 1980s and was found to be ineligible for the NRHP (NJDOT 1987). Attempts to relocate the cemetery in 2003 were unsuccessful, and researchers hypothesized that it was partially or completely destroyed during the widening of Washington Avenue (Kodlick 2003).

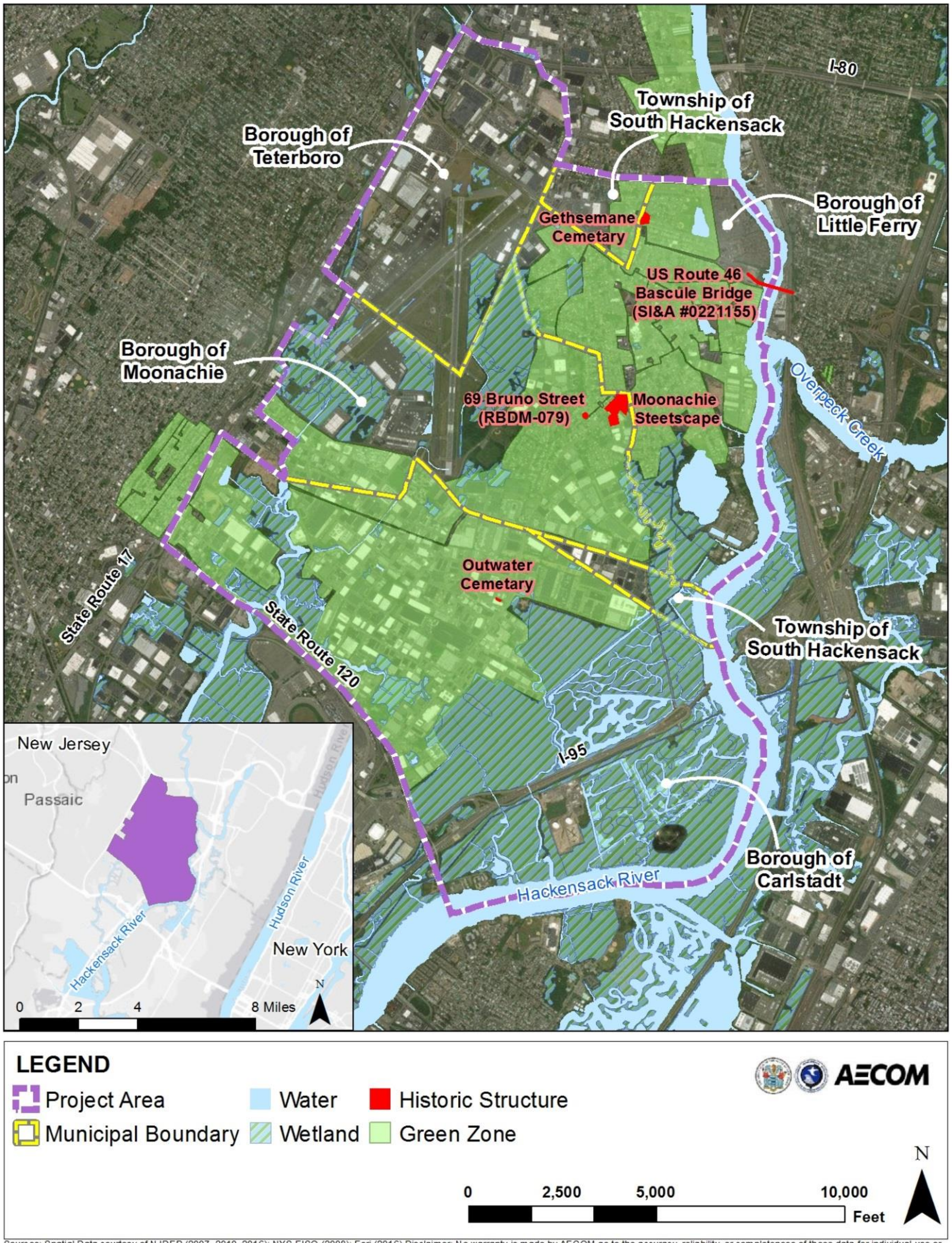
The Gethsemane Cemetery, a mid-19th century African American burial ground listed on the State and National Registers of Historic Places in 1994, is located on Liberty Street just north of US Route 46 in the Borough of Little Ferry. In 1860, this 1-acre site was set aside for Hackensack's African American population. Burial and health records document that it was mainly a family cemetery for the local African American population, but it also served as a potter's field for indigent Caucasians. Approximately 28 gravestones exist and a ground-penetrating radar survey conducted in 1990 suggested the presence of 238 burials (Geismar 1993).

The Moonachie Streetscape is a 17-property historic residential streetscape along Moonachie Road that forms the gateway to the Borough of Moonachie at its border with Little Ferry. This historic streetscape was first identified in the 1980-1981 *Bergen County Historic Sites Survey* as part of an eight-block area bounded by Albert Street, Joseph Street, Moonachie Road, and the Little Ferry Border and later in the reduced two-block Moonachie Road/Ramella Avenue area identified in the 2005 update (Trevisan 2005, Niederer 1981). The streetscape area is comprised of modest, one-and-a-half and two-story, end gable, brick and frame structures constructed during the first quarter of the 20th century. Their roof form, raised basements, consistent setbacks and regular rhythm of one-story front porches lend a cohesive feeling to the northeastern-most end of Moonachie Road.

The dwelling at 69 Bruno Street was individually identified in the 2005 update of the *Bergen County Historic Sites Survey* (Trevisan 2005). The one-and-a-half story, end-gable, brick dwelling at 69 Bruno Street was constructed circa 1911 in the Washington Gove / Washington Park neighborhood of the Borough of Moonachie. With its unpainted red brick walls and tan brick accents, it stands on a corner lot among largely circa 1980 split-level frame dwellings as a distinctive and easily recognizable remnant of an earlier era of development.

There are two cultural resources in the Project Area that have not been formally recorded with the NJHPO. The first, recognized by the American Institute of Aeronautics and Astronautics, is the Bendix Aviation Factory Complex at Teterboro Airport as a national historic site in the aerospace industry (NJDCHA 2005). The second resource is Maple Grove Cemetery, originally called New York Cemetery of the Dutch Reform Church of New York, which is located along the northern portion of the Project Area. In 2003, over 4,000 remains were removed from a historic potter's field in Secaucus, New Jersey, and brought to Maple Grove Park Cemetery to be honored and remembered (Louis Berger Group 2005).

An additional 31 historic resources have been recorded within a 1-mile radius of the Project Area, including 4 historic districts and 27 individual properties (**Table 3.6-2**). Of these resources, 4 districts and 27 individual properties have been identified, determined eligible for listing, or listed on the NRHP.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.6-1: Documented Historical Resources within the Project Area

Table 3.6-2: Inventoried Historic Districts and Individual Properties within 1-Mile Radius of the Project Area

NJ-HPO ID	Name	NRHP Status
N/A	Little Ferry Shops - Railroad Turntable Historic District	Eligible for listing
N/A	Rutherford Downtown Historic District	Eligible for listing
218	Bergen County Line Historic District	Eligible for listing
N/A	Erie Railroad Main Line Historic District	Eligible for listing
520	Bergen County Court House	Listed
523	Dutch Reformed Church and Green in Hackensack	Listed
524	John Hopper House	Listed
521	James A. Brinkerhoff House	Eligible for listing
522	Doremus House	Listed
525	U.S.S. Ling (SS2977)	Listed
N/A	Bogota Boro Hall	Identified, but not evaluated
4555	Court Street Bridge (Str #020004A)	Eligible for listing
437	New York, Susquehanna and Western Railroad Bridge	Eligible for listing
N/A	Apartment House	Identified, but not evaluated
701	Casper Westervelt House	Listed
639	Paulison-Christie House	Listed
638	Overpeck Creek Drawbridge	Eligible for listing
2961	Dutch Reformed Church of the English Neighborhood	Listed
2819	Baker-Post House	Eligible for listing
3561	NYS & W Railroad Tunnel and Cut	Eligible for listing
666	Kip Homestead	Listed
462	Richard Outwater House	Listed
669	William Carlos Williams House	Listed
667	Rutherford Railroad Station	Listed
N/A	East Rutherford Municipal Building	Identified, but not evaluated
3964	Fridolin Arnault House (also Arnault-Bianchi House)	Listed
722	Brinkerhoff House	Listed
529	Franklin School	Eligible for listing
2822	Curtiss-Wright Plant	Eligible for listing
485	English Neighborhood School	Eligible for listing
486	Zabriske-Monahan House	Listed

Source: NJHPO

3.6.3.5 Previous Cultural Resource Studies

An examination of the NJHPO maps identified 23 cultural resource management related documents on file that contain some level of archaeological and/or historic aboveground research undertaken within the Project Area. Most of the studies were done in support of transportation-related projects. The density of sites and aboveground resources cannot be determined because survey acreage was not consistently reported, but some of these projects covered large areas that extended well beyond the current Project Area. The studies included sensitivity analyses (Phase IA), identification-level archaeological surveys (Phase I), and evaluation-level archaeological investigations (Phase II). In some cases, Phase IA and Phase I investigations included the documentation and evaluation of historic aboveground resources. Little to no archaeological excavations have been conducted in the study area.

Hunter Research, Inc. (2006) reviewed paleoenvironmental and cultural resource studies relevant to archaeological sensitivity in the Meadowlands District. They found that while there is little disagreement about the high subsistence value of the marshland environment for prehistoric populations in terms of plant and animal resources, the way in which those resources were exploited is much less certain. It remains unknown whether groups used the Meadowlands to procure resources for base camps in the uplands or whether the camps were in the Meadowlands themselves. As Hunter Research, Inc. (2006) notes, the Meadowlands are not a static environment and small changes in climate and sea level would have affected what areas were habitable at different points in time.

In terms of historic-period sensitivity Hunter Research, Inc. (2006) cites palynological studies that indicate agricultural use of the Meadowlands as early as the second quarter of the 17th century. The major economic emphasis in the Meadowlands toward the end of the 17th century was the exploitation of salt hay, and Meadowland drainage projects aimed at improving their economic value began in the early 19th century. For the most part, settlement was limited to dry ground; however, Hunter Research, Inc. (2006) cautions that changes in water levels may indicate current wet areas may not have been the same throughout the historic period.

Several large cultural resource studies conducted in the Project Area suggested sensitivity for both prehistoric and historic period archaeological resources. However, subsequent testing uncovered no evidence of prehistoric or historic activities and no further work was recommended (Richard Grubb & Associates, Inc. 1989, Matthews 1993, Boylan 1978).

Smaller cultural resource studies conducted across the Meadowlands have characterized the Project Area as having low sensitivity for the possible presence of archaeological resources and yielded no cultural materials (Eldridge 2001, Lenik and Gibbs 1997, URS 2012, URS 2013, Veit and Walezak 1997). However, past studies have identified the possible presence of three historic tide gates associated with the drainage and dike systems constructed to drain the Meadowlands within the Project Area. A Phase I archaeological survey, conducted by Richard Grubb and Associates in 2011 for a wetland mitigation bank in the Borough of Carlstadt, encountered the presence of wooden and earthwork features associated with the historic drainage and dike systems (Wieczorek and Tvaryanas 2011). These features are most likely associated with the early 20th century efforts to control mosquito populations in New Jersey. Due to evidence of recent modification and repair, no further work was recommended.

3.7 Transportation and Circulation

3.7.1 Introduction

This section describes the existing transportation network, infrastructure, and operations. To supplement existing information on regional and local transportation and circulation within the Project Area, a site-specific transportation study was conducted within the Project Area. Traffic data were collected on major roads within the Project Area. These data were used to generate existing traffic volumes, determine the peak hour for all three peak periods analyzed (weekday morning (AM), midday (MD), and evening (PM)), and conduct a traffic analysis of existing conditions to determine level of service (LOS) at study locations. Crash records from the New Jersey Department of Transportation (NJDOT) were used to perform a safety analysis. Existing parking, pedestrian and bicycle facilities, freight facilities, and ancillary transportation facilities are also summarized in this section. This section also includes an assessment of existing public transportation services and facilities, including bus and passenger rail services.

3.7.2 Regulatory Context

The Transportation Research Board (TRB) Highway Capacity Manual (HCM) establishes the methodology to use when conducting traffic analyses (Transportation Research Board 2010). The traffic analysis conducted for this study is compatible with the 2010 HCM. The proposed construction staging and proposed permanent roadway improvements would be required to comply with the NJDOT State Highway Access Management Code (NJAC 16:47), NJDOT Roadway Design Manual (NJDOT 2015a), and NJDOT Traffic Mitigation Guidelines (NJDOT 2014a). Furthermore, the proposed construction-related maintenance of traffic devices and permanent traffic control devices would be required to comply with the FHWA's Manual on Uniform Traffic Control Devices (MUTCD) (23 CFR Part 655) (FHWA 2009). More information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

3.7.3 Existing Conditions

The following sections include a description on the current status of the roadway network and operations, such as traffic peak hours, traffic volumes, LOS, and roadway safety. Additionally, these sections include an overview of the existing transportation facilities, including parking, pedestrian, and bicycle; transit service; freight; and other ancillary facilities within the Project Area.

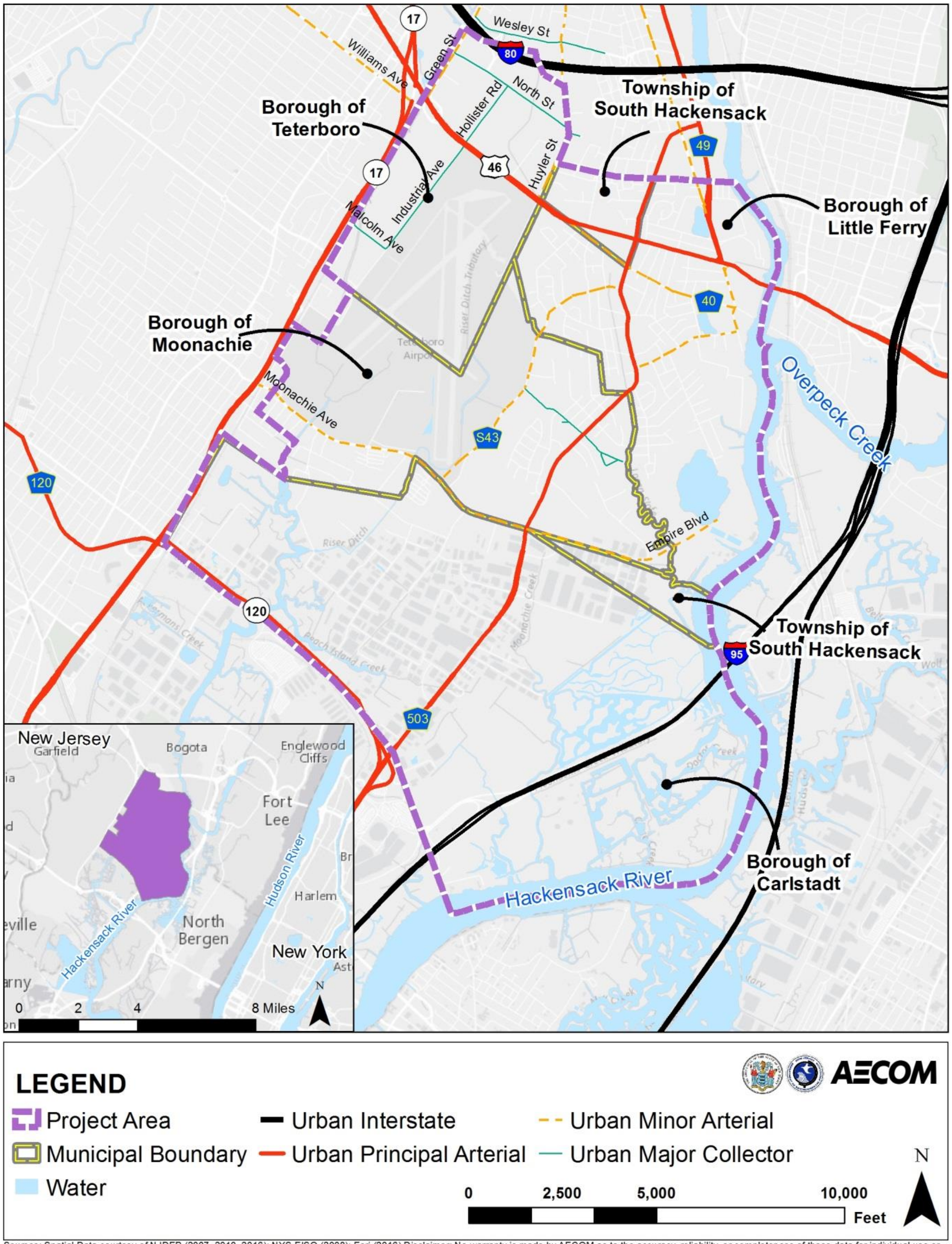
3.7.3.1 Roadways

The Project Area is bounded by I-80 to the north, Hackensack River to the east, State Route 120 (Paterson Plank Road) to the south, and State Route 17 to the west. The regional roadway network is connected to the Project Area by two major interstate routes, two US routes, and several State routes, including I-80, I-95, and Interstate 280 (I-280); US Route 1-9 and US Route 46; and State Routes 3, 7, 17, 120, and 495. Major roadways in the Project Area, including their roadway functional classification and Average Annual Daily Traffic (AADT), are shown in **Table 3.7-1** and **Figure 3.7-1**. AADT is the daily average vehicular traffic measured on a specific roadway segment over a period of 365 days. According to the NJDOT Straight Line Diagrams, the highest AADT in the Project Area is along State Route 17, with 89,300 AADT in 2014 (NJDOT 2015b). AADT is not available for minor roadways in the Project Area.

Table 3.7-1: Major Roadway Functional Classifications and AADT

Roadway Name	Functional Class	AADT
State Route 17	Urban Principal Arterial	59,000-89,300 (2014)
State Route 120 (Paterson Plank Road)	Urban Principal Arterial	19,500-48,300 (2012)
US Route 46	Urban Principal Arterial	37,600-54,300 (2012)
Bergen County Route 40 (Main Street)	Urban Minor Arterial	7,400 (2015)
Bergen County Route S40 (Huyler Street)	Urban Minor Arterial	NA
Bergen County Route S43 (Redneck Avenue)	Urban Minor Arterial	7,400 (2012)
Bergen County Route 49 (South River Street)	Urban Principal Arterial	14,700 (2013)
Bergen County Route 120 (Paterson Avenue)	Urban Minor Arterial	18,800 (2012)
Bergen County Route 124 II (Bergen Turnpike)	Urban Principal Arterial	14,300 (2014)
Bergen County Route 503 (Washington Avenue/Moonachie Road /Liberty Street)	Urban Principal Arterial	17,500 (2010)
Bergen County Route 36 (Moonachie Avenue)	Urban Minor Arterial	6,521 (2012)
Washington Avenue, Little Ferry	Urban Minor Arterial	NA
Wesley Street, Hackensack	Urban Major Collector	NA
Green Street, Hackensack	Urban Minor Arterial	NA
Joseph Street, Moonachie	Urban Major Collector	NA

Source: (NJDOT 2015b), (NJDOT 2014b)



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

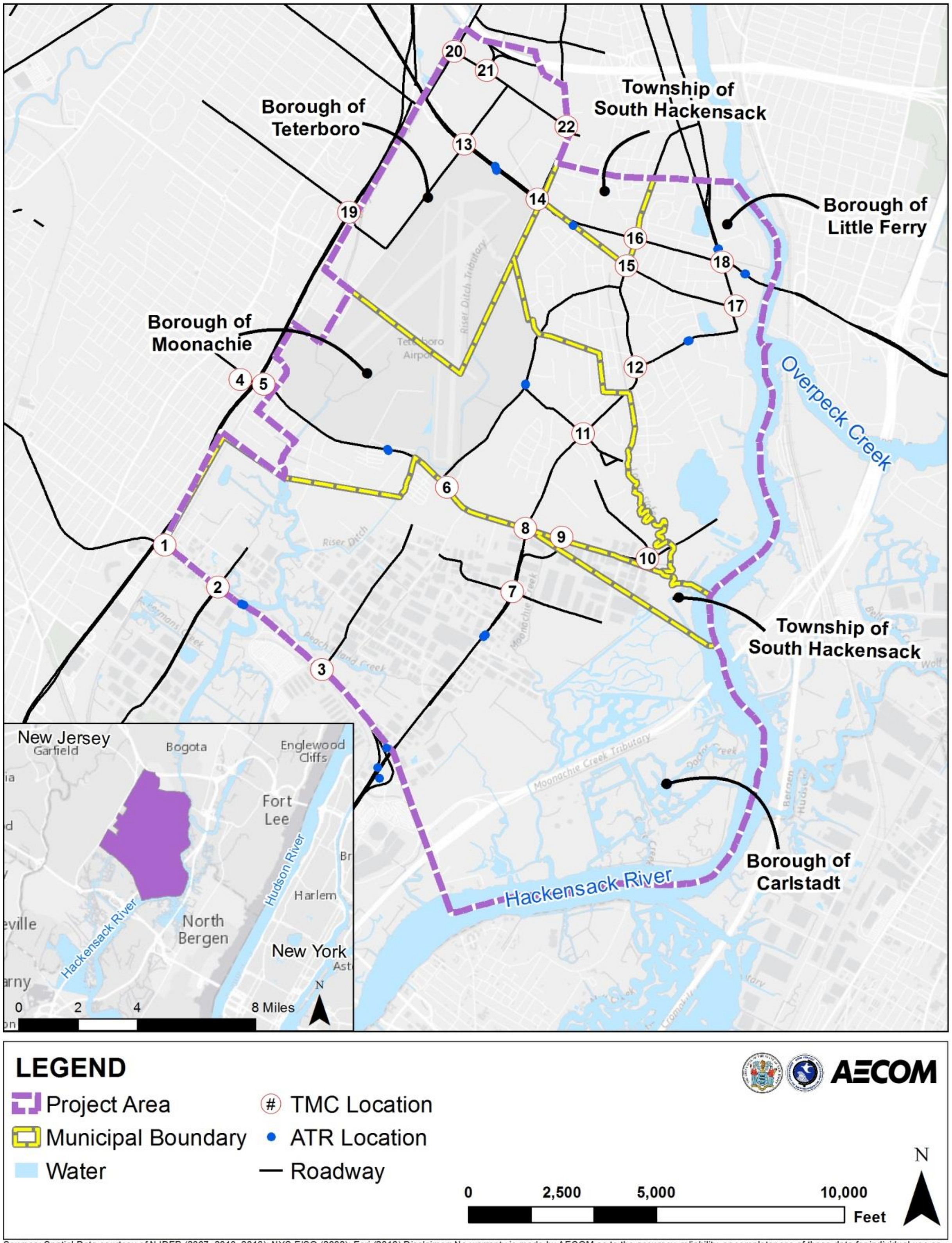
Figure 3.7-1: Regional Roadway Network

Traffic Data Collection

Available roadway, intersection, and traffic control data were collected from the NJDOT, the NJSEA, Bergen County, and local municipalities. In addition, intersection turning movement counts (TMC) that measure the type and number of vehicles making a left turn, though, or right turn movement were collected, as well as the number of pedestrians and bicycles. Data were collected in 15-minute intervals on Thursday, September 15, 2016 during the typical weekday AM, MD, and PM peak periods (3 hours each) at key intersections that may potentially be affected by the Proposed Project. Travel time and delay data for the major corridors were also collected concurrently during the TMC data collection periods. Further, Automatic Traffic Recorders (ATR) were installed to collect 24-hour vehicular volumes in 15-minute intervals for 9 days from Saturday, September 10, 2016 through Monday, September 19, 2016 on local roadways. Video ATR data were collected to supplement standard ATR data for 3 days from Tuesday, September 13, 2016 through Thursday, September 15, 2016. **Table 3.7-2** and **Figure 3.7-2** list and illustrate the study locations where TMC data were collected.

Table 3.7-2: Study Intersections

Intersection ID	Intersection Name	Jurisdiction
1	State Route 120 (Paterson Plank Road) and State Route 17 NB Exit Ramp	NJDOT
2	State Route 120 (Paterson Plank Road) and Murray Hill Parkway	NJDOT
3	State Route 120 (Paterson Plank Road) and Gotham Parkway	NJDOT
4	State Route 17 SB Exit Ramp and Moonachie Avenue	NJDOT
5	State Route 17 NB Exit Ramp and Moonachie Avenue	NJDOT
6	Moonachie Avenue and Redneck Avenue/Private Driveway	Bergen County
7	Washington Avenue and Commerce Road	Bergen County
8	Washington Avenue and Moonachie Road	Bergen County
9	Empire Boulevard and Terminal Boulevard	Borough of Moonachie
10	Empire Boulevard and State Street	Borough of Moonachie
11	Moonachie Road and E Joseph Street	Bergen County
12	Washington Avenue and Liberty Street	Bergen County
13	US Route 46 and Hollister Road	NJDOT
14	US Route 46 and Huyler Street	NJDOT
15	Main Street and Liberty Street	Borough of Little Ferry
16	US Route 46 and Liberty Street	NJDOT
17	Main Street and Washington Avenue	Bergen County
18	US Route 46 and Bergen Turnpike	NJDOT
19	State Route 17 and Franklin Avenue/Malcolm Avenue	NJDOT
20	North Street and Green Street	Bergen County
21	North Street and I-80 EB Exit 65 on & off ramps	NJDOT
22	Huyler Street and North Street	Bergen County



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.7-2: Study Intersection Locations

Peak Hour Determination

The peak hour is defined as the hour with the highest traffic volumes during each of the AM, MD, and PM periods on a typical weekday. Traffic peak hours were calculated based on TMC and ATR traffic volumes collected during the AM, MD, and PM peak hour periods. All the 15-minute TMC and ATR volumes were first summed to produce rolling 60-minute (hourly) volumes of the Project Area. The temporal distribution of traffic volumes was then plotted to determine the common peak hours of the Project Area, as illustrated in **Figure 3.7-3**. The difference in TMC and ATR volumes shown in **Figure 3.7-3** occurs because the TMC volumes represent the volumes at 22 TMC locations, including both mainline and cross street volumes, whereas the ATR volumes represent volumes at 13 locations along the mainline roadways only.

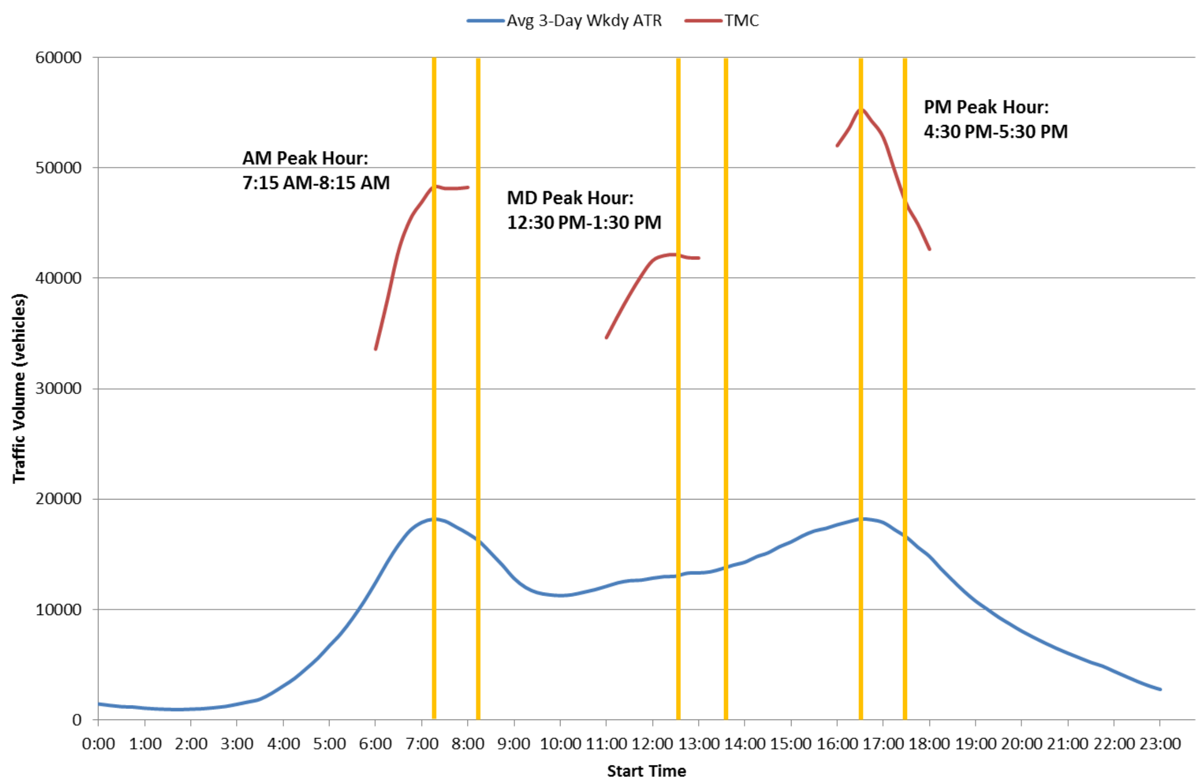


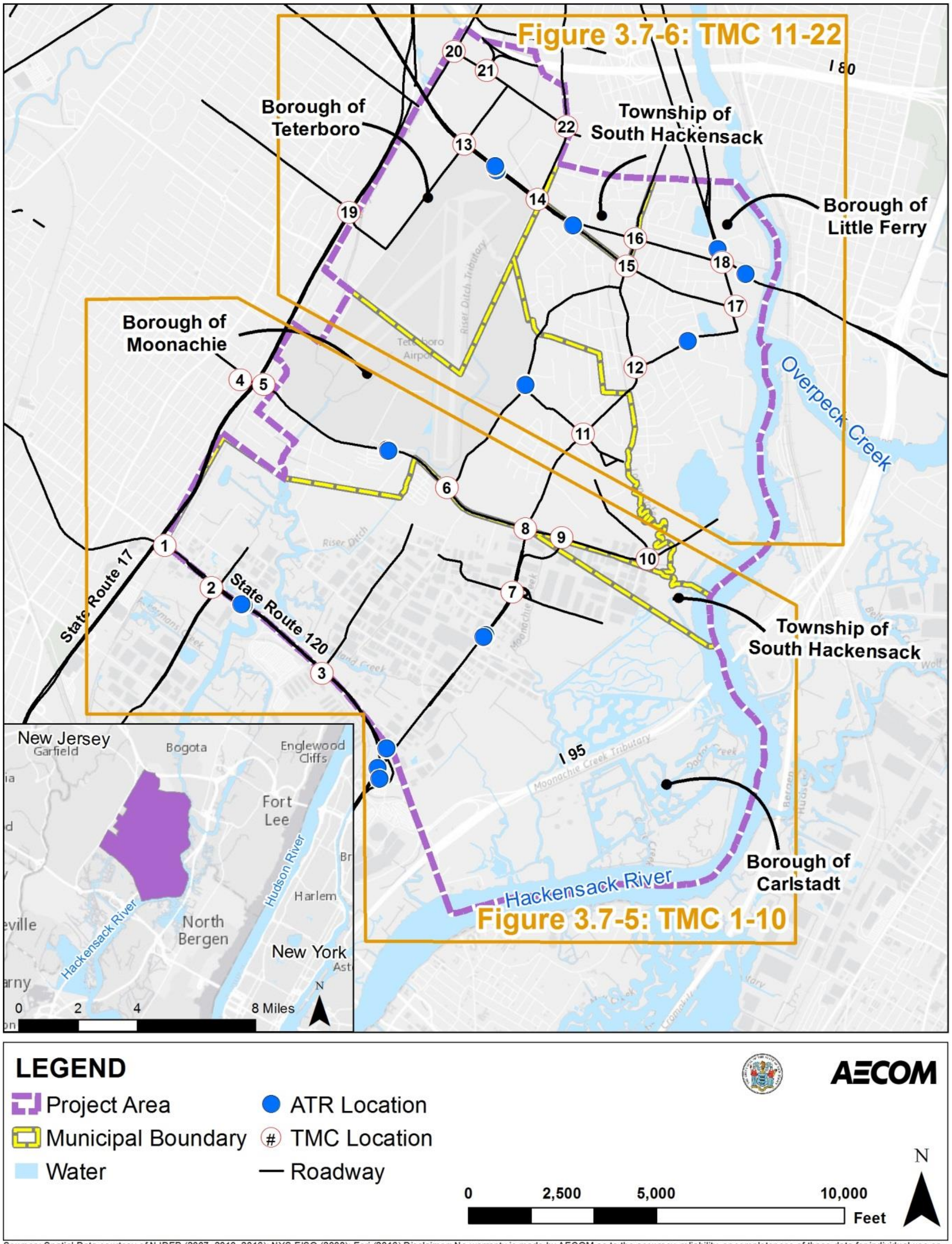
Figure 3.7-3: Traffic Volume Temporal Distribution – Rolling Hour Volumes

The common peak hours for the weekday AM, MD, and PM peak periods are as follows:

- Weekday AM Peak Hour: 7:15 AM to 8:15 AM;
- Weekday MD Peak Hour: 12:30 PM to 1:30 PM; and
- Weekday PM Peak Hour: 4:30 PM to 5:30 PM.

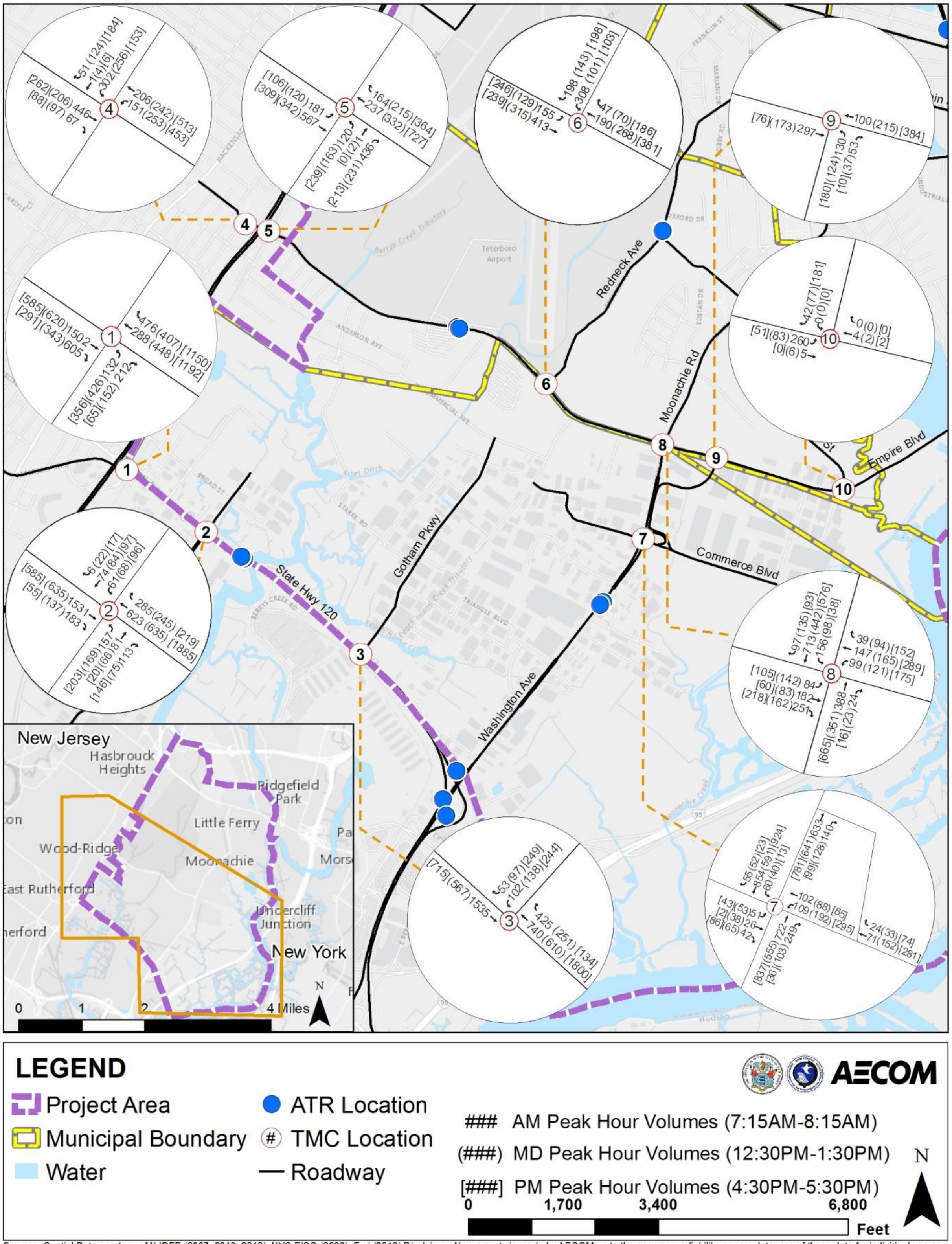
Existing Peak Hour Volumes

Existing peak hour volumes were balanced for closely spaced intersections, such as TMC 4 and TMC 5, and against ATR data at TMC 2, TMC 13, TMC 14, and TMC 18. All other TMC locations were not balanced due to volume sinks and sources between the TMCs, such as large parking lots and side streets. **Figure 3.7-4**, **Figure 3.7-5**, and **Figure 3.7-6** illustrate the peak hour volumes under existing conditions.



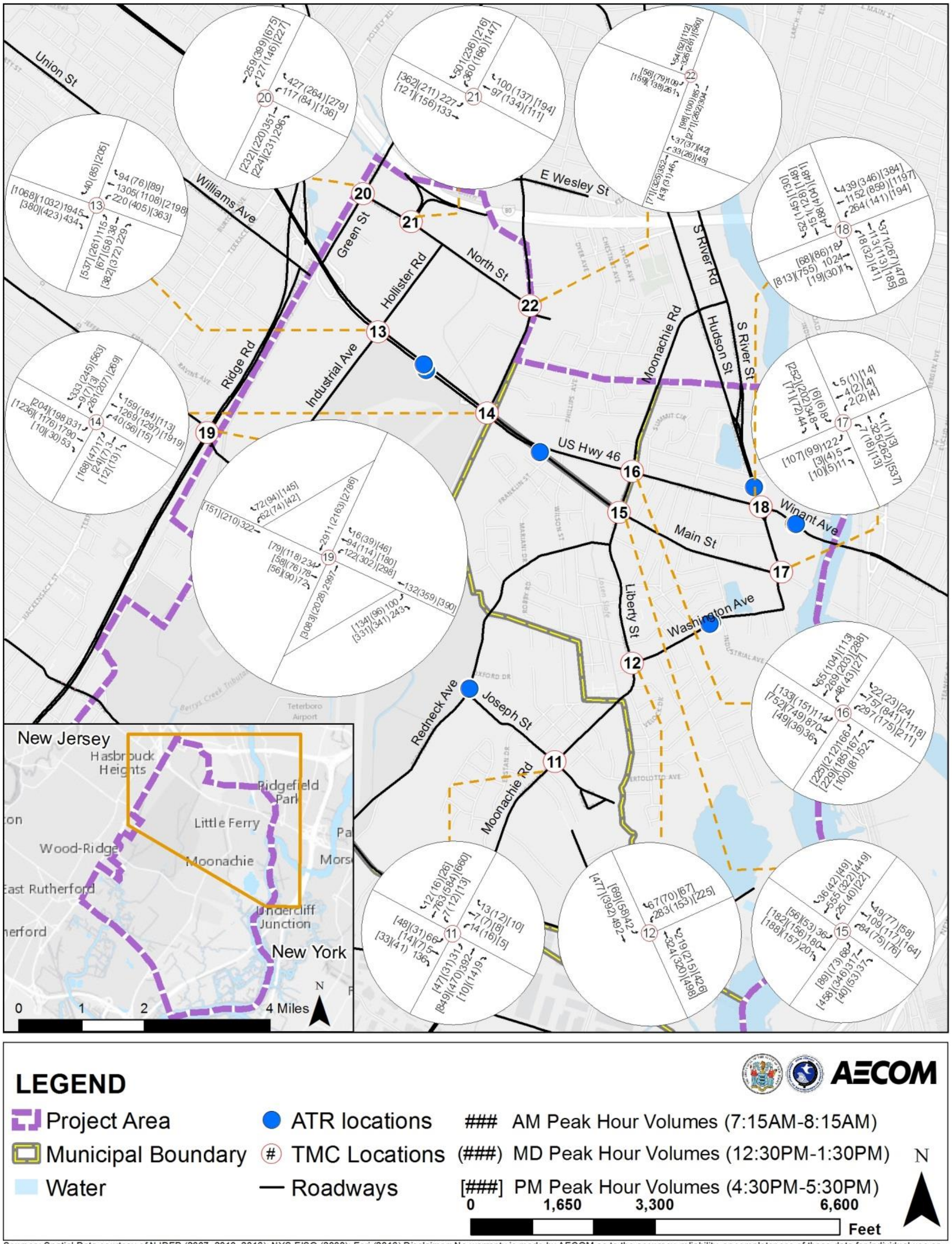
Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.7-4: Existing Traffic Volume Index Map



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.7-5: Existing Traffic Volumes (TMC 1-10)



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.7-6: Existing Traffic Volumes (continued) (TMC 11-22)

Existing Levels of Service

LOS is defined by the HCM as a quantitative performance measure to represent quality of service of a transportation facility, ranging from A to F for signalized and not signalized intersections (Transportation Research Board 2010). In general, LOS A represents the best traffic operating condition and LOS F represents the worst condition (typically associated with congestion and long delays). The LOS values for unsignalized and signalized intersections are defined in terms of average delay. **Table 3.7-3** lists the LOS criteria for signalized and unsignalized intersections.

Table 3.7-3: 2010 HCM LOS Criteria for Signalized and Unsignalized Intersections

LOS	Average Control Delay (seconds/vehicle)	
	Signalized	Unsignalized
A	Less than or equal to 10.0	Less than or equal to 10.0
B	>10.0 to 20.0	>10.0 to 15.0
C	>20.0 to 35.0	>15.0 to 25.0
D	>35.0 to 55.0	>25.0 to 35.0
E	>55.0 to 80.0	>35.0 to 50.0
F	Greater than 80.0	Greater than 50.0

Source: (Transportation Research Board 2010)

To build a baseline condition, a detailed traffic analysis was performed to assess the existing vehicular delay and LOS at study intersections. A traffic model was built in Synchro Version 8, build 806, revision 77, and calibrated to replicate the existing conditions as observed during the TMC data collection process. In the Synchro calibration process, factors such as lane utilization, lost time adjustment, and saturation flow rate based on field observations and videos were used to adjust the queue length results to better represent field conditions. Overall intersection and lane group LOS results were generated by the Synchro model.

Intersections 1 through 8, and 19, are operated under the NJSEA Meadowlands Adaptive Signal System for Traffic Reduction (MASSTR). The adaptive controller optimized the signal timing parameters for each cycle based on live traffic demand. Therefore, the cycle lengths and phase splits for the adaptive signals are constantly changing. NJSEA provided average signal timings for the three peak periods on a typical weekday. In the Synchro model, the adaptive signals are analyzed with an optimized signal timing to account for the adaptive nature of these intersections. The cycle lengths and phase splits are within close range of the average values.

In general, the existing intersections are found to be operating at an acceptable LOS during the AM, MD, and PM peak hours, with the exception of intersections 4 and 5. The intersections of State Route 17 exit ramps and Moonachie Avenue operates at LOS E during the analyzed peak hours, especially during the PM peak hour, which experiences a poor LOS E.

Table 3.7-4 summarizes the average delay and LOS at the intersection level for the AM, MD, and PM peak hours. Detailed Synchro intersection analysis results for the existing conditions during the peak hours, including volume-to-capacity ratio as a measure of theoretical roadway capacity, average delay in seconds per vehicle, and LOS for both signalized and unsignalized intersections are included in **Appendix F**.

Table 3.7-4: Existing Synchro Model Results for AM, MD, and PM Peak Hours

Intersection ID	Intersection Name	AM Peak Hour		MD Peak Hour		PM Peak Hour	
		Delay	LOS	Delay	LOS	Delay	LOS
1	State Route 120 (Paterson Plank Road) and State Route 17 NB Exit Ramp	12.2	B	14.7	B	16.2	B
2	State Route 120 (Paterson Plank Road) and Murray Hill Parkway	13.3	B	13.6	B	17.3	B
3	State Route 120 (Paterson Plank Road) and Gotham Parkway	7.5	A	11.1	B	42.6	D
4-5	State Route 17 & Moonachie Ave	56.5	E	53.5	E	74.8	E
6	Moonachie Avenue and Redneck Avenue/Private Driveway	16.8	B	9.0	A	12.2	B
7	Washington Avenue and Commerce Road	17.6	B	21.3	C	26.0	C
8	Washington Avenue and Moonachie Road	27.9	C	18.9	B	20.3	C
9*	Empire Boulevard and Terminal Boulevard	4.7	A	3.7	A	4.9	A
10*	Empire Boulevard and State Street	0.2	A	0.1	A	0.1	A
11	Moonachie Road and E Joseph Street	12.5	B	10.7	B	18.6	B
12	Washington Avenue and Liberty Street	15.5	B	13.0	B	17.2	B
13	US Route 46 and Hollister Road	20.6	C	24.0	C	30.9	C
14	US Route 46 and Huyler Street	34.5	C	26.7	C	39.2	D
15	Main Street and Liberty Street	27.2	C	21.2	C	28.8	C
16	US Route 46 and Liberty Street	42.3	D	35.8	D	48.8	D
17*	Main Street and Washington Avenue	16.3	C	11.5	B	27.4	D
18	US Route 46 and Bergen Turnpike	39.6	D	33.0	C	39.2	D
19	State Route 17 and Franklin Avenue/Malcolm Avenue	35.2	D	33.2	D	34.3	D
20	North Street and Green Street	10.2	B	8.3	A	9.9	A
21*	North Street and I-80 EB Exit 65 on & off ramps	25.4	D	10.4	B	15.8	C
22	Huyler Street and North Street	29.9	C	22.7	C	28.9	C

*Intersection is not signalized.

3.7.3.2 Safety

A crash analysis was conducted as part of the transportation assessment to assess existing roadway safety conditions within the Project Area. Three-year crash records (2012 to 2014) of major roadways in the Project Area were provided by NJDOT and are provided in **Appendix F** along with the statewide average crash rates. These data were analyzed to determine the average crash rates and crash patterns of the major roadway segments and key intersections in the Project Area. High crash roadway segments are defined as segments with a crash rate that exceeds the statewide average for a particular roadway type. High crash intersections are identified by the number of crashes that occurred during the three-year period. **Table 3.7-5** presents a summary of roadway segment crashes within the Project Area and a comparison against the NJDOT statewide crash rates by cross section geometry. **Table 3.7-6** includes a summary of Project Area intersection crashes by year.

Table 3.7-5: Project Area Roadway Segment Crash Summary (2012-2014)

Roadway Segment	Mile Post		Total Crashes	AADT	Crash Rate (crashes/mvm)	NJ Avg. Crash Rate for 2012-2014 (crashes/mvm)	Percent Difference
	From	To					
State Route 17	5.84	7.40	128	59036	1.27	1.63	-22%
	7.40	8.44	298	78939	3.31	1.63	103%
State Route 120 (Paterson Plank Road)	1.03	2.65	79	37056	1.20	2.98	-60%
US Route 46*	68.21	68.37	25	54348	2.63	1.63	61%
	68.37	68.51	19	54348	2.28	2.15	6%
	68.51	69.19	127	37561	4.54	4.48	1%
	69.19	70.25	287	37561	6.58	5.98	10%
Bergen County Route 40 (Main Street)	0.00	0.95	44	7422	5.70	3.79	50%
Bergen County Route S40 (Huyler Street)	0.00	0.59	9	6000	2.32	3.79	-39%
Bergen County Route S43 (Redneck Avenue)	0.00	1.44	26	7371	2.24	3.79	-41%
Bergen County Route 49 (South River Street)	0.00	0.20	2	14706	0.62	4.48	-86%

Roadway Segment	Mile Post		Total Crashes	AADT	Crash Rate (crashes/mvm)	NJ Avg. Crash Rate for 2012-2014 (crashes/mvm)	Percent Difference
	From	To					
Bergen County Route 124 II (Bergen Turnpike)	0.00	0.19	5	14258	1.69	3.79	-56%
	0.19	0.55	81	14258	14.41	2.98	384%
	0.55	0.69	9	14258	4.12	3.79	9%
Bergen County Route 503 (Washington Avenue)	0.23	0.50	3	17531	0.58	4.48	-87%
	0.50	0.75	17	17531	3.54	2.98	19%
	0.75	1.07	31	17531	5.05	4.48	13%
	1.07	1.42	32	17531	4.76	2.98	60%
	1.42	1.59	3	17531	0.92	4.48	-79%
Bergen County Route 503 (Liberty Street, Moonachie Road)	1.59	3.58	181	17531	4.74	3.79	25%
Bergen County Route 36 (Moonachie Avenue)	0.37	1.87	51	6521	4.76	3.79	26%

*The intersection of US Route 46 and Bergen Turnpike was changed from a traffic circle (Little Ferry Circle) to a four-legged intersection in 2016. This is not reflected in the 2012-2014 crash data.
Highlighted rows indicate where crash rates above the statewide average.
mvm = million vehicle miles

Table 3.7-6: Project Area Intersection Crash Summary (2012-2014)

Intersection Number	Intersection	Number of Crashes in 2012	Number of Crashes in 2013	Number of Crashes in 2014	Total
1	State Route 120 (Paterson Plank Road) and State Route 17 NB Exit Ramp	2	2	0	4
2	State Route 120 (Paterson Plank Road) and Murray Hill Parkway	1	4	4	9
3	State Route 120 (Paterson Plank Road) and Gotham Parkway	6	7	2	15
4/5*	State Route 17 and Moonachie Avenue	NA	NA	NA	NA
6	Moonachie Avenue and Redneck Avenue	3	4	5	12
7	Washington Avenue and Commerce Road	7	5	10	22
8	Washington Avenue and Moonachie Road	11	10	15	36
9	Empire Boulevard and Terminal Boulevard	0	0	2	2
10	Empire Boulevard and State Street	0	0	2	2
11	Moonachie Road and E Joseph Street	5	4	9	18
12	Washington Avenue and Liberty Street	5	6	0	11
13	US Route 46 and Hollister Road	20	26	15	61
14	US Route 46 and Huyler Street	21	16	23	60
15	Main Street and Liberty Street	13	8	0	21
16	US Route 46 and Liberty Street	43	21	0	64
17	Main Street and Washington Avenue	1	3	0	4
18**	US Route 46 and Bergen Turnpike	86	69	0	155
19	State Route 17 and Franklin Avenue/Malcolm Avenue	32	35	21	88
20*	North Street and Green Street	NA	NA	NA	NA
21*	North Street and I-80 EB Exit 65 on & off ramps	NA	NA	NA	NA
22	Huyler Street and North Street	0	2	0	2

*Crash data was not available for this location.
**US Route 46 was reconstructed in 2016 from mileposts 69.17 to 70.45. The intersection of US Route 46 and Bergen Turnpike was changed from a traffic circle (Little Ferry Circle) to a four-legged intersection in 2016. This is not reflected in the 2012-2014 crash data.

The roadway segment crash rate along US Route 46 within the Project Area exceeds the statewide average crash rate, with a significant deviation from the statewide average crash rate at 61 percent above the average between mileposts 68.2 and 68.4. The intersection of US Route 46 and Bergen Turnpike has the greatest number of crashes at 155 reported crashes in the 3-year period. In addition, Bergen Turnpike between mileposts 0.2 and 0.6 has the greatest deviation from the statewide average crash rate at 384 percent above the average. This may be attributed to the traffic circle at Bergen Turnpike and US Route 46, known as the Little Ferry Circle. This was replaced with a conventional four-legged intersection in 2016, and is not reflected in the 2012 to 2014 crash data.

Other roadway segments within the study area that show a large deviation above the statewide average crash rate include:

- State Route 17 between mileposts 7.4 and 8.4: 103 percent above the average, which includes the intersection of State Route 17 and Franklin Avenue/Malcom Avenue with 88 crashes during the three-year period;
- Washington Avenue between mileposts 1.1 and 1.4: 60 percent above the average, which includes the Washington Avenue and Commerce Road intersection with 22 crashes during the three-year period; and
- Main Street between mileposts 0.0 and 1.0: 50 percent above the average, which includes the Main Street and Liberty Street intersection with 21 crashes during the three-year period.

The study intersections along US Route 46 include four of the five top study intersection crash locations in the Project Area. The top five crash locations and three-year crash totals are as follows:

1. US Route 46 and Bergen Turnpike (155 crashes)
2. State Route 17 and Franklin Avenue/Malcolm Avenue (88 crashes)
3. US Route 46 and Liberty Street (64 crashes)
4. US Route 46 and Hollister Road (61 crashes)
5. US Route 46 and Huyler Street (60 crashes)

However, NJDOT recently completed reconstruction of US Route 46 from Main Street (milepost 69.2) in the Township of South Hackensack to Ridgefield Avenue (milepost 70.5) in the Village of Ridgefield Park. The major improvements included converting the Little Ferry Circle where US Route 46 intersects Bergen Turnpike into a regular four-legged intersection, additional turn lanes at signalized intersections, new traffic signal equipment, lighting, and sidewalks. The crash data were collected for years prior to the reconstruction of US Route 46. It is anticipated that these improvements would reduce the number of crashes along the US Route 46 corridor, especially at the intersection of US Route 46 and the Bergen Turnpike.

After construction information for the Build Alternatives is received, additional safety analyses will be conducted for locations where construction vehicles would be temporarily added along the roadway network, which would be determined based on the construction vehicle routes. Additional safety analysis will be conducted to identify and summarize major concerns, crash clusters, or crash contributing factors within the Project Area.

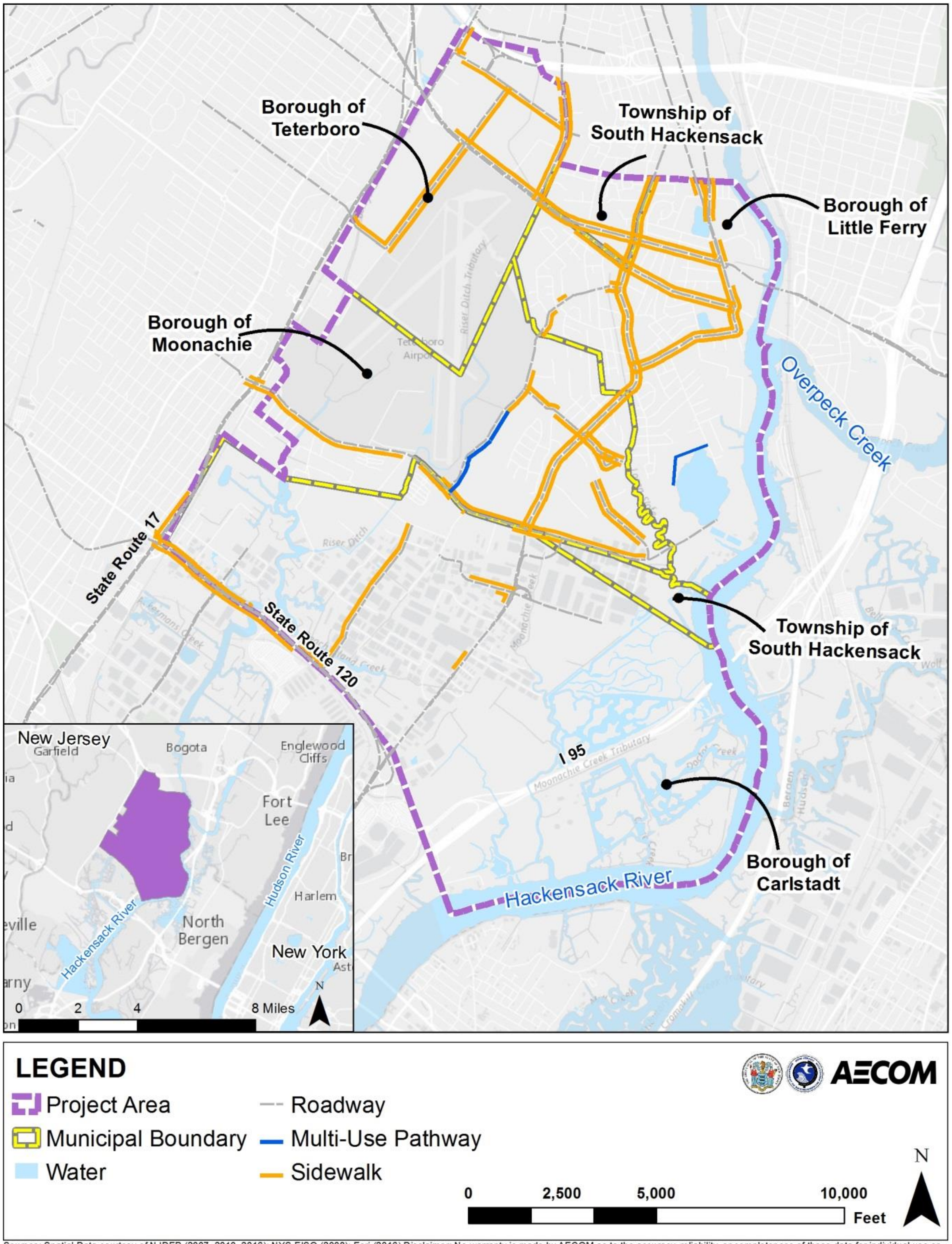
3.7.3.3 Parking

Existing parking facilities in the Project Area include free and paid on-street parking and off-street parking in private and public lots. Private lots are limited to use by private businesses, business patrons, and local and commercial retail patrons. Public lots include park-and-ride facilities available for bus and rail passengers.

On-street parking is prohibited on all the Urban Principal Arterials and Urban Minor Arterials, which are identified in **Table 3.7-1**. On-street parking is provided along some collector roads, local streets in downtown, and local commercial corridors, as well as in residential areas. In the Project Area along roadways where traffic data were collected, on-street parking is available on roadways such as Redneck Avenue, Washington Avenue, and Main Street in the Borough of Little Ferry; and Joseph Street in the Borough of Moonachie. Overnight parking is restricted and/or requires resident permitting throughout the majority of the Project Area.

3.7.3.4 Pedestrians and Bicycles

Existing pedestrian and bicycle facilities in the Project Area include sidewalks, pedestrian and bicycle pathways, and limited bike paths. Sidewalks in commercial and residential areas are typically continuous and well-maintained, while sidewalks in industrial and warehouse areas are limited. A 0.5-mile-long pedestrian and bicycle pathway is located in the Project Area, which runs through Losen Slote Creek Park in the Borough of Little Ferry, and is a segment of the 5.4-mile-long Meadows Path. Losen Slote Creek Park also includes hiking trails for pedestrians and bicyclists. **Figure 3.7-7** depicts the locations of existing pedestrian and bicycle pathways.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.7-7: Pedestrian and Bicycle Pathways in the Project Area

3.7.3.5 Transit

Transit services include bus and commuter rail. NJ TRANSIT is the primary public transportation agency that provides bus and passenger rail service within the Project Area. Transit facilities within the Project Area, including bus stops, rail stations, and park-and-ride facilities are shown in **Figure 3.7-8**. As listed in **Table 3.7-7**, a total of seven NJ TRANSIT bus routes have designated stops in the vicinity of the Project Area. Private bus and shuttle companies such as DeCamp Bus Company and EZ Ride serve some of the boroughs around the Project Area; however, their routes and bus stops fall outside the Project Area.

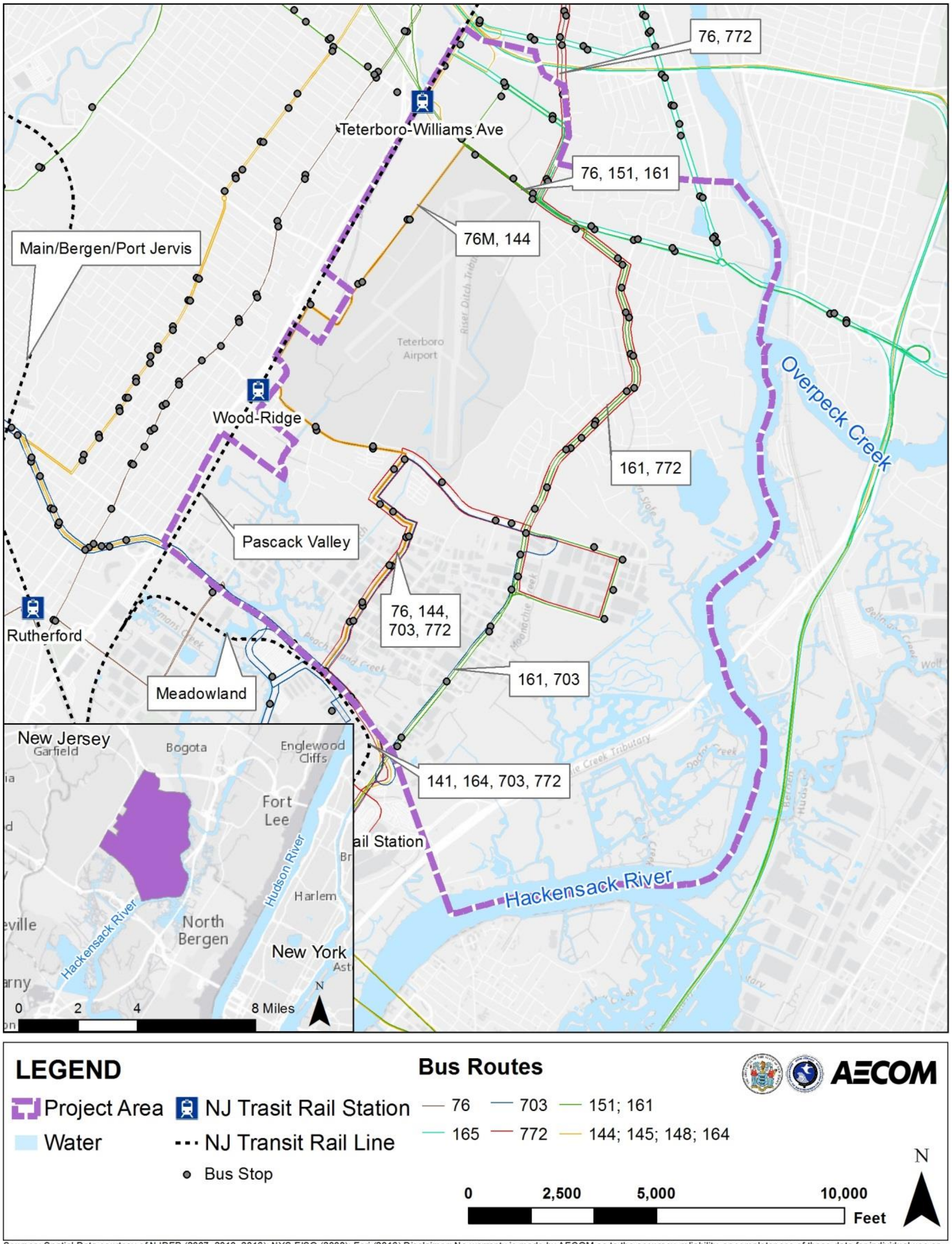
The NJ TRANSIT Pascack Valley Line services the Project Area, with the Wood-Ridge Station and Teterboro Stations providing service between Spring Valley, New York and Hoboken, New Jersey. Rail service at these stations operates at a frequency of up to three trains per hour during weekday AM and PM peak hours. Passengers must transfer at Secaucus Junction for service to and from New York Penn Station in New York City. Secaucus Junction is a major transit hub in the vicinity of the Project Area that functions as a transfer point for several NJ TRANSIT rail lines for service to destinations in New Jersey, as well as New York Penn Station.

Two NJ TRANSIT park-and-ride facilities are located along State Route 17 near the Project Area. The NJ TRANSIT Wood-Ridge Station has one parking lot with 130 standard and six handicap-accessible spaces, located on Anderson Avenue and Park Place East in the Borough of Wood-Ridge. The Teterboro Station has a 27-space parking lot located on Green Street in the Borough of Teterboro.

Table 3.7-7: NJ TRANSIT Bus Routes in the Project Area

Bus Route	Service Area	Major Roads Traveled	Average Maximum Directional Weekday Peak Hour Headway
76 (Meadowlands)	Newark – Hackensack	Paterson Plank Road, Gotham Parkway, Moonachie Avenue, Industrial Avenue, Huyler Street	40 minutes
144	Elmwood Park – Hackensack – New York City	Paterson Plank Road, Gotham Parkway	9 minutes
151 (Express)	Paterson – New York City	Main Street	12 minutes
161	Paterson, Passaic – New York City	Washington Avenue, Moonachie Road	8 minutes
165	Westwood – New York City	Main Street	8 minutes
703	Haledon – Paterson – East Rutherford	Paterson Plank Road, Washington Avenue	10 minutes
772	New Milford – Hackensack – Meadowlands	Washington Avenue, Moonachie Road	30 minutes

Source: (NJ Transit 2016)



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.7-8: NJ TRANSIT Service in and around the Project Area

3.7.3.6 Freight

The Project Area lies within the nation's largest metropolitan market area, thus making it a prime location for trucking services and associated land uses. Based on existing land use maps, major freight generators within the Project Area include Teterboro Airport, and local commercial and industrial/manufacturing businesses. The roads within and around the Project Area provide a link between businesses and freight facilities, resulting in a high percentage of heavy vehicles traveling on roadways in the Project Area. The 2015 NJDOT Truck Map shows two types of designated truck routes within the Project Area, including New Jersey access network and national network routes (NJDOT Bureau of TDD 2015).

I-80 is a national truck route. State Route 17, US Route 46, and State Route 120 are all New Jersey access network truck routes. Trucks are prohibited on Liberty Street within the Borough of Little Ferry. No rail yards lie within the Project Area; the nearest rail yard, the Little Ferry Rail Yard, is located east of the Hackensack River. Norfolk Southern Railroad shares the Pascack Valley Line tracks owned by NJ TRANSIT within the Project Area, and also owns and operates spur lines branching from the Pascack Valley Line between the Wood-Ridge and Teterboro-Williams Avenue stations (NJDOT 2015c). **Figure 3.7-9** shows the truck routes, major freight origin/destination areas, and railroad infrastructure.

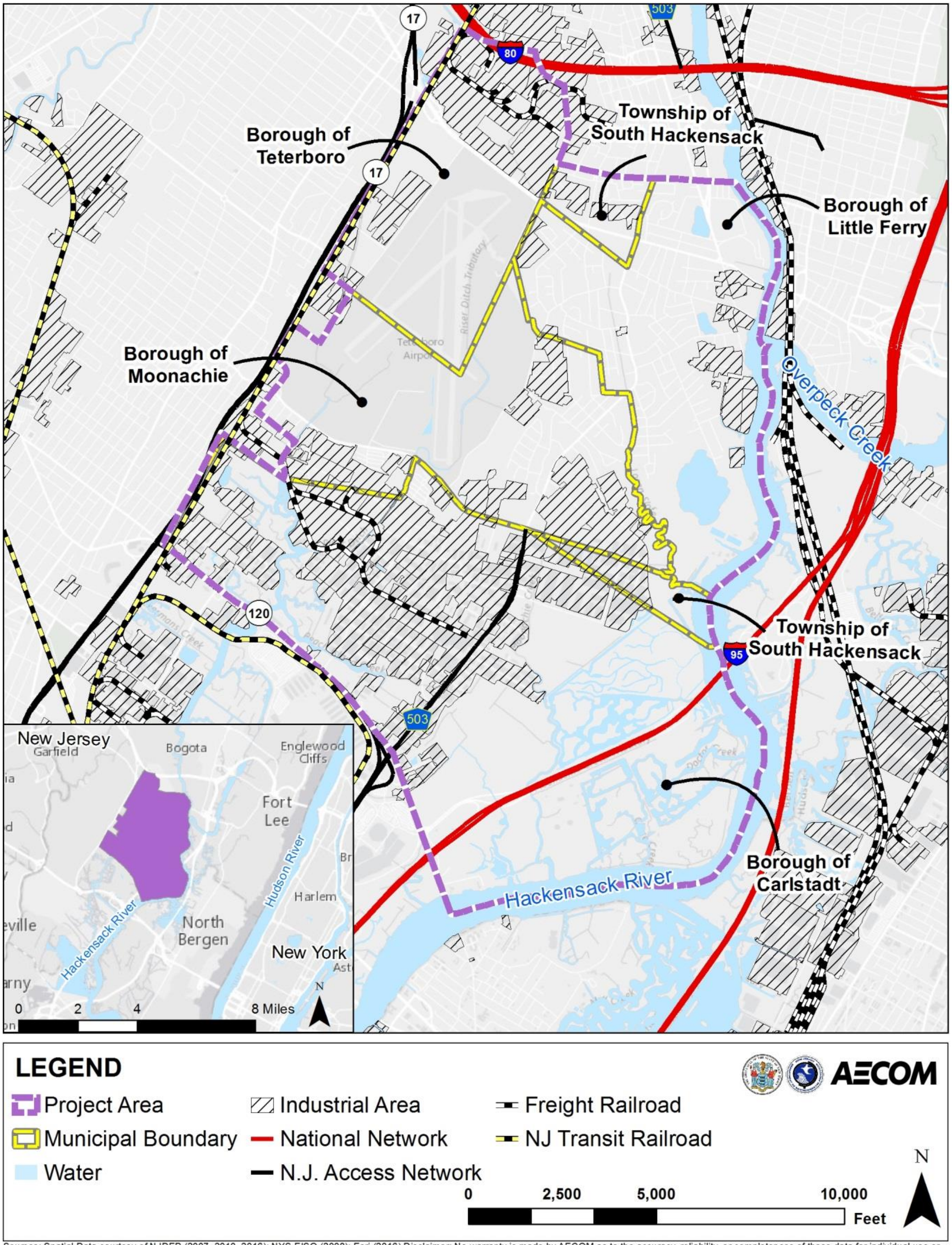
3.7.3.7 Ancillary Facilities

Teterboro Airport

Teterboro Airport is one of the oldest operating airports in the New York and New Jersey metropolitan area, and is owned and operated by the PANYNJ. It borders the municipalities of Teterboro, Hasbrouck Heights, Little Ferry, Moonachie, and Wood-Ridge. The airport is a critical facility in the Borough of Teterboro (Bergen County Office of Emergency Management 2015) and is considered a general aviation "reliever" that helps remove smaller and slower aircraft from regional air traffic to avoid major congestions at other PANYNJ commercial airports. Teterboro Airport provides air transportation access for private aircraft owners and local freight companies, and is operational between 6:00 AM and 11:00 PM. In 2015, Teterboro Airport had 172,866 aircraft operations, consisting mostly of private charter flights (AirNav 2016). Business services include charter flights, aircraft leasing, cargo, shipping, medically-oriented flight activities, and international travel. Access to the airport is available by train, bus, taxi, or private automobile. Train and bus stops are approximately 1 mile from the airport. The NJ TRANSIT Pascack Valley Line station on Williams Avenue is the closest station to Teterboro Airport. Currently, there is no central parking facility at the airport; however, fixed-base operators such as Atlantic Aviation, Signature Flight Support, Jet Aviation, and Meridian Teterboro offer parking services.

Little Ferry Seaplane Base

The Little Ferry Seaplane Base was a privately-owned seaplane base for public use located east of the central business district of the Borough of Little Ferry on the Hackensack River, and had very little, if any, air traffic. The facility has not been in place for at least the last couple of years as it is in disrepair and unusable (FAA 2017).



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.7-9: Freight Facilities in and around the Project Area

3.8 Noise and Vibration

3.8.1 Introduction

This section describes ambient noise and vibration conditions and local noise regulations in the Project Area. Although the terms noise and sound are often used interchangeably, noise is defined as unwanted sound. It can be any sound that is undesirable because it interferes with communications or other human activities, is intense enough to affect hearing, or is otherwise annoying. Noise may be intermittent or continuous, steady, or impulsive. Human response to noise varies depending on the sound pressure level, type of the noise, distance from the noise source, sensitivity, and time of day.

Sound is made up of tiny fluctuations in air pressure. Sound, within the range of human hearing, can vary in intensity by over 1 million units. Therefore, a logarithmic scale, known as the decibel scale (dB), is used to quantify sound intensity and to compress the scale to a more manageable range.

Sound is characterized by its amplitude (how loud it is), frequency (pitch), and duration. The human ear does not hear all frequencies equally. The human hearing organs of the inner ear deemphasize low and very high frequencies. The A-weighted decibel scale (dBA) is used to reflect this selective sensitivity of human hearing. The human range of hearing amplitude extends from 0 dBA to 120 dBA, 0 dBA being the threshold of hearing for someone with a normal hearing mechanism and 120 dBA being the threshold of pain. **Table 3.8-1** shows a range of typical sound pressure levels from common sources.

Table 3.8-1: Common Sound Sources and Pressure Levels

Sound Pressure Level, dBA	Typical Source or Surrounding Environment
120	Siren 50 feet away; threshold of pain
110	Rock concert
100	Club with music
90	Sidewalk next to a passing heavy truck or bus
80	Sidewalk next to a busy highway
70	Sidewalk next to a local street
60	Normal urban area
50	Normal suburban area in the daytime
40	Quiet suburban area at night
30	Quiet rural area at night
20	Inside an isolated broadcast booth
10	Inside an audiometric booth
0	Threshold of hearing

Source: (Cowan 2016)

The sounds that we hear are a combination of many sounds of different pitches. It is possible to use a frequency analyzer to separate sound into its different frequency components. Frequency is measured in Hertz (Hz), or cycles per second. The State of New Jersey regulates, through its Noise Control Code (NJAC 7:29), total A-weighted sound pressure levels and levels in full-octave frequency bands.

Environmental noise is often expressed as a sound pressure level occurring over a stated period of time, typically 1 hour. When the acoustic energy is averaged over the stated period of time, the resulting equivalent sound pressure level represents the energy-based average sound pressure level. This is called the equivalent sound pressure level, or L_{eq}. The L_{eq} represents a constant sound that, over the specified time period, has the same acoustic energy as the actual time-varying sound. The day-night average sound pressure level, L_{dn}, is a 24-hour L_{eq} with a 10-dB penalty applied during nighttime hours (10:00 PM to 7:00 AM). The penalty accounts for the increased sensitivity to nighttime noise. The L_{dn} is often used to describe community sound pressure levels.

Other statistical descriptors used to describe sound pressure levels include L_{10}, L_{50}, and L_{90}. L_{10} is the sound pressure level exceeded 10 percent of the time and is often higher where intermittent sounds occur. L_{50} is the median sound pressure level or sound pressure level exceeded 50 percent of the time. L_{90} is the sound pressure level exceeded 90 percent of the time, often considered to describe the residual background sound level. These descriptors are used to characterize the distribution of noise over a given time period.

Vibrations are perceived by feeling rather than hearing, but they can also excite building components to generate airborne sound. As with noise, vibration varies with frequency and is rated using a logarithmic dB scale, but it is based on displacement rather than pressure. Vibrational energy is typically rated using the vibration decibel scale (VdB), referenced to vibration velocity. The VdB scale is not weighted by frequency sensitivity as the dBA scale is for sound. On this scale, 65 VdB is considered to be the average threshold of perception, while the human annoyance threshold is considered to be 72 VdB. Structural damage to buildings begins to be a concern for levels exceeding 90 VdB, depending on the type of building foundation.

Construction activities that tend to generate the highest vibration levels are blasting and pile driving. These types of construction activities have the potential to generate vibration levels exceeding building damage criteria, although other types of construction activities may have the potential to generate vibration levels above human annoyance thresholds at close distances.

3.8.2 Regulatory Context

The Proposed Project would require construction activities near noise-sensitive receptors. Construction vehicles would travel to and from work sites and construction equipment would operate within those work sites. Following construction, the Proposed Project would operate pump stations which would include emergency generators. The study area for the noise assessment includes the Boroughs of Little Ferry, Moonachie, Carlstadt, Teterboro, and East Rutherford; the Township of South Hackensack; and the City of Hackensack in Bergen County, New Jersey. These seven municipalities do not overlap. Federal, State, and local regulations were reviewed to determine any noise and vibration requirements applicable to the Proposed Project. HUD regulates noise for HUD-funded residential housing projects in accordance with 24 CFR Part 51, Subpart B. The intent of HUD's noise rules is to evaluate the noise compatibility of sites where HUD-funded housing developments are proposed; however, the Proposed Project is not a housing project. In addition, per 24 CFR § 51.101(a)(3), HUD's noise policy does not apply to actions under disaster assistance provisions or appropriations that are provided to save lives, protect property, and protect public health and safety. Therefore, HUD's noise rules would not apply to the Proposed Project. The State of New Jersey has regulations pertaining to noise and vibration, but

Bergen County does not have its own noise or vibration ordinances. Therefore, the following sections are focused on State noise regulations and local municipality requirements with regard to noise and vibration. More information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

3.8.2.1 State of New Jersey

The State of New Jersey regulates noise through its 2012 Noise Control Code (NJAC 7:29), which includes quantitative noise limits for stationary noise sources at industrial, commercial, and community service facilities. Community service facilities include offices and buildings of agencies or offices of Government; however, emergency generators are exempt during power outages. The regulations include limits for continuous airborne sound and impulsive sound. NJAC 7:29 defines continuous airborne sound as sound with a duration of 1 second or more, which can be measured using the slow response setting of a sound level meter. Impulsive sound is defined as a single peak or burst of peaks with a duration of less than 1 second. Rapidly repetitive impulsive sounds with durations of 1 second or more are considered continuous airborne sound. Construction activities and vehicles on public roadways are exempt from the noise regulation. Broadband noise performance standards for noise generated from industrial, commercial, and community facilities are provided in **Table 3.8-2**.

Table 3.8-2: State of New Jersey Broadband Noise Performance Standards for Industrial, Commercial, and Community Service Facilities

Duration	Sound Pressure Level at Residential Property Line during the Day (7:00 AM to 10:00 PM), dBA	Sound Pressure Level at Residential Property Line during the Night (10:00 PM to 7:00 AM), dBA	Sound Pressure Level at Commercial or Community Service Facility Property Line at Any Time, dBA
Continuous Airborne Sound	65	50	65
Impulsive Sound in Air	80	80 (50 if the impulsive sound repeats more than four times in any hour)	80

Source: NJAC 7:29

The broadband limits apply at the land use that receives the noise and vary based on the time of day. The limits for impulsive sound in air are maximum sound pressure levels. **Table 3.8-3** contains spectral (by frequency band) noise performance standards for noise generated from industrial, commercial, and community facilities. Noise sources associated with the Proposed Project were compared to both the broadband and spectral noise limits, as applicable.

Table 3.8-3: State of New Jersey Spectral Noise Performance Standards for Industrial, Commercial, and Community Service Facilities

Octave Band Center Frequency, Hz	Sound Pressure Level at Residential Property Line during the Day (7:00 AM to 10:00 PM), dB	Sound Pressure Level at Residential Property Line during the Night (10:00 PM to 7:00 AM), dB	Sound Pressure Level at Commercial or Community Service Facility Property Line at Any Time, dB
31.5	96	86	96
63	82	71	82
125	74	61	74
250	67	53	67
500	63	48	63
1,000	60	45	60
2,000	57	42	57
4,000	55	40	55
8,000	53	38	53

Source: NJAC 7:29

The spectral limits also apply at the land use that receives the noise and vary based on the time of day. The NJAC 7:29 noise rules address the types of noise measurement equipment that must be used to evaluate compliance and allowable meteorological conditions during those measurements.

The State of New Jersey has implemented Meadowlands District Zoning Regulations (NJAC 19:4) in 1970 to enforce policies set forth in the NJSEA Master Plan to guide redevelopment in the Meadowlands District. The Meadowlands District includes portions of the study area, including areas within the Boroughs of Little Ferry, Moonachie, Carlstadt, Teterboro, and East Rutherford; and the Township of South Hackensack. Although not within the designated Meadowlands District, the City of Hackensack is adjacent to the Project Area and could potentially be affected by the Build Alternatives; therefore, it is also included in the study area. Subchapter 7 of NJAC 19:4 provides performance standards required to be met by development, including standards for noise and vibration. The NJSEA (formerly the NJMC) defines in Subchapter 5 of NJAC 19:4 which land use zones are held to Performance Standard Categories A, B, and C, as indicated in **Table 3.8-4**.

Table 3.8-4: NJSEA Noise Performance Standard Categories

Performance Standard Category	Land Use Zone
A	Low Density Residential Neighborhood Commercial Parks and Recreation Waterfront Recreation Environmental Conservation
B	Planned Residential Regional Commercial Highway Commercial Commercial Park Aviation Facilities Light Industrial A/B Intermodal A Transportation Center
C	Intermodal B Heavy Industrial Public Utilities

Source: NJAC 19:4

The maximum permitted sound levels allowable for any proposed use, occupancy, structure, process, or equipment within the Meadowlands District are provided in **Table 3.8-5**. Where more than one sound level applies, the most restrictive shall govern. These maximum permitted sound levels may be exceeded by 10 dBA for a single 15-minute period each day. The maximum permitted sound levels, set forth in **Table 3.8-5**, are increased by 20 dB for impact noises, which are defined as "those noises whose peak values are more than 6 dB higher than the values indicated on the sound level meter" (NJAC 19:4-7.3(h)). In addition, as specified in NJAC 19:4-7.3(f), the noise level in any residential zone shall not exceed 55 dBA during the hours of 7:00 AM to 9:00 PM and 45 dBA during the hours of 9:00 PM to 7:00 AM. Construction or other temporary (60 days or less) uses can exceed the maximum permitted sound levels provided in NJAC 19:4-7.3 if a noise mitigation plan is approved by the NJSEA. Exemptions to the NJAC 19:4-7.3 maximum permitted sound levels are provided in NJAC 19:4-7.3 (j) and they include an exemption for emergency work when public health or safety is involved.

Table 3.8-5: Meadowlands District Zoning Regulations Noise Performance Standards

Performance Standard Category	Maximum Permitted Sound Level, dBA	Where Measured
A	65	On or beyond the subject property boundary line
B	70	On or beyond the subject property boundary line
C	76	On or beyond the zone boundaries

Source: NJAC 19:4

Section 7.4 of NJAC 19:4 provides vibration limits in a similar format to the maximum permitted sound levels listed in **Table 3.8-5**, but in maximum peak particle velocities (inches per second) of 0.02 for Performance Standard Category A, 0.05 for Category B, and 0.10 for Category C. In addition, as specified in NJAC19:4-7:4(d), the vibration level in any residential zone shall not exceed 0.02 inch per second during the hours of 7:00 AM to 9:00 PM and 0.01 inch per second during the hours of 9:00 PM to 7:00 AM. Also, these limits assume continuous exposure. Discrete impulses that do not exceed 60 impulses per minute (as would be the case for pile driving) have limits of twice those listed above.

The New Jersey Noise Control Act (NJSA 13:1G) gave the NJDEP the authority to set forth noise regulations. NJDEP developed a Model Noise Ordinance that can be adopted by local municipalities. None of the municipalities in the Project Area have adopted the Model Noise Ordinance as of June 2, 2017; therefore, the Model Noise Ordinance does not apply to the Proposed Project.

3.8.2.2 Borough of Little Ferry

Per Section 3-3.2 of the Code of the Borough of Little Ferry, excavation, demolition, construction, repair, or alteration work is prohibited on Sundays and between 8:00 PM and 8:00 AM. An emergency permit may be given by the Superintendent of Public Works for a period not to exceed 3 days, for work to occur on Sundays and between 8:00 PM and 8:00 AM. No quantitative noise limits were identified for the Borough of Little Ferry.

The Performance Standards in Section 35-113.14 of the Code of the Borough of Little Ferry prohibit "vibration beyond the immediate site on which such use is conducted" within the Light Industrial Zone; however, there are no requirements established for vibrations related to construction activities.

3.8.2.3 Borough of Moonachie

Per Section 3-2.2 of the Revised General Ordinances of the Borough of Moonachie, excavation, demolition, construction, repair, or alteration work in connection with any building, structure, or other improvement is prohibited on Sundays and between 8:00 PM and 7:00 AM. An emergency permit may be given by the Construction Official for a period not to exceed 3 days (if the emergency continues it may be renewed for an additional 3 days). Chapter III of the Revised General Ordinances of the Borough of Moonachie provides additional details regarding an emergency permit. Additionally, noise-producing blowers, power fans, or internal combustion engines that cause noise due to the explosion of operating gases or fluids must be equipped with a muffling device.

Section 22-5.11 of the Revised General Ordinances of the Borough of Moonachie contains quantitative noise limits; however, motor vehicles or other transportation facilities on public highways, operations involved in construction or demolition of structures, and emergency alarm signals or time signals are excluded. Noise levels must be measured with a sound level meter and an octave band analyzer that conform to specifications published by the American National Standards Institute (ANSI). **Table 3.8-6** contains the maximum permissible sound pressure levels for smooth and continuous noise between the hours of 8:00 PM and 8:00 AM.

The maximum permitted noise levels, found in **Table 3.8-6**, are increased by 3 dB if the noise only occurs during the daytime (8:00 AM to 8:00 PM) or if the noise only occurs less than five percent of any 1-hour period. The noise levels are decreased by 5 dB if the noise is of a peculiar character, such as a scream or hum. For impulsive noise, the impulse peaks may not exceed the noise levels in **Table 3.8-6** and the average sound pressure level during an impulsive noise event may not exceed the noise levels minus 5 dB. When the values in **Table 3.8-6** are converted to current octave frequency bands, they translate to an overall baseline level of 45 dBA.

The Performance Standards in Section 22-5.11 of the Zoning Ordinance list quantitative vibration limits; however, construction activities are exempt from those requirements.

Table 3.8-6: Borough of Moonachie Noise Performance Standards

Frequency Band, cycles per second	Maximum Permitted Sound Pressure Level at the Property Line or Along Any Public Right-of-Way Within the Property, dB
20 – 75	60
75 – 150	54
150 – 300	47
300 – 600	41
600 – 1,200	37
1,200 – 2,400	34
2,400 – 4,800	31
Above 4,800	28

Source: Chapter XXII, Zoning, Revised General Ordinances of the Borough of Moonachie, Section 22-5.11

3.8.2.4 Borough of Carlstadt

Per Section 5-10 of the Revised General Ordinances of the Borough of Carlstadt, excavation, demolition, construction, repair, or alteration work is only allowed between the hours of 7:00 AM and 6:00 PM on weekdays and Saturday. An emergency permit may be given by the Borough Engineer for a period not to exceed 3 days (if the emergency continues it may be renewed for an additional 3 days) for work to be carried on during the hours specified in the permit.

Chapter V also prohibits the creation of excessive or unreasonable noise on a street adjacent to a clearly marked school, institution of learning, church, hospital, or court while in use.

There are no vibration stipulations in the Revised General Ordinances of the Borough of Carlstadt.

3.8.2.5 Borough of East Rutherford

Section 199-9 of the Code of the Borough of East Rutherford contains quantitative noise limits that apply along the real property boundary of the premises where a noise complaint originates. The noise limits are 65 dBA between the hours of 7:00 AM and 10:00 PM, and 50 dBA between the hours of 10:00 PM and 7:00 AM. These limits do not apply to municipal, county, State, or Federal Government agencies. These limits also do not apply to construction activity; however, Section 199-3 states that construction activity is only allowed between 7:00 AM and 6:00 PM on weekdays. The Borough Inspector may grant permission for work between 6:00 PM and 7:00 AM if the public health and safety would not be impaired and if loss or inconvenience would result from daytime only work.

There are no vibration stipulations in the Code of the Borough of East Rutherford.

3.8.2.6 Borough of Teterboro

The Zoning Ordinance of the Borough of Teterboro has quantitative noise limits. **Table 3.8-7** presents the noise performance standards from Section 185-17. A of Article VII of the Zoning Ordinance. The Zoning Ordinance of the Borough of Teterboro does not define the land use types within each Performance Standard Category, thus the definitions in **Table 3.8-4** are adopted for the Proposed Project.

The noise performance standards define daytime from 7:00 AM to 9:00 PM and nighttime from 9:00 PM to 7:00 AM. The maximum permitted sound levels, found in **Table 3.8-7**, may be exceeded by 10 dBA for a single 15-minute period each day. The maximum permitted sound levels, set forth in **Table 3.8-7**, are increased by 20 dB for impact noises, which are defined as “those noises whose peak values are more than 6 dB higher than the values indicated on the sound level meter” (Borough of Teterboro Zoning Ordinance, Article VII, Section 185-17.A). In addition, the noise level in any residential zone shall not exceed 55 dBA during the hours of 7:00 AM to 9:00 PM and 45 dBA during the hours of 9:00 PM to 7:00 AM. There is no mention of construction noise in the Zoning Ordinance of the Borough of Teterboro.

Table 3.8-7: Borough of Teterboro Noise Performance Standards

Performance Standard Category	Maximum Permitted Sound Level, dBA	Where Measured
A	55	On or beyond the boundaries of neighboring uses or adjacent lot lines, whichever is more restrictive
B	60	On or beyond the boundaries of neighboring uses or adjacent lot lines, whichever is more restrictive
C	66	On or beyond the district boundaries

Source: Article VII, Zoning Ordinance of the Borough of Teterboro, Section 185-17.A

Section 185-17.B of the Teterboro Code provides vibration limits in a similar format to the noise limits listed in **Table 3.8-7**, but in terms of peak particle vibration velocity limits (in inches per second) of 0.02 for Performance Standard Category A, 0.05 for Category B, and 0.10 for Category C. The limit of 0.02 inches per second is lowered to 0.01 inches per second in residential communities during nighttime hours (9:00 PM to 7:00 AM). Also, these limits assume continuous exposure. Short-duration impulses have limits twice those listed above.

3.8.2.7 Township of South Hackensack

Per Chapter 225, Nuisances, Public Health, of the Code of the Township of South Hackensack, the township adopted the Public Health Nuisance Code of New Jersey of 1953. Section IV of the Public Health Nuisance Code of New Jersey (1953) prohibits any unnecessary, annoying, or injurious noises. No quantitative noise limits were identified in the Township of South Hackensack Public Health Code.

The Performance Standards in Chapter 208, Zoning, of the Code of the Township of South Hackensack prohibit “vibration beyond the immediate site on which such use is conducted” for Mixed-Use, Commercial, and Industrial Zones, but there is no mention of vibrations related to construction activities.

3.8.2.8 City of Hackensack

Section 112-4 of the Code of the City of Hackensack contains quantitative noise limits that apply at or within the property line of the receiving property. **Table 3.8-8** contains the noise limits for the City of Hackensack.

There are no vibration stipulations in the Code of the City of Hackensack.

Table 3.8-8: City of Hackensack Maximum Permissible Sound Levels

Sound Source Property Category	Sound Pressure Level at Residential Property Line during the Day (7:00 AM to 10:00 PM), dBA	Sound Pressure Level at Residential Property Line during the Night (10:00 PM to 7:00 AM), dBA	Sound Pressure Level at Commercial Property Line, dBA	Sound Pressure Level at Industrial Property Line, dBA
Residential	65	50	65	75
Commercial, Public Spaces, or Rights-of-Way	65	50	65	75
Industrial	65	50	65	75

Source: Chapter 112, Noise, Section 112-5, of the Code of the City of Hackensack

Construction activity is exempt from the limits specified in **Table 3.8-8**; however, Section 112-5 states that construction equipment must be equipped with functioning mufflers and construction activity is only allowed between 7:00 AM and 6:00 PM on weekdays (non-holiday) and between 9:00 AM and 6:00 PM on Saturdays. Construction activities are not allowed on Sundays or holidays. Per Section 112-6, emergency repairs, construction, or other duties performed by a utility company or governmental agency in the interest of public safety, health, or public welfare, are exempt from the requirements of Chapter 112.

3.8.3 Existing Conditions

Existing noise conditions were documented by measuring current environmental noise levels in the Project Area according to the methodology discussed in **Section 3.8.3.2**. Vibration levels were not monitored in the Project Area because there are no obvious sources of vibration in the area that would generate vibration levels approaching annoyance or structural damage limits at any buildings.

3.8.3.1 Typical Environmental Noise Levels

Noise-sensitive land uses in the Project Area include residences, schools, and churches. Noise levels in residential environments vary and are typically influenced by the population density of the area and proximity to major transportation corridors. The Project Area includes existing noise from Teterboro Airport; trains along the western edge of the Project Area and on the east side of the Hackensack River; and vehicular traffic on I-80, US Route 46, State Route 17, and other local roadways. Other typical noise sources in residential environments include air conditioning units, lawn and landscape maintenance equipment (e.g., leaf blowers, weed trimmers, lawnmowers, and chainsaws), people, and natural sounds (e.g., bird chirps, insects, and rustling vegetation). **Table 3.8-9** lists typical daytime and nighttime noise levels for various residential land use categories.

Table 3.8-9: Typical Daytime and Nighttime Noise Levels for Residential Land Uses

Residential Land Use Category	Daytime Level, dBA	Nighttime Level, dBA
Very noisy urban	66	58
Noisy urban	61	54
Urban and noisy suburban	55	49
Quiet urban and normal suburban	50	44
Quiet suburban	45	39
Very quiet suburban and rural	40	34

Source: ANSI/ASA S12.9-2013 Part 3

Environmental noise levels are generally higher in more densely populated areas; however, site-specific conditions would result in varying noise levels. Therefore, existing noise levels in the Project Area were measured to document current noise conditions.

3.8.3.2 Current Noise Environment

A site-specific noise study was conducted to quantify existing noise conditions within the Project Area. For informational purposes, the measured existing noise levels were compared to the State noise standards. Existing noise levels were measured between August 23, 2016, and September 14, 2016, using procedures specified in NJAC 7:29. Existing noise levels were measured on Tuesdays, Wednesdays, and Thursdays to document existing conditions with typical traffic. Noise measurements were performed outdoors generally under favorable weather conditions (i.e., no precipitation or high winds). Based on meteorological data from the Teterboro Airport, wind speeds may have exceeded 12 miles per hour during portions of the 24-hour measurements. Microphone-height wind speeds were measured using a handheld Kestrel 2000 for short-term, attended measurements; the measured wind speeds were generally lower than the reported wind speeds from the Teterboro Airport. Hours when the average or gust wind speed from the Teterboro Airport exceeded 12 miles per hour were noted in the detailed measurement results, even though the wind speeds from the Teterboro Airport may be different from the microphone-height wind speeds collected at the measurement locations.

Digital sound level meters and handheld calibrators that meet Type 1/Class 1 precision requirements of the ANSI and International Electrotechnical Commission (IEC) standards, respectively, were used. Instruments used to measure noise levels were calibrated on an annual basis by an independent accredited calibration laboratory using standards traceable to the National Institute of Standards and Technology. Certificates documenting these laboratory calibrations are included in **Appendix G**. Calibration checks were performed in the field prior to and on completion of each series of measurements using laboratory-calibrated field calibrators.

Noise measurements were conducted at 36 locations representative of noise-sensitive land uses (e.g., residences, hotels, schools, churches). At eight of these locations, existing noise levels were measured for a continuous 24-hour period to document diurnal variations in background sound levels for each general noise-sensitive region. The remaining 28 locations were monitored to document short-term

(20 minutes minimum each) background noise levels. The noise measurement locations were selected based on noise-sensitive land uses, accessibility, and their vicinity to Proposed Project activities. **Figure 3.8-1**, **Figure 3.8-2**, **Figure 3.8-3**, and **Figure 3.8-4** show the approximate noise measurement locations and **Table 3.8-10** lists their specific locations. Note: Measurement Location 12 is not included because permission for access to any representative properties in that area could not be obtained.

Table 3.8-10: Noise Measurement Locations

Location	Receptor Type	Address	Municipality	Duration	Date
1	Residential	2 West 2nd Street	Carlstadt	24 hours	8/23-24/2016
2	Hotel	100 Paterson Plank Rd	Carlstadt	22 minutes	9/8/2016
3	Hotel	304 Paterson Plank Rd	Carlstadt	20 minutes	9/7/2016
4	Residential	37 Hartwick Street	Little Ferry	22 minutes	8/25/2016
5	Park / Residential	95 Main Street	Little Ferry	20 minutes	8/24/2016
6	Residential	9 Jefferson Street	Little Ferry	21 minutes	9/7/2016
7	School	130 Liberty Street	Little Ferry	23 minutes	8/25/2016
8	Residential	29 Lincoln Street	Little Ferry	24 hours	8/23-24/2016
9	Residential	5 McCabe Court	Little Ferry	21 minutes	8/25/2016
10	Residential	69 Washington Avenue	Little Ferry	24 hours	8/24-25/2016
11	Residential	17 Kaufman Avenue	Little Ferry	20 minutes	8/24/2016
13	Residential	5 Garfield Place	Little Ferry	20 minutes	8/24/2016
14	Church	31 Chamberlain Avenue	Little Ferry	21 minutes	8/25/2016
15	Residential	100 Main Street	Little Ferry	24 hours	8/24-25/2016
16	Residential	35 Joseph Street	Little Ferry	20 minutes	9/1/2016
17	Residential	45 Monroe Street	Little Ferry	21 minutes	8/25/2016
18	Residential	95 Van Buren Street	Little Ferry	20 minutes	9/1/2016
19	Residential	54 Waterside Drive	Little Ferry	20 minutes	8/24/2016
20	Residential	17 Sand Hill Court	Little Ferry	20	8/23/2016

Location	Receptor Type	Address	Municipality	Duration	Date
				minutes	
21	Residential	124 Washington Avenue	Little Ferry	20 minutes	8/24/2016
22	Residential	22 Romanko Avenue	Little Ferry	20 minutes	8/24/2016
23	Residential	80 East Joseph Street	Moonachie	20 minutes	8/25/2016
24	Residential	1 Washington Place	Moonachie	24 hours	9/13-14/2016
25	Residential	6 Jubilee Way	Moonachie	20 minutes	9/7/2016
26	Residential	33 Ramella Avenue	Moonachie	21 minutes	8/25/2016
27	Residential	107 Moonachie Avenue	Moonachie	20 minutes	8/23/2016
28	Church	221 Moonachie Road	Moonachie	20 minutes	8/25/2016
29	School / Residential	20 West Park Street	Moonachie	20 minutes	8/25/2016
30	Residential	95 Sabina Street	Little Ferry	20 minutes	9/7/2016
31	Residential	32 Union Street	Moonachie	24 hours	9/7-8/2016
32	Residential	295 Liberty Street	South Hackensack	20 minutes	9/1/2016
33	Residential	9 Hegner Court	South Hackensack	24 hours	9/7-8/2016
34	Hotel	636 Huyler Street	South Hackensack	20 minutes	9/1/2016
35	Youth Shelter	200 North Street	Teterboro	21 minutes	9/1/2016
36	Residential	608 Huyler Street	Teterboro	24 hours	8/24-25/2016
37	Church	370 North Street	Teterboro	20 minutes	8/23/2016

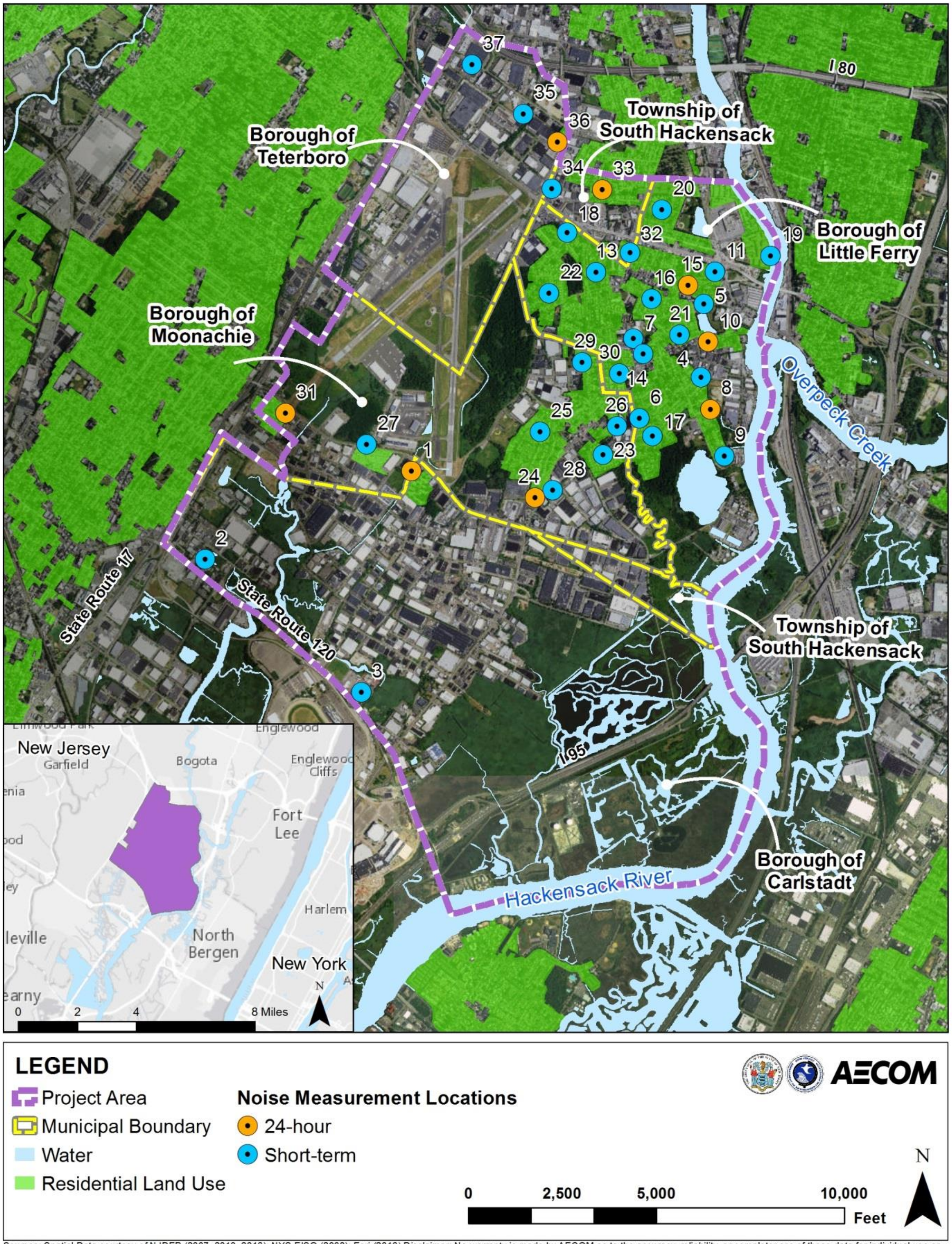
The majority of the measurement locations were within the Boroughs of Little Ferry and Moonachie due to the higher concentration of noise-sensitive land uses in those boroughs. **Table 3.8-11** summarizes the noise measurement results from the 24-hour measurement locations.

Table 3.8-11: Noise Measurement Results from the 24-hour Locations

Municipality	Measurement Location	Daytime L_{eq}, dBA	Nighttime L_{eq}, dBA	L_{dn}, dBA
Borough of Carlstadt	**1**	59	54	62
Borough of Little Ferry	**8**	53	49	56
	10	55	52	59
	15	55	50	58
Borough of Moonachie	**24**	57	54	61
	31	70	62	71
Township of South Hackensack	**33**	54	52	59
Borough of Teterboro	**36**	59	54	62

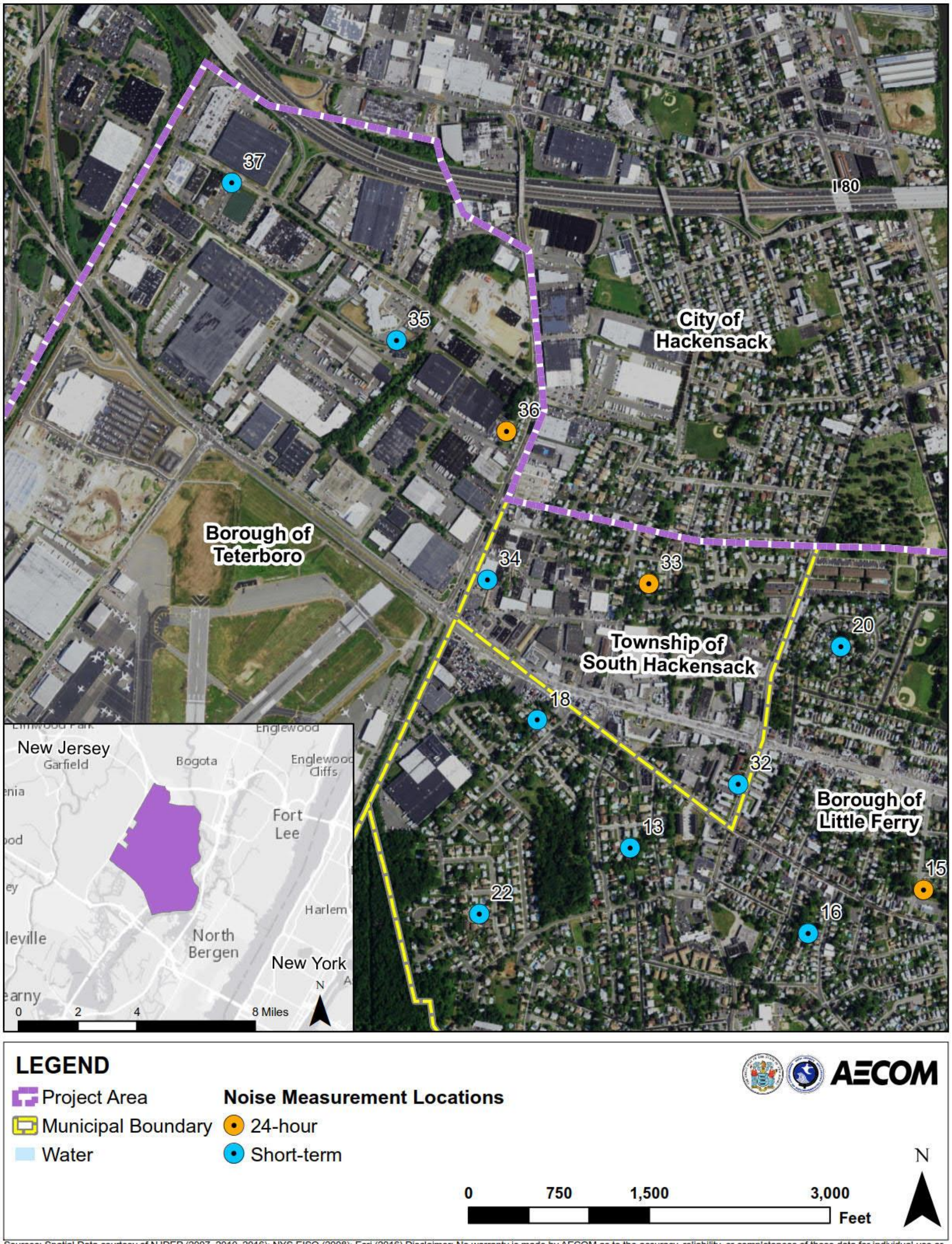
Daytime L_{eq} = equivalent sound level over the State-defined daytime hours (7:00 AM to 10:00 PM)
Nighttime L_{eq} = equivalent sound level over the State-defined nighttime hours (10:00 PM to 7:00 AM)
L_{dn} = day-night average sound level

The measured daytime noise levels ranged from 53 to 59 dBA and the measured nighttime noise levels ranged from 49 to 54 dBA at the majority of the 24-hour locations. The exception was location 31 in the Borough of Moonachie, where the measured daytime noise level was 70 dBA and the measured nighttime noise level was 62 dBA. Location 31 was within 2,000 feet of one of the Teterboro Airport runways and was exposed to frequent airplane flyovers during the measurement. Field staff observed 5 to 10 airplanes flying overhead and approaching the runway during a 20- to 25-minute period at location 31. More detailed noise measurement results for each of the above listed 24-hour measurement locations can be found in **Appendix G**.



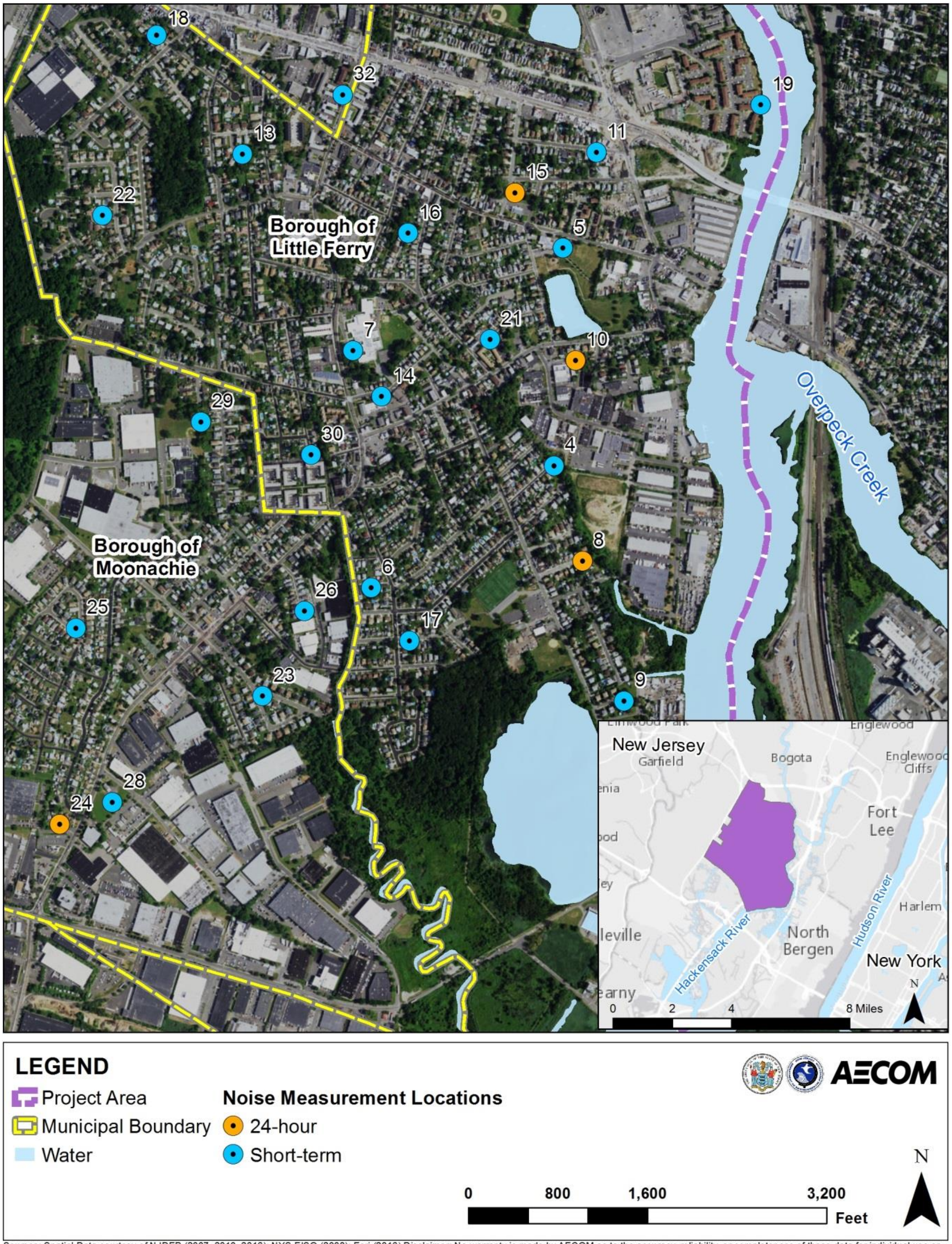
Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.8-1: Noise Measurement Locations Overview



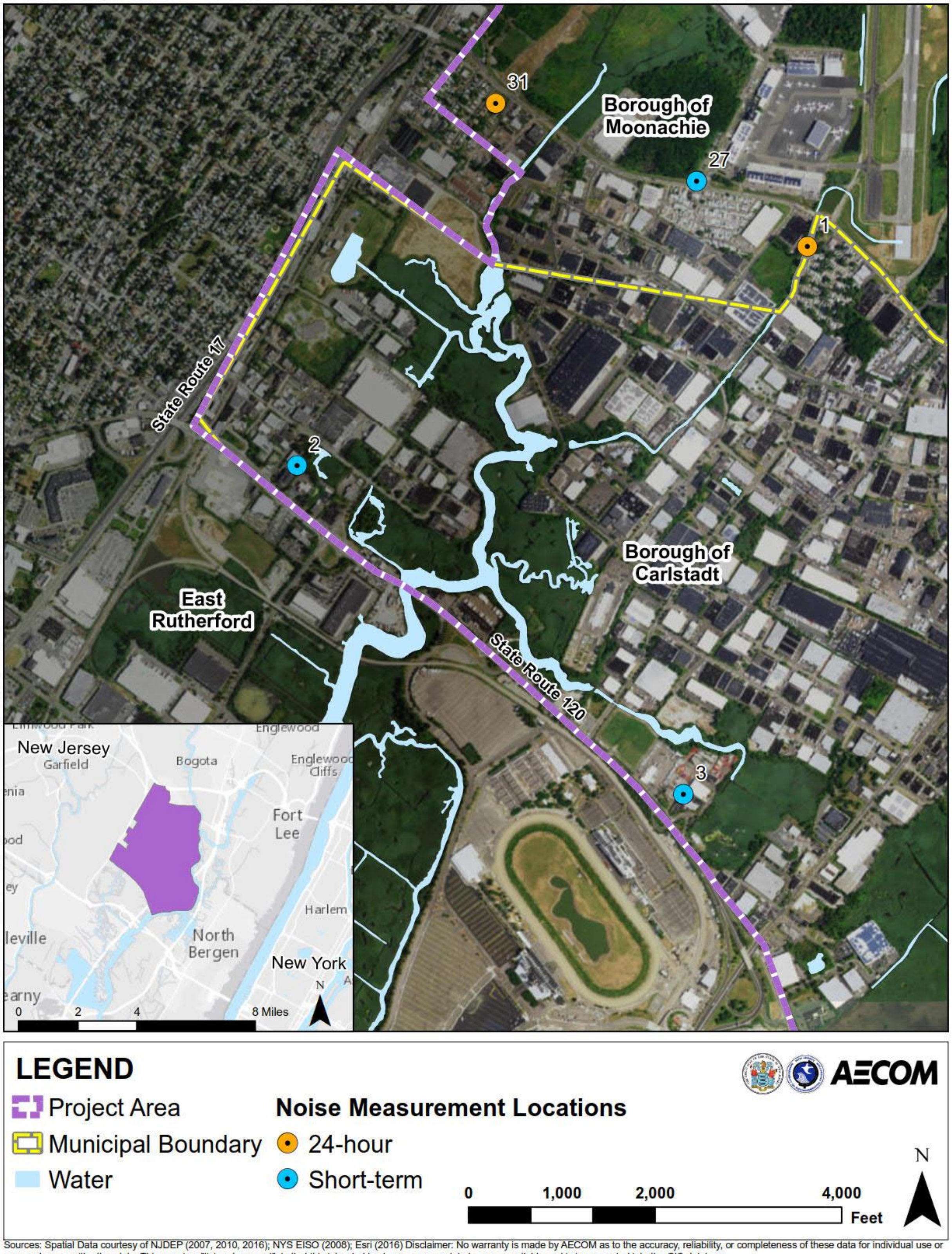
Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.8-2: Noise Measurement Locations North



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.8-3: Noise Measurement Locations East



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.8-4: Noise Measurement Locations South

Figure 3.8-5 compares the measurement results from the 24-hour measurement locations. In general, the 24-hour measurement locations in the northern and eastern portions of the Project Area (locations 8, 10, 15, and 33) tended to be quieter than the 24-hour measurement locations in the western and southern portions of the Project Area (locations 1, 24, 31, and 36). The western portion of the Project Area includes the Teterboro Airport and the southern portion of the Project Area is primarily industrial. The majority of the residences within the Project Area are located in the northeast.

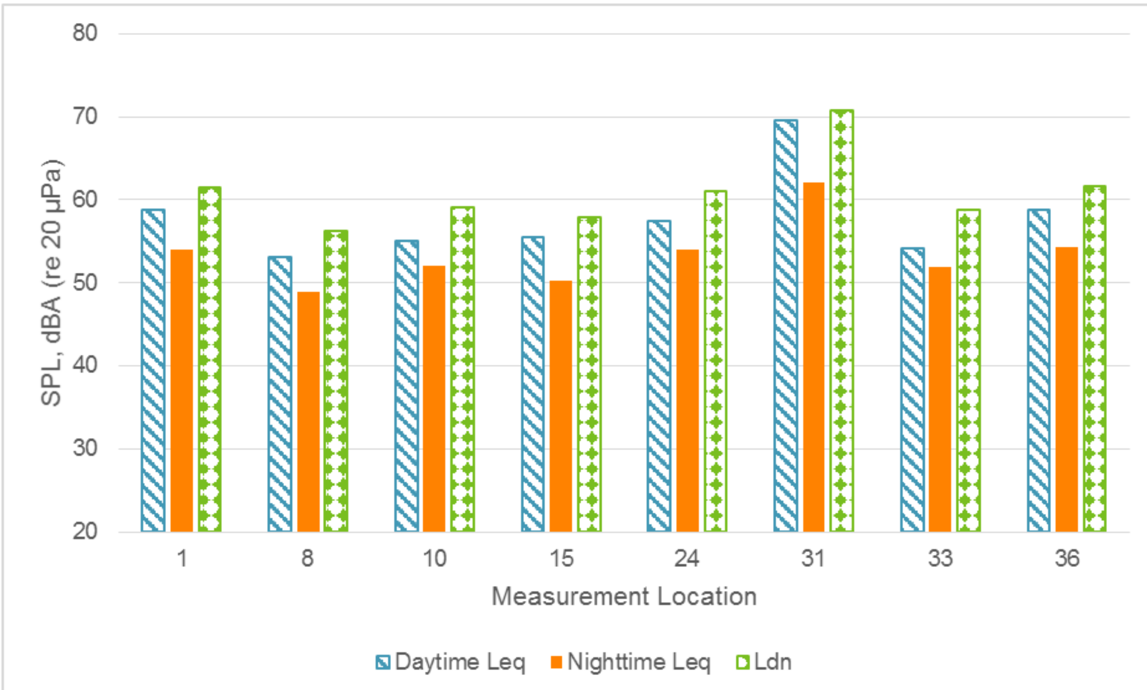
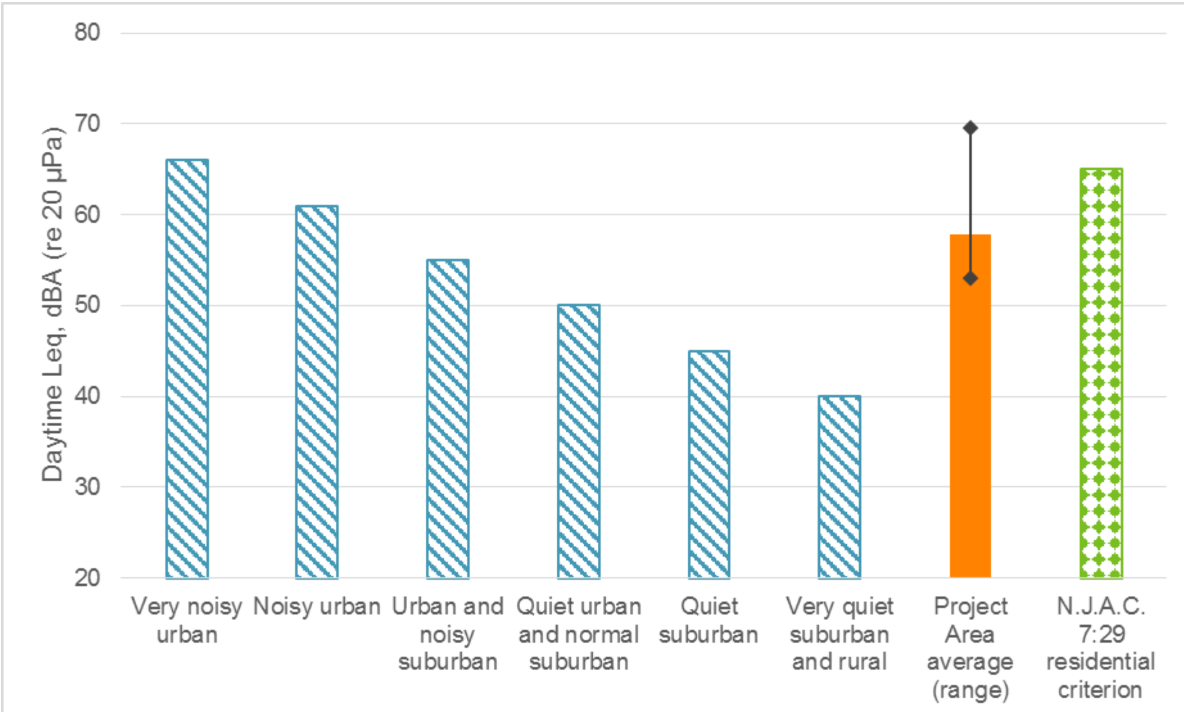


Figure 3.8-5: Noise Measurement Results from the 24-hour Locations

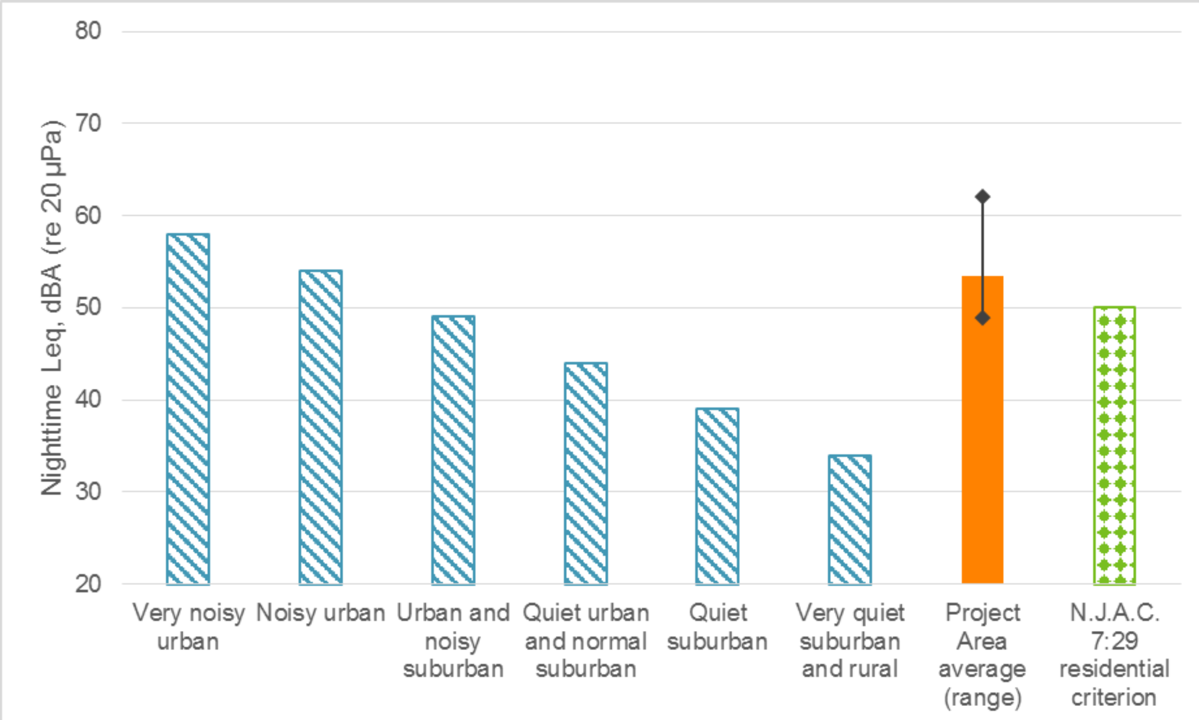
Figure 3.8-6 compares the average measured daytime noise levels from the 24-hour locations to typical residential daytime noise levels and the NJAC 7:29 daytime limits for continuous airborne sound in residential areas. The vertical black line represents the loudest and quietest daytime L_{eq} measured at the eight 24-hour locations. The measured daytime noise levels were on the higher end of the typical residential noise environments. Based on the arithmetic average of the measured daytime noise levels, the existing noise environment in the Project Area is typical of either an urban and noisy suburban residential area or a noisy urban residential area. The measured daytime L_{eq} at location 31 exceeded the NJAC 7:29 residential criterion of 65 dBA.



Source: ANSI/ASA S12.9-2013 Part 3

Figure 3.8-6: Average Measured Daytime Noise Level from the 24-hour Locations

Figure 3.8-7 compares the average measured nighttime noise levels from the 24-hour locations to typical residential nighttime noise levels and the NJAC 7:29 nighttime limits for continuous airborne sound in residential areas. The vertical black line represents the loudest and quietest nighttime L_{eq} measured at the eight 24-hour locations. The measured nighttime noise levels were also on the higher end of the typical residential noise environments. Based on the arithmetic average of the measured nighttime noise levels, the existing noise environment in the Project Area is typical of a noisy urban residential area. The measured nighttime L_{eq} at six of the eight 24-hour locations exceeded the NJAC 7:29 residential criterion of 50 dBA.

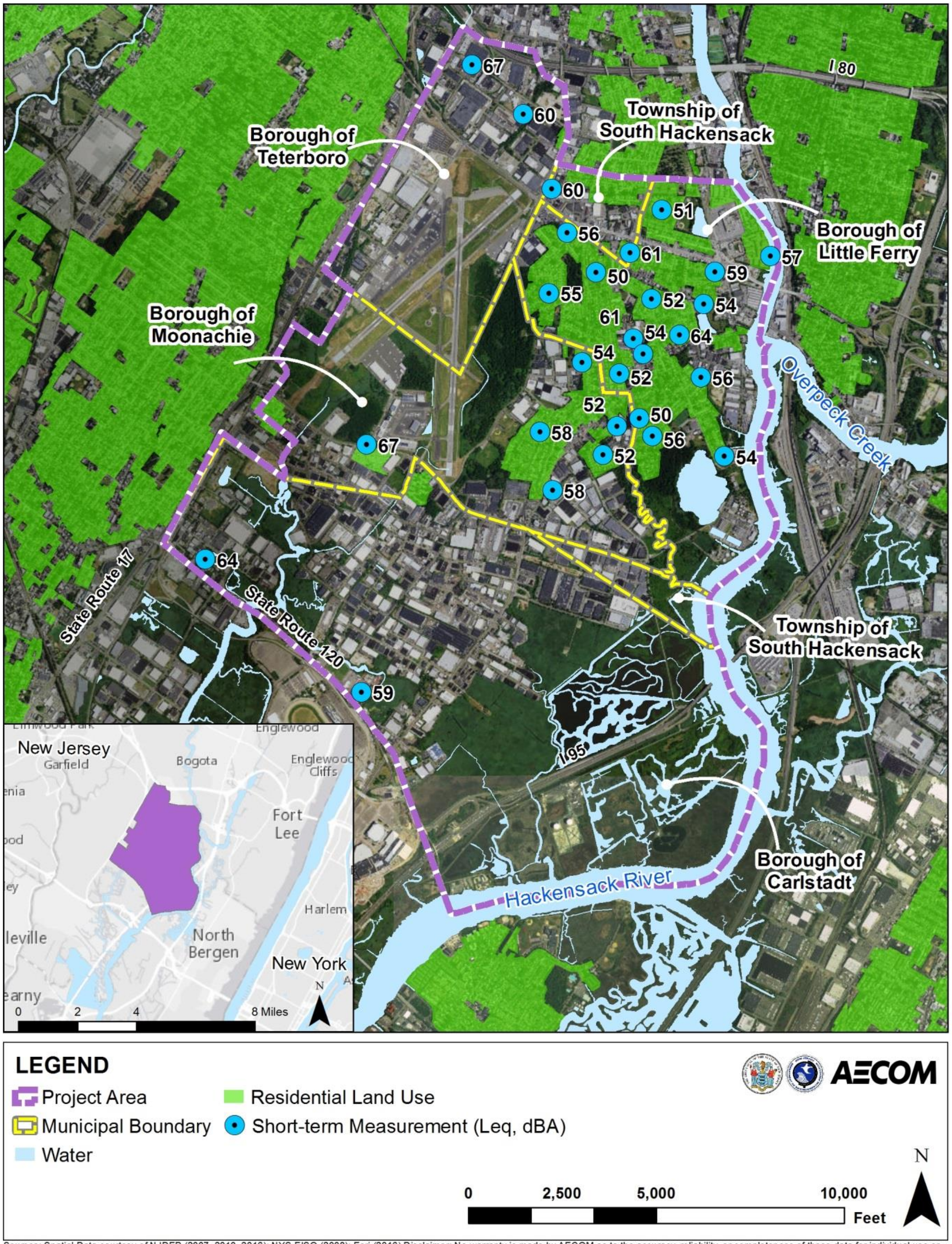


Source: ANSI/ASA S12.9-2013 Part 3

Figure 3.8-7: Average Measured Nighttime Noise Level from the 24-hour Locations

Figure 3.8-8 shows the measured noise levels from the short-term locations. In general, the short-term measurement results indicate similar trends to the 24-hour measurement results. Measured noise levels in the northeast portion of the Project Area tended to be quieter with L_{eq} results generally in the 50's dBA range. There were some exceptions due to localized noise sources, such as proximity to busy roadways and aircraft overflights. Measured noise levels in the western and southern portions of the Project Area tended to be louder with L_{eq} results ranging between 58 and 67 dBA.

The noise measurement results quantified the existing noise environment within the Project Area. Existing noise levels vary throughout the Project Area, and in some areas exceed noise regulations applicable to the Proposed Project. Specifically, monitored sound levels in the Boroughs of Moonachie and Teterboro exceeded the municipal limits at all associated measurement locations, mostly due to nearby aircraft operations at Teterboro Airport. More detailed noise measurement results for the short-term measurement locations can be found in **Appendix G**.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.8-8: Noise Measurement Results from the Short-Term Locations

3.9 Air Quality and Greenhouse Gas Emissions

3.9.1 Introduction

The Clean Air Act (CAA) of 1970 and its amendments required the USEPA to establish National Ambient Air Quality Standards (NAAQS) for ambient air pollutants considered harmful to public health and the environment known as "criteria pollutants." USEPA and local governments are also concerned about the toxic and hazardous air pollutants (HAPs) being emitted in the environment and their effect on the population. Under CAA, USEPA established New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAPs) to minimize emissions of criteria pollutants and HAPs from man-made emission sources.

Air quality in regards to the criteria pollutants, as well as HAPs, will be reviewed in this section based on Federal, State, and local (i.e., county) requirements on a localized basis in the affected area. Since GHGs are relatively stable in the atmosphere and are essentially uniformly mixed throughout the troposphere and stratosphere, the climatic impact of GHG emissions does not depend on source location and any impacts from GHGs is likely a function of global impacts. Therefore, air quality in regards to GHG emissions will be reviewed on a broader scale at the Federal and State level.

Pollutants considered during air quality evaluation include criteria pollutants, HAPs, and GHG pollutants, as described in the following subsections below.

Ozone, Oxides of Nitrogen, and Volatile Organic Compounds

Ground-level ozone (O_3), a criteria pollutant, results from a chemical reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of sunlight. NO_x is the collective term for the ozone precursors nitrogen monoxide (NO) and nitrogen dioxide (NO_2). VOCs and NO_x are emitted from both stationary (e.g., fossil fuel burning equipment such as boilers and generators) and mobile (e.g., fossil fuel bring equipment such as vehicles and mobile construction equipment) sources. Breathing ozone can trigger health issues in humans, such as asthma, chest pain, coughing, and throat irritation or inflammation. Ground-level ozone can also cause or contribute to problems in natural ecosystems through vegetation disease, decreased plant growth, and reduced photosynthesis by hindering sunlight (USEPA 2016a). In addition to being an ozone precursor, NO_2 is also a regulated criteria pollutant. NO_2 is primarily emitted from stationary sources, and can be major concern at large stationary point sources, such as fossil fuel power plants or other heavy industrial sources. Like ozone, NO_2 can cause or contribute to adverse effects in humans when breathed in, such as asthma and other respiratory problems (USEPA 2016b).

Sulfur Dioxide

Sulfur dioxide (SO_2) is a criteria pollutant that is primarily emitted from stationary sources that use sulfur-containing fuels, such as oil and coal. SO_2 can cause or contribute to respiratory problems in humans when breathed in, can damage or decrease the growth of vegetation, and can cause a reduced visibility in the atmosphere through haze (USEPA 2016c).

Carbon Monoxide

Carbon monoxide (CO) is a criteria pollutant that is primarily emitted by fuel combustion sources such as stationary and mobile sources. When breathed in by humans, CO can cause or contribute to serious health effects by decreasing oxygen delivery throughout the body. If inhaled at extremely high levels, CO can cause death (USEPA 2016d).

Particulate Matter

Particulate matter is a criteria pollutant that is regulated in two forms: particulate matter that is 10 micrometers or less in diameter (PM_{10}) and particulate matter that is 2.5 micrometers or less in diameter ($PM_{2.5}$). SO_2, NO_x, ammonia (NH_3), VOCs, and other gases are precursors for $PM_{2.5}$ when they meet and react in the atmosphere. Particulate matter is emitted from both stationary and mobile sources and may be either in the form of liquid droplets or solids suspended in the atmosphere. Heavy duty diesel-powered vehicles, such as buses and large construction equipment and trucks, are a significant source of fine particulate matter. Particulate matter can cause or contribute to serious respiratory problems in humans when breathed in and is the main cause of reduced visibility in the atmosphere through haze (USEPA 2016e).

Lead

Lead (Pb) is a criteria pollutant that is typically associated with industrial sources and vehicles that used leaded fuel. Lead can cause or contribute to adverse effects to humans' internal systems and functions, most commonly neurological effects in children and cardiovascular effects in adults. Lead in the environment can contaminate soil and water, resulting in decreased growth and reproductive issues in plants and animals (USEPA 2016f). As of January 1996, the CAA banned the sale of leaded fuel, concluding a 25-year effort to phase it out completely (USEPA 1996). No significant sources of lead are associated with the Proposed Project; therefore, analysis of lead emissions will not be considered.

Hazardous Air Pollutants

HAPs are air pollutants that may cause or contribute to a serious illness, such as cancer, or cause or contribute to death in humans. HAPs may also cause serious adverse environmental effects when they are deposited in soil or water. HAPs are usually present in minimal quantities in the ambient air; however, their high toxicity may pose a threat to public health even at low concentrations. The USEPA regulates 187 HAPs, which includes, but is not limited to: benzene, which can be found in gasoline; methylene chloride, which can be found in some solvents and paint strippers; naphthalene, which can be found in pesticides; and asbestos, which can be found in some buildings and structures (USEPA 2016g).

Greenhouse Gases

There is scientific consensus that GHG-emitting human activities are changing the chemical composition of the Earth's atmosphere and causing a shift in the global climate (i.e., global warming and climate change). GHGs are emitted from stationary and mobile sources, resulting in trace amounts in the atmosphere. GHGs include water vapor, carbon dioxide (CO_2), nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Water vapor occurs naturally and is the most abundant GHG, with CO_2 being the second most abundant. Because CO_2 constitutes an abundant amount of human-caused GHG emissions, CO_2 is used as the basis for calculating the equivalent amounts of CO_2 (i.e., CO_{2e}) other GHGs would emit. The carbon dioxide equivalent (CO_{2e}) is therefore used as a measurement of GHGs as a common unit and allows GHGs to be expressed as a single number (USEPA 2016h).

3.9.2 Regulatory Context

3.9.2.1 USEPA Standards and Requirements

The CAA established two types of NAAQS: primary standards to protect public health and secondary standards to protect public welfare (40 CFR Part 50). The NAAQS are expressed as a concentration in air and duration of exposure, often both short-term and long-term exposure. The USEPA uses geographic regions, often defined and separated by county lines, to designate the NAAQS attainment status of an area. As defined by the CAA, an attainment area meets the NAAQS, a non-attainment area does not meet one or more of the NAAQS, and a maintenance area has attained compliance with the NAAQS (a previous non-attainment area that is now in attainment) (USEPA 2016i). As with all aspects of environmental regulations, States have the authority to adopt stricter standards. **Table 3.9-1** lists the criteria pollutants, the USEPA ambient air quality standards, and, if applicable, stricter New Jersey standards.

The General Conformity Rule (40 CFR Parts 51 and 93) requires Federal actions or federally funded actions planned to occur in a non-attainment or maintenance area to be reviewed prior to their implementation to ensure that the actions would not interfere with State's plans to meet or maintain the NAAQS. A General Conformity Analysis considers the total direct and indirect emissions of a Proposed Project. If, after the analysis, the total air emissions are not exempt or below *de minimis* levels (i.e., minimum thresholds for which a conformity determination must be performed for various criteria pollutants in various non-attainment areas) as specified in 40 CFR § 93.153, then a Conformity Determination is required. In addition, USEPA has designated the region from Northern Virginia to New England as an ozone transport region, whereby the USEPA has established *de minimis* levels for ozone precursors (i.e., VOCs and NO_x) that may be more restrictive.

Under Section 112 of the CAA, the USEPA has also set NESHAPs for air pollutants that may cause or contribute to an increase in mortality or in serious illness in humans or may cause serious adverse environmental effects. NESHAP applies to stationary sources (with the exception of asbestos which has separate building renovation and demolition standards). NESHAP defines HAP source categories for stationary equipment and the maximum degree of emission reduction that can be reached for that particular category, known as the Maximum Achievable Control Technology (MACT) (USEPA 2016g).

Besides criteria pollutants and HAPs, GHGs are regulated under Section 202 of the CAA. The USEPA regulates GHGs through mobile source emission standards and permitting requirements under programs called “Title V Operating Permits” and “Prevention of Significant Deterioration” (USEPA 2016k, 2016l). These regulations include fuel efficiency and renewable fuel standards on light-duty, medium-duty, and heavy-duty vehicles (USEPA 2016l). Other GHG standards and initiatives implemented by the USEPA would not apply to the Proposed Project because they generally apply to large, significant sources of GHGs, such as power plants and industrial facilities (USEPA 2016m).

Table 3.9-1: Criteria Pollutant Federal and State Standards

Criteria Pollutant	Primary/ Secondary	USEPA Air Quality Standards	Type	New Jersey State Standards	Type
O_3	Primary and secondary	8-hour average (in effect December 28, 2015): 0.070 parts per million (ppm)	Annual fourth-highest maximum 8-hour concentration, averaged over 3 years	1-hour average: 0.12 ppm (primary) and 0.08 ppm (secondary)	Not to be exceeded more than once a year
				8-hour average: Same as Federal	Same as Federal
NO_2	Primary	1-hour average: 100 parts per billion (ppb)	98th percentile of 1-hour maximum concentrations, averaged over 3 years	Same as Federal	Same as Federal
	Primary and secondary	1-year average: 53 ppb	Not to be exceeded	1-year average: 0.05 ppm	Not to be exceeded
SO_2	Primary	1-hour average: 75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over three years	1-year average: 0.03 ppm	Not to be exceeded
				24-hour average: 0.14 ppm	Not to be exceeded more than once a year
	Secondary	3-hour average: 0.5 ppm	Not to be exceeded more than once a year	1-year average: 0.02 ppm	Not to be exceeded
				24-hour average: 0.1 ppm	Not to be exceeded more than once a year
				3-hour average: same as Federal	Same as Federal

Criteria Pollutant	Primary/ Secondary	USEPA Air Quality Standards	Type	New Jersey State Standards	Type
CO	Primary and secondary	1-hour average: 35 ppm 8-hour average: 9 ppm	Not to be exceeded more than once a year	Same as Federal	Same as Federal
PM_{10}	Primary and secondary	24-hour average: 150 micrograms per cubic meter (µg/m3)	Not to be exceeded more than once a year on average over three years	Same as Federal	Same as Federal
$PM_{2.5}$	Primary	1-year average: 12 µg/m3	Annual mean, averaged over three years	Same as Federal	Same as Federal
	Secondary	1-year average: 15 µg/m3	Annual mean, averaged over three years	Same as Federal	Same as Federal
	Primary and secondary	24-hour average: 35 µg/m3	98^{th} percentile, averaged over 3 years	Same as Federal	Same as Federal
Pb	Primary and secondary	Rolling 3-month average: 0.15 µg/m3	Not to be exceeded	Same as Federal	Same as Federal

Source: (NJDEP 2016a, USEPA 2016j, and NJAC 7:27-13)

3.9.2.2 NJDEP Standards and Requirements

NJDEP has developed Toxic Substances regulations under the 1979 Control and Prohibition of Air Pollution by Toxic Substances (NJAC 7:27-17). The State regulations require the registration of stationary sources that emit certain HAPs, permitting and control technology requirements for certain HAP emitting facilities, and risk assessments to confirm emissions are below health benchmarks for HAP emitting sources that meet certain criteria. NJDEP has also instituted a number of voluntary programs and incentives to reducing or controlling HAP emissions (NJDEP 2016b).

On a State-level, NJDEP has developed comprehensive GHG emissions mitigation goals under the New Jersey Global Warming Response Act of 2007 (GWRA; NJSA 26:2C-37). The GWRA establishes two milestone limits, one by 2020 and one by 2050, with the end goal being a reduction of State-wide GHG emissions by 80 percent from 2006 levels by 2050. That is a goal reduction of 25.4 million metric tons of CO_{2e} (NJDEP 2015a).

3.9.3 Existing Conditions

Natural climatic factors can affect the air quality of an area through the transport and dilution of pollutants in the atmosphere. The Project Area is in Bergen County, which is within the central climate zone of the State of New Jersey. The central zone generally has a large number of flat, urban areas with high volumes of vehicles and industries that emit pollutants and a concentration of built and paved surfaces that trap heat. Because of this, the central zone typically has more pollutants in the atmosphere and temperatures are typically warmer (an average mean temperature of around 53 degrees Fahrenheit [°F]) than in surrounding zones that are suburban or rural. Measurable precipitation typically occurs on 120 days throughout the year, with an average annual precipitation between 43 and 47 inches. Typically 25 to 30 of the precipitation events are thunderstorms (ONJSC 2002). Wind direction and wind speed was reviewed for Newark, New Jersey, approximately 10 miles to the southwest of the Project Area. Wind in Newark, New Jersey generally moves west, with an annual average wind speed between 10 and 12 miles per hour (Western Regional Climate Center 2012).

Bergen County is designated by the USEPA as a moderate nonattainment area for 8-hour O_3 and a maintenance area for CO. Bergen County was re-designated from moderate nonattainment to attainment on October 22, 2002 (40 CFR § 81.331) for CO. All other criteria pollutants (i.e., SO_2, $PM_{2.5}$, PM_{10}, NO_2, and Pb) are in attainment for Bergen County. Bergen County was designated as a maintenance area for the 1997 and 2006 $PM_{2.5}$ standards, but was re-designated to attainment on September 4, 2013 (40 CFR § 81.331) following the re-classification of $PM_{2.5}$ standards in 2012. **Table 3.9-2** provides a summary of Bergen County's NAAQS attainment status.

Table 3.9-2: Bergen County NAAQS Attainment Status

Criteria Pollutant[1]	Attainment Status	NAAQS Not Met or Previously Not Met[2]	Classification Notes
O_3	Non-attainment	8-hour average: 0.070 ppm	Classified as "moderate," or having a design value of 0.086 ppm up to, but not including, 0.100 ppm
CO	Maintenance	1-hour average: 35 ppm 8-hour average: 9 ppm	Classified as "moderate" with a design value greater than 12.7 ppm

Criteria Pollutant[1]	Attainment Status	NAAQS Not Met or Previously Not Met[2]	Classification Notes
$PM_{2.5}$	Attainment	Not applicable, currently in attainment	Re-designated from maintenance to attainment on September 4, 2013 (40 CFR § 81.331) following the re-classification of $PM_{2.5}$ standards in 2012

1. All other criteria pollutants (i.e., SO_2, PM_{10}, NO_2, and Pb) are in attainment for Bergen County.
2. See **Table 3.9-1** for additional details on the type of NAAQS (i.e., primary/secondary and concentration/exceedance details).

Source: (USEPA 2016i)

NJDEP maintains three air quality monitoring stations in Bergen County:

1. One is located in the southeastern portion of the county in the Borough of Leonia ("Leonia") that measures ozone;
2. One is located near the eastern boarder of the county in the Borough of Fort Lee ("Fort Lee Near Road") that measures CO, NO, NO_2, NO_x, and $PM_{2.5}$; and
3. One is located near the eastern border of the county in the Borough of Fort Lee ("Fort Lee Library") that measures $PM_{2.5}$.

All stations are within 5 miles of the eastern border of the Project Area (NJDEP 2016c). Data from the monitoring stations were not consistently available for the past three years (2013 to 2015), so USEPA "design values" were used instead to compare existing local air quality to the NAAQS. A design value is a statistical computation that is calculated once a year by the USEPA Office of Air Quality Planning and Standards. Design values are used to determine attainment designations of areas and to analyze an area's progress with meeting the NAAQS (USEPA 2015). The design values were reviewed for the past 3 years (2013 to 2015) and compared to the NAAQS, as shown in **Table 3.9-3**. (It should be noted that station "Fort Lee Near Road" was not established until March of 2014, so 2013 readings were not available for comparison at this station.) The data indicate that the design values for all of the recorded pollutants are below the NAAQS, except for 8-hour O_3.

Table 3.9-3: 2013 through 2015 Bergen County Air Quality

Pollutant	Monitoring Station			Federal Air Quality Standard	State Air Quality Standard
	Fort Lee Near Road	Fort Lee Library	Leonia		
	2014-2015 Design Value	2013-2015 Design Value	2013-2015 Design Value		
CO 1-hour	1.9 ppm	--	--	35 ppm	35 ppm
CO 8-hour	0.9 ppm	--	--	9 ppm	9 ppm
NO_2 1-hour	78 ppb	--	--	100 ppb	100 ppb
NO_2 1-year	18.5 ppb	--	--	53 ppb	0.05 ppm
$PM_{2.5}$ 24-hour	27 µg/m^3	27 µg/m^3	--	35 µg/m^3	35 µg/m^3
$PM_{2.5}$ 1-year	11.3 µg/m^3	9.1 µg/m^3	--	12 µg/m^3	12 µg/m^3
O_3 1-hour	--	--	NA	--	0.12 ppm
O_3 8-hour	--	--	0.074 ppm	0.070 ppm	0.070 ppm

Source: (USEPA 2015)
NA = data are not available

In addition to maintaining local air-quality stations and local criteria pollutant readings, NJDEP has developed comprehensive State-level GHG emissions mitigation goals under the GWRA. Emission estimates are conducted by NJDEP to review progress with the goals set in the GWRA. A 2012 GHG emissions estimate found the annual GHG emissions State-wide to be 104,600,000 metric tons of CO_{2e}. **Table 3.9-4** shows the breakdown by sector of 2012 GHG emissions. As **Table 3.9-4** shows, the main contributor to GHG emissions in the State of New Jersey is mobile sources.

Table 3.9-4: 2012 New Jersey State GHG Emissions by Sector

Sector	GHG Emissions (million metric tons of CO_{2e})
Residential	12.1
Commercial	10.1
Industrial	10.3
Combined Heat and Power Combustion	0.0
Mobile Sources	46.2
Electricity	20.9
Other	12.7
Naturally occurring GHG removal (i.e., sinks)	-7.9
Total:	**104.6**

Source: (NJDEP 2015a)

3.10 Global Climate Change and Sea Level Change

3.10.1 Introduction

Global climate change is an important environmental challenge facing the world today, and human activity is one of the drivers affecting it (Walsh, et al. 2014). Research on this topic is well-documented in reports by the United Nations Intergovernmental Panel on Climate Change, US Climate Change Science Program's Science Synthesis and Assessment Products, and the US Global Change Research Program. This section presents a summary of the regulatory drivers and current Project Area conditions as they relate to climate change. As with any attempt to predict future events and conditions, there is uncertainty in the information presented in this section; however, this information represents the most current, scientifically accepted data available on this subject.

Overall as shown in this section, current data suggest that, within the region of the Project Area, sea level will rise in the next 80 years, as illustrated in **Figure 3.10-1**; average annual temperatures, the number of heat waves, the number of warm/hot days, and the frost-free season will increase; and precipitation, including the frequency of heavy precipitation events and intense storms, will increase throughout the 21st century.

3.10.2 Regulatory Context

The NJDEP considered climate change from the following two perspectives: (1) the potential effects of a proposed action on climate change as indicated by assessing GHG emissions; and (2) the effects of climate change on a proposed action and its environmental impacts. The discussion of GHGs, as they pertain to the existing conditions in the Project Area, is presented in **Section 3.9**. The current section focuses on the metrics of climate change, as well as associated sea level change, as they pertain to the existing conditions in the Project Area. More information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

3.10.3 Existing Conditions

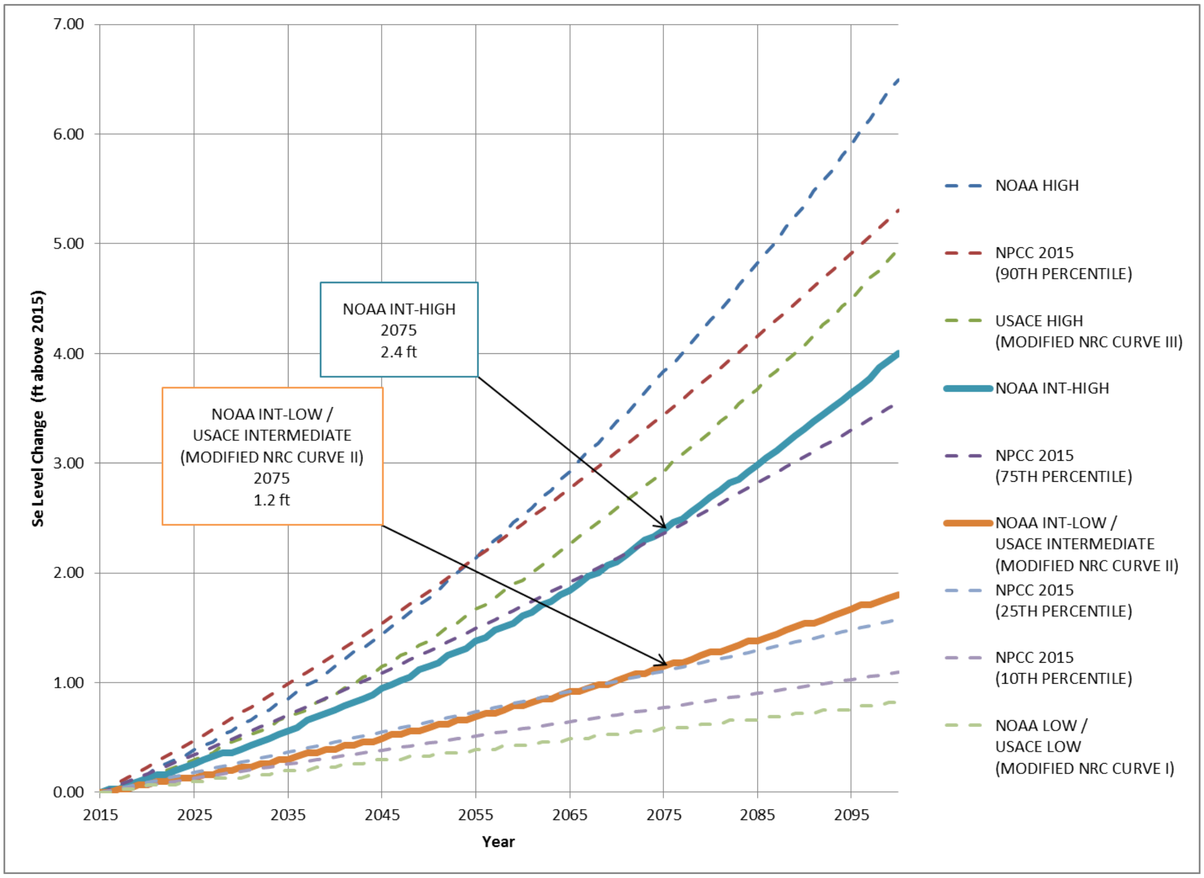
3.10.3.1 Sea Level Change

As discussed in **Section 1.4**, the Project Area has an extensive history with both inland and coastal flooding. Due to the tidal influence of the Hackensack River, sea level change could have a direct impact on coastal flooding in the Project Area, particularly in conjunction with past SLR. The tidal range between mean low water and mean high water for the Hackensack River is 5.2 feet in Kearny, NJ, and 4.7 feet in New Milford, NJ (see **Section 3.17.3.4**) (NJDEP 2001). Since 1900, average global sea level has risen approximately 8 inches (Horton, et al. 2014). However, several factors have combined to increase the rate of SLR specifically in the northeast region of the US, including land subsidence and a potential weakening of the primary oceanic current off the east coast. These factors have resulted in an approximate 12-inch rise in sea level for the northeast region since 1900, which is 50 percent more than the global average (Horton, et al. 2014). In 2015, the New York Panel on Climate Change (NPCC) released a report specific to the New York metropolitan region, which includes the Project Area. This report cited a local rate of SLR of 1.2 inches per decade since 1900, which is approximately double the global rate of 0.5 to 0.7 inch per decade (Horton, et al. 2015a).

Various agencies have published projections to analyze potential sea level change over the coming decades, all of which anticipate sea level to continue to rise, and many of which have produced similar results. In 2013, the USACE established Low, Intermediate, and High SLR projections, which were based in part on projections established by the National Research Council (NRC) in 1987 (USACE 2013, NRC 1987). Additionally, NOAA published four global average SLR projections (Low, Intermediate-Low, Intermediate-High, and High), which were most recently updated in 2013 (NOAA 2013a). Of these, the Low Scenario corresponded with the USACE Low Scenario, and the Intermediate-Low Scenario corresponded with the USACE Intermediate Scenario.

In 2015, the NPCC published revised projections of relative sea level change specific to the New York metropolitan region. These projections also include four scenarios: the 10^{th}, 25^{th}, 75^{th}, and 90^{th} percentiles (Horton, et al. 2015a). The 25^{th} and 75^{th} percentiles encompass the middle of the NPCC projections, and correlate closely with the global NOAA Intermediate-Low and Intermediate-High projections, respectively. Accordingly, NJDEP will focus on the NOAA Intermediate-Low and Intermediate-High projections for analysis in this document.

All of the aforementioned SLR projections are represented in **Figure 3.10-1** below to display the full range of possible sea level change in the region of the Project Area. The NOAA Intermediate-Low and Intermediate-High projections are distinguished with solid lines. As shown in this graphic, these projections range from an increase in sea level of one to over six feet in the next 80 years.



Sources: (NOAA 2013a, Horton, et al. 2015a, USACE 2013)
Note: NOAA values have been regionally corrected with additional modeling data (NOAA 2013a).

Figure 3.10-1: Sea Level Change Estimates for the Battery, NY

The Hackensack River is strongly influenced by the tides, and would be affected by rising sea levels. The projections presented in **Figure 3.10-1** are for the Battery tide station in Lower Manhattan, which is the most proximate available data for the Project Area. Because the Project Area is located along an upstream section of a river and the Battery tide station is located directly along Upper New York Bay, the changes experienced in the Project Area could be somewhat less compared to the Battery tide station.

Table 3.10-1 identifies the projected SLR at Battery, New York for the years 2050, 2075, and 2100 according to each curve shown above. The NOAA Intermediate-Low and Intermediate-High projections are distinguished in gray; the other projections are displayed for context. According to the NOAA Intermediate-Low and Intermediate-High projections, sea level could rise between 1.2 and 2.4 feet near the Project Area by the year 2075, and between 1.8 and 4.0 feet by 2100 (NOAA 2013a). These sea level changes would be in addition to the approximately one foot of SLR that has already occurred since 1900 (Horton, et al. 2014).

Table 3.10-1: Sea Level Change Estimates Relative to 2015 Sea Level

Projection	2050	2075	2100
NOAA High	1.8 feet (ft)	3.8 ft	6.5 ft
NPCC 2015 90th Percentile	1.8 ft	3.4 ft	5.3 ft
USACE High (Modified NRC Curve III)	1.4 ft	2.9 ft	5.0 ft
NPCC 2015 75th Percentile	1.3 ft	2.4 ft	3.6 ft
NOAA Intermediate-High	1.1 ft	2.4 ft	4.0 ft
NOAA Intermediate-Low / USACE Intermediate (Modified NRC Curve II)	0.6 ft	1.2 ft	1.8 ft
NPCC 2015 25th Percentile	0.6 ft	1.1 ft	1.6 ft
NPCC 2015 10th Percentile	0.5 ft	0.8 ft	1.1 ft
NOAA Low / USACE Low (Modified NRC Curve I)	0.3 ft	0.6 ft	0.8 ft

Sources: (NOAA 2013a, Horton, et al. 2015a, USACE 2013)

3.10.3.2 Temperature

Changes in temperature are affected by many climatic factors. However, as a result of the greenhouse effect, changes in temperature are strongly correlated over the long-term with changes in GHG concentrations in the atmosphere. As GHG concentrations in the atmosphere increase, they retain more energy from the sun, which increases earth's temperature (Horton, et al. 2015b). Changes in temperature are assessed in this document by the following metrics: (1) average annual temperature; and (2) number of warm days. These are discussed on regional and local scales below.

Average Annual Temperature

Average annual global temperature has increased about 1.5 °F between 1880 and 2012. During approximately the same timeframe, the average US temperature has increased between 1.3 and 1.9°F; most of this increase has occurred since 1970. Nationwide, the 2000 to 2009 decade was the warmest on record (Walsh, et al. 2014). Between 1895 and 2011, the average annual temperature in the northeast region of the US has increased at a rate of 0.16°F per decade, for a total increase of nearly 2°F (Horton, et al. 2014). Over approximately the same timeframe, New Jersey has experienced an increasing temperature rate of 0.22°F per decade, and the New York metropolitan region has experienced an increasing temperature at a rate of 0.3°F per decade (Broccoli, et al. 2013, Horton, et al. 2015b).

Depending on the level of future GHG emissions, the average annual temperature in the northeast is projected to increase another 3 to 10°F by the 2080s (Horton, et al. 2014). These projections are corroborated on the local level by the NPCC. Using a baseline of 1971 to 2000, the middle range of the NPCC projections identify an increase in average annual temperature of 5.3 to 8.8°F during the same timeframe (Horton, et al. 2015b). **Table 3.10-2** summarizes the middle range of NPCC-projected changes in average annual temperature during the 2020s, 2050s, 2080s, and by 2100.

Table 3.10-2: Middle Range of NPCC Projected Changes in Average Annual Temperature

Timeframe	25th Percentile	75th Percentile
2020s	2.0°F	2.9°F
2050s	4.1°F	5.7°F
2080s	5.3°F	8.8°F
2100	5.8°F	10.4°F

Source: (Horton, et al. 2015b)

Number of Warm Days

Changes in temperature can also be assessed by changes in the length of the frost-free season, which is characterized as the period between the last 32°F instance in the spring and the first 32°F instance in the fall. Between 1991 and 2011, the average frost-free season increased by 10 days in the northeast as compared to the period between 1900 and 1960. By the period of 2070 to 2099, the frost-free season is projected to increase by an additional 20 to 40 days, depending on the level of GHG emissions. The length of the frost-free season affects the vegetation (including crops) growing in a particular area. A longer frost-free season also indicates a longer growing season, which can lead to increases in the productivity of crops and forests, as well as increase the amount of CO_2 that plants remove from the atmosphere (Walsh, et al. 2014).

The number of annual days exceeding 90°F is expected to increase as well. Between 1971 and 2000, northeastern New Jersey averaged 10 to 15 days exceeding 90°F each year. By mid-century (2041 to 2070), this number may increase to between 30 and 50 days, depending on GHG emission levels (Horton, et al. 2014). The New York metropolitan region, which has averaged 18 days exceeding 90°F annually during this timeframe, is projected to see an increase of 21 to 34 days by the 2050s, and of 26 to 58 days by the 2080s. Heat waves are also expected to increase in frequency and duration (Horton, et al. 2015b). Among other consequences, these events may lead to increased instances of heat-related illnesses and deaths, ground-level ozone (which can aggravate asthma), and strain on electrical infrastructure from air conditioning demand (Horton, et al. 2014). **Table 3.10-3** summarizes the NPCC projections on heat waves and days exceeding 90°F.

Table 3.10-3: Middle Range of NPCC Projected Changes to Heat Waves and Number of Days Exceeding 90°F

Metric	Baseline (1971 – 2000)	2050s		2080s	
		25th Percentile	75th Percentile	25th Percentile	75th Percentile
Average Annual Number of Heat Waves	2	5	7	6	9
Average Duration of Heat Waves (days)	4	5	6	5	7
Average Annual Number of Days Exceeding 90°F	18	39	52	44	76

Source: (Horton, et al. 2015b)

3.10.3.3 Precipitation

In addition to sea level change, existing and future changes to precipitation could lead to impacts on inland flooding in the Project Area. As in the case of sea level change and temperature, precipitation changes occur as a result of many influencing factors (man-made and natural) that govern the water cycle on a local, regional, and global scale. While increasing trends in future sea levels and global temperatures are relatively certain, precipitation trends are generally less certain, and are subject to large variability between decades (Broccoli, et al. 2013, NOAA 2013b).

Changes in precipitation are fundamentally related to changes in temperature. Increases in atmospheric temperatures lead to increased capacities of the atmosphere to hold moisture which likely leads to increases in precipitation amounts (Kharin, et al. 2013, Allen and Ingram 2002). However, where exactly this increased precipitation occurs depends on the changes to circulation patterns in the atmosphere, which are highly uncertain (Groisman et al. 2013). As such, precipitation is more easily measured at a regional level, even though it is inherently a local-scale process and can vary significantly throughout a region. Precipitation is described here using three metrics: (1) average annual precipitation; (2) seasonal precipitation; and (3) extreme precipitation. These metrics are discussed below on both regional and local scales.

Two primary sources of analysis were used to project future changes in precipitation. The first source of analysis is the NPCC, which projected changes to precipitation for the New York metropolitan region, and developed projections at the 10th, 25th, 75th, and 90th percentiles. As in the discussion of changes to temperature, the 25th and 75th percentile projections are used in the following analyses, as those represent the middle range. For the purposes of comparison with other analyses, NPCC data on the 2020s are considered early century, data on the 2050s are considered mid-century, and data on the 2080s are considered late century. These data compare future projections to a baseline period of 1971 to 2000.

The other primary source of analysis is general circulation models. In the analyses below, two data sets are used that evaluate data from 20 different models and downscale it to a relatively local level. These data sets originate from the Bureau of Reclamation and the University of Idaho (Bureau of Reclamation 2013, Abatzoglou and Brown 2012). The region of data used by each data set is displayed in **Figure 3.10-2** and **Figure 3.10-3**, respectively. Precipitation statistics were calculated for three future periods: 1980 to 2050 (early century), 2005 to 2075 (mid-century), and 2030 to 2100 (late century). These future periods compare to a baseline period of 1950 to 2015.

Figure 3.10-2: Locality of Precipitation Data from Bureau of Reclamation

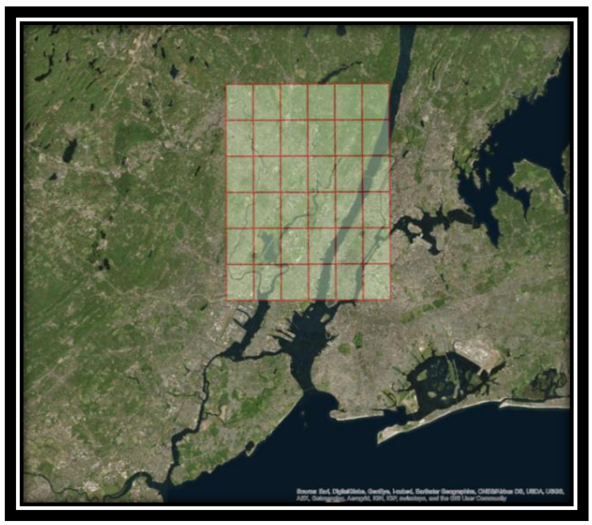


Figure 3.10-3: Locality of Precipitation Data from University of Idaho

Average Annual Precipitation

Between 1895 and 2011, the northeast region of the US experienced an increase in average annual precipitation of approximately 0.39 inch per decade, which has culminated in a total increase of over 10 percent during that span (NOAA 2013b, Horton, et al. 2014). Similarly, the Rutgers Climate Institute reports that New Jersey has seen an increase in average annual precipitation of approximately 9 percent per century over the same timeframe (Broccoli, et al. 2013). Additionally, another NOAA assessment found that average annual precipitation in the northeast is projected to further increase by 0 to 10 percent by mid-century (NOAA 2015).

Locally, average annual precipitation has increased in the New York metropolitan region at a rate of approximately 0.8 inch per decade between 1900 and 2013, which is approximately twice the rate of the northeast region; the NPCC projects that annual precipitation could continue to increase throughout the next century. These projections are presented in **Table 3.10-4**. In the near term, increases between 1 and 8 percent may be expected. However, by mid- and late century, increases in average annual precipitation may reach an additional 4 to 11 percent and 5 to 13 percent, respectively (Horton, et al. 2015b).

Table 3.10-4: Middle Range of NPCC Projected Changes in Average Annual Precipitation

Timeframe	25th Percentile	75th Percentile
2020s	1%	8%
2050s	4%	11%
2080s	5%	13%
2100	-1%	19%

Source: (Horton, et al. 2015b)

Seasonal Precipitation

The National Climate Assessment reports that winter and spring precipitation levels are expected to increase in the northeast, with winter precipitation increasing between 5 and 20 percent (Horton, et al. 2014). Another NOAA analysis projects that winter and spring precipitation levels may increase between 5 and 15 percent throughout the northeast. Summer and fall precipitation levels appear to show lesser projected increases in precipitation, but the models are not consistently statistically significant (NOAA 2015).

Overall, these projections are mirrored at the local level. Local changes to seasonal precipitation were analyzed using projections from both the NPCC, and from the Bureau of Reclamation and University of Idaho data sets. The results of these analyses are compared in **Table 3.10-5**.

Although these analyses have different baselines, they yield similar results: winter and spring are projected to experience the greatest increases in precipitation (between 3 and 25 percent), while summer and fall are projected to experience small increases or possibly decreases in seasonal precipitation (between a 5 percent decrease and an 18 percent increase) (Bureau of Reclamation 2013, Abatzoglou and Brown 2012).

Table 3.10-5: Comparison of Projected Percent Changes to Seasonal Precipitation

Time Period	Season	NPCC		General Circulation Models	
		25th Percentile	75th Percentile	Bureau of Reclamation Data Set	University of Idaho Data Set
Mid-Century	Autumn	1%	10%	3%	2%
	Winter	7%	18%	6%	4%
	Spring	3%	12%	5%	5%
	Summer	-5%	11%	4%	3%
Late Century	Autumn	-1%	11%	4%	5%
	Winter	10%	25%	15%	13%
	Spring	4%	15%	12%	11%
	Summer	-5%	18%	9%	5%

Sources: (Bureau of Reclamation 2013, Abatzoglou and Brown 2012)

Extreme Precipitation

Between 1958 and 2010, the northeast region experienced more than a 70 percent increase in the amount of precipitation falling during the heaviest one percent of storms, which is the largest such increase of any region in the US. These heavy downpours are expected to become even more common as the century continues (Horton, et al. 2014). According to NOAA, the amount of precipitation falling during the heaviest one percent of storms is expected to further increase in the northeast between 60 and 90 percent by mid-century (NOAA 2015). In New Jersey, heavy precipitation events have occurred more than twice as often in the past 20 years as they have in the last century overall (Broccoli, et al. 2013).

At the local level, the intensity of large storms, as measured by 24-hour precipitation totals, was also analyzed using the Bureau of Reclamation and University of Idaho data sets. Large storms are often identified by their frequency, or return period. For example, the largest storm that is likely to occur in a particular location once every five years would have a return period of five years, and may be referred to as the 5-year storm. In this analysis, the intensities of the 2-year, 5-year, 10-year, 25-year, 50-year, 100-year, and 500-year storms were projected for the years 2050, 2075, and 2100. These data are displayed in **Table 3.10-6**.

Table 3.10-6: Comparison of Intensity Changes for Large Storms

Return Period (Years)	2	5	10	25	50	100	500
2050							
Bureau of Reclamation Data Set	4%	3%	3%	3%	3%	3%	2%
University of Idaho Data Set	5%	7%	9%	13%	16%	20%	32%
2075							
Bureau of Reclamation Data Set	8%	6%	5%	4%	3%	1%	-2%
University of Idaho Data Set	12%	15%	17%	21%	24%	28%	37%
2100							
Bureau of Reclamation Data Set	10%	9%	7%	5%	4%	2%	-3%
University of Idaho Data Set	15%	18%	19%	21%	23%	24%	28%

Sources: (Bureau of Reclamation 2013, Abatzoglou and Brown 2012)

Both data sources suggest that future large storms are expected to increase in intensity. Uncertainty increases substantially for the larger return period events, but this is to be expected due to both their rarity and the unpredictable weather patterns that create such large storms. For example, by the year 2075, the intensity of the 5-year storm is projected to increase by 6 to 15 percent, while the intensity of the 100-year storm is projected to increase by 1 to 28 percent. Similarly, by the year 2100, the intensity of the 5-year storm is projected to increase by 9 to 18 percent, while the intensity of the 100-year storm is projected to increase by 2 to 24 percent (Bureau of Reclamation 2013, Abatzoglou and Brown 2012). Notwithstanding any changes in stormwater management, increases in the intensities of these storms could lead to worsening flooding conditions, increased property damages, and increased disruptions to businesses and residents. See **Section 3.17.3.6** for more detailed information regarding precipitation in the Project Area.

3.11 Recreation

3.11.1 Introduction

This section describes existing parks, open spaces, and recreational land/facilities within the Project Area. Open spaces and recreational land are defined as areas of land remaining in their natural state or free from intensive residential, commercial, industrial, or institutional development. These also include areas preserved for scenic beauty and visual quality along highways, roads, and other routes, including public parks and recreation areas. This land often protects biodiversity through the conservation of protected species habitat, rare natural features, and significant ecosystems, as well as watersheds and water quality (New Jersey State Planning Commission 2001). The Hackensack River is an important recreational resource to the Project Area. In addition to providing habitat for numerous species of plants and animals, the Hackensack River and other wetlands and waterways improve quality of life by providing a wide variety of recreational and educational opportunities (Bergen County Department of Planning and Economic Development 2004).

Information on parks, open spaces, and recreational facilities within the Project Area was obtained by reviewing the NJDEP Bureau of GIS database, the NJDEP Recreational and Open Space Inventory (ROSI), the Meadowlands Environmental Site Investigation Compilation, and the NJSEA Master Plan. The ROSI data are maintained by the Green Acres Program and includes municipal, county, and non-profit parkland encumbered by Green Acres restrictions under NJAC 7:36-4.1; it does not reflect State-owned parkland (NJDEP 2016g). Field reconnaissance was also conducted in July and August 2016 to confirm available data.

3.11.2 Regulatory Context

The Hackensack Meadowlands Reclamation and Development Act (NJSA 13:17-1 *et seq.*) recognizes the Meadowlands District along the lower Hackensack River as “a resource of incalculable opportunity for new jobs, homes, and recreational sites.” The objectives of the Act include: (1) the preservation of nature; (2) protection from air and water pollution, as well as from solid waste disposal; and (3) development of additional space for industrial, commercial, residential, recreational, and other uses (NJSEA 2004).

The State of New Jersey administers the Green Acres Program, created in 1961, which provides funding to municipalities to protect open space or buy out properties statewide. The Green Acres Program also administers the Blue Acres Program, which acquires properties that have either been damaged by storms or floods, may incur damage in the future, or may serve to buffer or protect other properties from storm or flood damage. The Green Acres, Farmland, Blue Acres, and Historic Preservation Bond Act of 2007 authorized $12 million to the Blue Acres Buyout Program for the acquisition of lands in the floodways of the Delaware, Passaic, and Raritan Rivers and their tributaries for recreation and conservation purposes. An additional $24 million was secured in the Green Acres, Water Supply and Floodplain Protection, and Farmland and Historic Preservation Bond Act of 2009. Green Acres parkland occurs in the Boroughs of Little Ferry and Moonachie within the Project Area, as illustrated in **Figure 3.11-1**, **Figure 3.11-2**, **Figure 3.11-3**, **Figure 3.11-4**, and **Figure 3.11-5**. None of the five communities are currently participating in the Blue Acres Program.

In accordance with NJAC 7:36-4.1 of the Green Acres Program (NJSA 13:8A-1 *et seq*.), a local government unit that receives Green Acres funding shall not convey, dispose of, or divert to a use for other than recreation or conservation purposes any lands held by the local government unit for those purposes at the time of receipt of Green Acres funding. According to the New Jersey State Plan, funds for the acquisition of recreational land and open space is reserved for critical environmental sites, greenbelts and greenways, areas of significant value, land with environmentally sensitive features, land needed for active recreation, and public spaces in urban areas supporting redevelopment efforts (New Jersey State Planning Commission 2001).

As authorized by the New Jersey Trails System Act of 1974, the New Jersey Trails Plan identifies the need for a statewide network of open space corridors (greenways) and waterway corridors (blueways) linking recreational and open space land. These connections are being made via corridors, paths, rivers, streams, migratory routes, hiking and biking trails, beaches, abandoned railroads, scenic trails, historic areas, and other open space resources, in cooperation between State, regional, and local governments, along with private groups and property owners (NJDEP and NJDOT 2009). With the establishment of this Act, the New Jersey Trails Program also administers Federal Recreational Trails Program grants to develop, maintain, and restore trails and trail-related facilities.

Local codes and ordinances for the Boroughs of Little Ferry (Code of the Borough of Little Ferry, Chapter X) and Moonachie (The Revised General Ordinances of the Borough of Moonachie, Chapter IX) regarding recreational areas establish the regulations for parks and recreational facilities in these boroughs. Local codes and ordinances regarding recreational areas in the Borough of Carlstadt can be found in the Police Regulations of The Revised General Ordinances of the Borough of Carlstadt (Chapter V). These regulations include, but are not limited to, littering violations, presence of pets and animals, prohibited acts, penalty costs, permit applications, and hours of use. More detailed information on Federal, State, and local regulatory requirements for the Proposed Project are presented in **Appendix B**.

3.11.3 Existing Conditions

Bergen County owns and maintains over 8,700 acres of preserved public open space and recreational areas. Parks and recreational facilities include playgrounds, picnic areas, ballfields, soccer fields, areas for court sports, swimming pools, bike trails, golf courses, marinas, and passive recreation areas (NJSEA 2004). Three key development trends likely to dominate the Project Area over the next 10 years include: (1) the suburbanization of existing semi-rural communities; (2) the redevelopment of suburban communities; and (3) the redevelopment of urban communities. Each of these trends has the potential to impact open space and recreation areas within the Project Area differently (Bergen County Department of Planning and Economic Development 2004).

Approximately 1,519 total acres of active and passive parkland, wetlands and mitigation banks, open spaces, recreational areas, and boating facilities occur within the Project Area (**Table 3.11-1**). These facilities are presented in this section by municipality. Several private boating facilities are also located in the Boroughs of Carlstadt and Little Ferry, offering varying amounts of boat storage, slips, repair facilities, and public launch areas (Bergen County Department of Planning and Economic Development 2004).

Table 3.11-1: Types of Recreational Land and Open Space within Project Area Municipalities

Type of Land	Acres in Project Area	Percent of Total Recreational Land and Open Space
Designated Parks and Recreational Fields/Facilities (includes school athletic fields)	147	10%
Marinas	11	1%
Wetlands and Mitigation Banks	1,155	76%
Other Open Spaces (includes cemeteries)	206	13%
Total	**1,519**	**100%**

3.11.3.1 Borough of Little Ferry

The Borough of Little Ferry has 11 public recreation areas and two private marinas (**Figure 3.11-1**). **Table 3.11-2** lists existing recreation areas. **Table 3.11-2** lists existing marinas within the Project Area.

Table 3.11-2: Recreation Areas in the Project Area: Borough of Little Ferry

Facility Name	Function and Use	Size (acres)
Indian Lake Park	Football, baseball, softball, Little League, soccer, playground/tot lot, pond with dock, field house, meeting hall, restrooms	15
Willow Lake Park	Baseball, softball, soccer, playground/tot lot, field house, pavilion, shuffleboard	13
Memorial School	Baseball, softball, basketball courts	8
Washington School	Basketball, playground/tot lot	2
Losen Slote Creek Park/Mehrhof Park	Open space including both areas surrounding the Losen Slote and Mehrhof Pond (Football, baseball, softball, soccer, hockey, natural area)	61
Birch Street Park	Open area	<1
Maple Grove Park Cemetery	Cemetery; open area (mostly in the Township of South Hackensack, partially in the Borough of Little Ferry)	1
Gethsemane Cemetery	Cemetery; Bergen County park	1
Bailey Park	Protected open space that provides a buffer between residential and commercial land uses; playground, basketball court, open playing field, bird sanctuary; 60 percent is open space without trees	2
Redneck Avenue Open Land	Wooded natural public space; bounded by Redneck Ave, Mariani Dr., Ann St., Grant St., Wilson St.	10
Teterboro Woods	Palustrine forested wetlands (on the western border of Little Ferry, owned by PANYNJ); candidate restoration/preservation site; primarily on airport land with limited access to the public	7
Waterside Village Recreation Area	Vacation rental community that provides areas for golfing, boating, and other outdoor recreation activities	2
Total		**123**

Table 3.11-3: Marinas in the Project Area: Borough of Little Ferry

Name	Marina	Public	Private	Activity
Riverside Boat Works	x		x	Slips (seasonal and live on), boat storage/repair, public boat ramp
Little Ferry Marina	x		x	Slips, storage, repair

3.11.3.2 Borough of Moonachie

The Borough of Moonachie has six parks/open spaces (**Figure 3.11-2** and **Table 3.11-4**). John Tucci, John Stevens, and Albert Pomponio Fields are located adjacent to each other along Redneck Avenue within Redneck Avenue Park. No marinas are present in the borough.

Table 3.11-4: Recreation Areas in the Project Area: Borough of Moonachie

Facility Name	Function and Use	Size (acres)
Redneck Avenue Park	Baseball, softball, Little League, field house, storage – includes John Tucci Field, John Stevens Field, and Albert Pompinio Field	10
Joseph Street Park	Basketball, tennis, street hockey, playground tot/lot, bike path, picnic area, senior center, gazebo	3
Concord Street Park	Playground/tot lot, picnic area, basketball	3
Teterboro Woods	258 total acres of palustrine forested wetlands (south of the Borough of Teterboro border in the Borough of Moonachie, owned by PANYNJ); candidate restoration/preservation site; primarily on airport land with limited access to the public	118
Losen Slote Creek Park	Open space of lowland forest and meadows within the Boroughs of Little Ferry and Moonachie	21
Birch Street Park	Open area	<1
Robert L. Craig School Athletic Field	Elementary school athletic field	4
Total		**160**

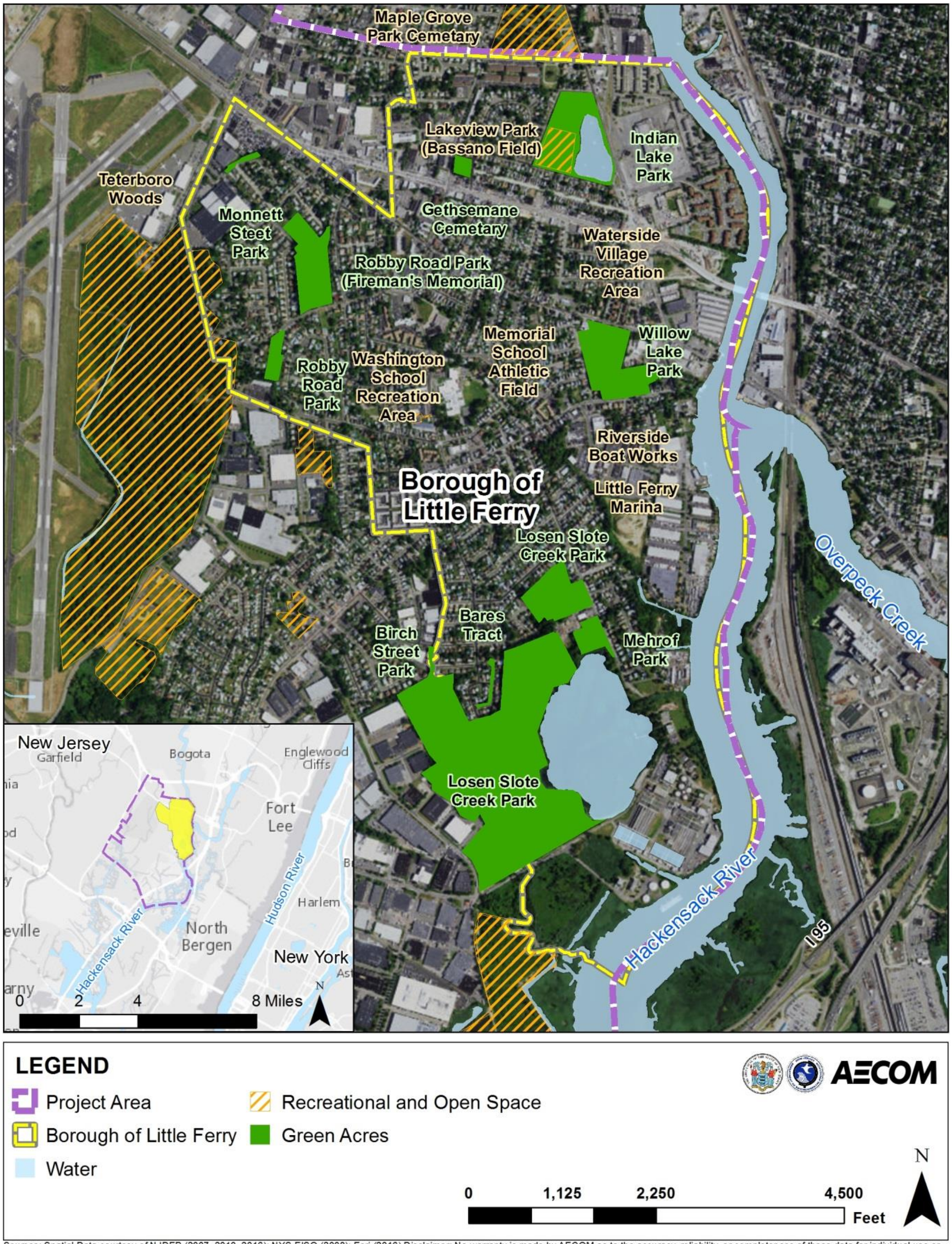


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Figure 3.11-1: Recreational and Open Land in the Borough of Little Ferry

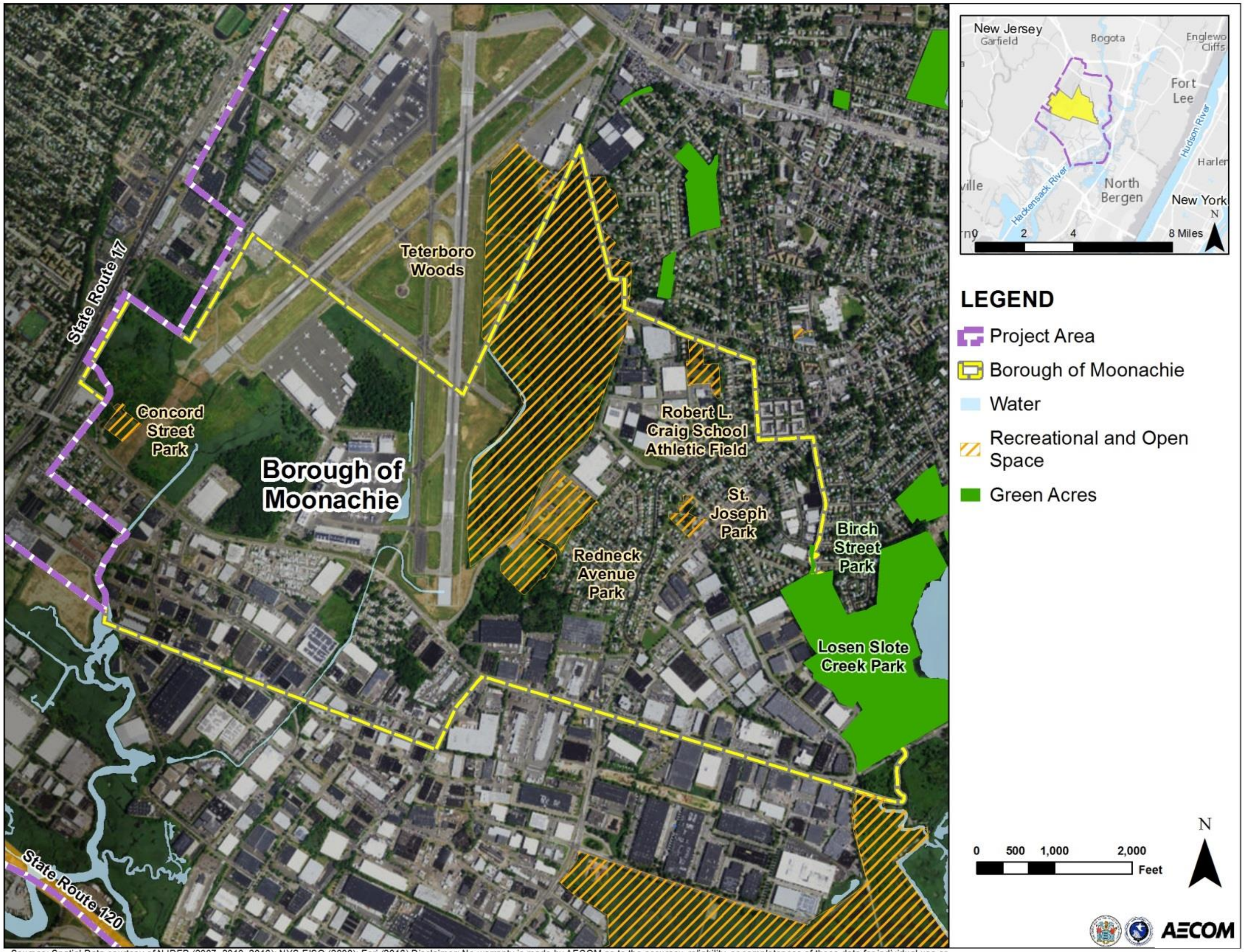

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Figure 3.11-2: Recreational and Open Land in the Borough of Moonachie

3.11.3.3 Borough of Carlstadt

The Borough of Carlstadt contains five large wetland preservation (recreation) areas, the Paterson Plank Road Corridor, two private marinas, and one public marina (**Figure 3.11-3**). **Table 3.11-5** lists existing recreation areas and **Table 3.11-6** lists existing marinas located within the Project Area.

Table 3.11-5: Recreation Areas in the Project Area: Borough of Carlstadt

Facility Name	Function and Use	Size (acres)
Metro Media Tract	Open wetlands	74
Richard P. Kane Natural Area	Existing restoration/preservation and/or mitigation site	370
Richard P. Kane Mitigation Bank	Existing restoration/preservation and/or mitigation site	217
MRI Phase 3 Wetland Mitigation Bank	Existing restoration/preservation and/or mitigation site	51
MRI Mitigation Bank	Existing restoration/preservation and/or mitigation site	206
Paterson Plank Road Corridor	305 acres of mixed-use development within the Boroughs of Carlstadt and East Rutherford, including recreation facilities and open space; 38 acres are in Project Area	38
Total		**956**

Table 3.11-6: Marinas in the Project Area: Borough of Carlstadt

Name	Marina	Public	Private	Activity
River Barge Park	x	x		Boat ramp, paddling and rowing launching points, marina, promenade with picnic tables, walking trails, education pavilion
Snipe Boat Club	x		x	Slips, club house, storage, boat ramp
Majestic Boat Club	x		x	Slips, club house, storage, boat ramp

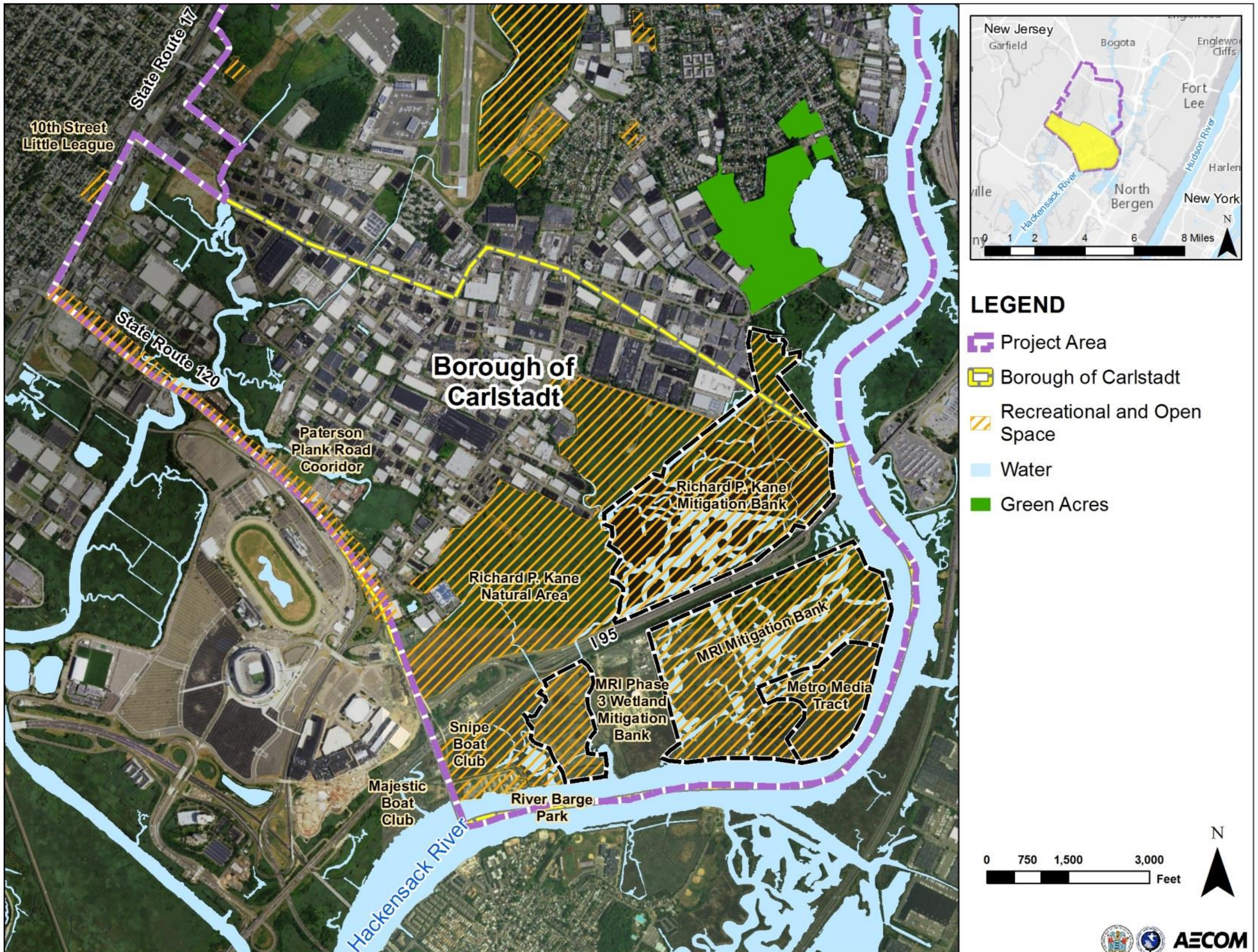

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Figure 3.11-3: Recreational and Open Land in the Borough of Carlstadt

3.11.3.4 Borough of Teterboro

The Borough of Teterboro has one small park and one open area (Teterboro Woods), which is a candidate site for restoration and preservation (**Figure 3.11-4**). **Table 3.11-7** lists the existing facilities.

Table 3.11-7: Recreation Areas in the Project Area: Borough of Teterboro

Facility Name	Function and Use	Size (acres)
Teterboro Woods	258 total acres of palustrine forested wetlands; candidate restoration/preservation site; primarily on airport land with limited access to the public	31
Small, unnamed park	Small park (about 0.5 acres) established in 1981	<1
Total		**32**

3.11.3.5 Township of South Hackensack

The portions of South Hackensack within the Project Area do not contain any active recreational facilities; a portion of the Richard P. Kane Mitigation Bank is located within the Township of South Hackensack (**Table 3.11-8**), but is primarily within the Borough of Carlstadt (**Figure 3.11-5**).

Table 3.11-8: Recreation Areas in the Project Area: Township of South Hackensack

Facility Name	Function and Use	Size (acres)
Richard P. Kane Mitigation Bank	Existing restoration/preservation and/or mitigation site	20
Total		**20**

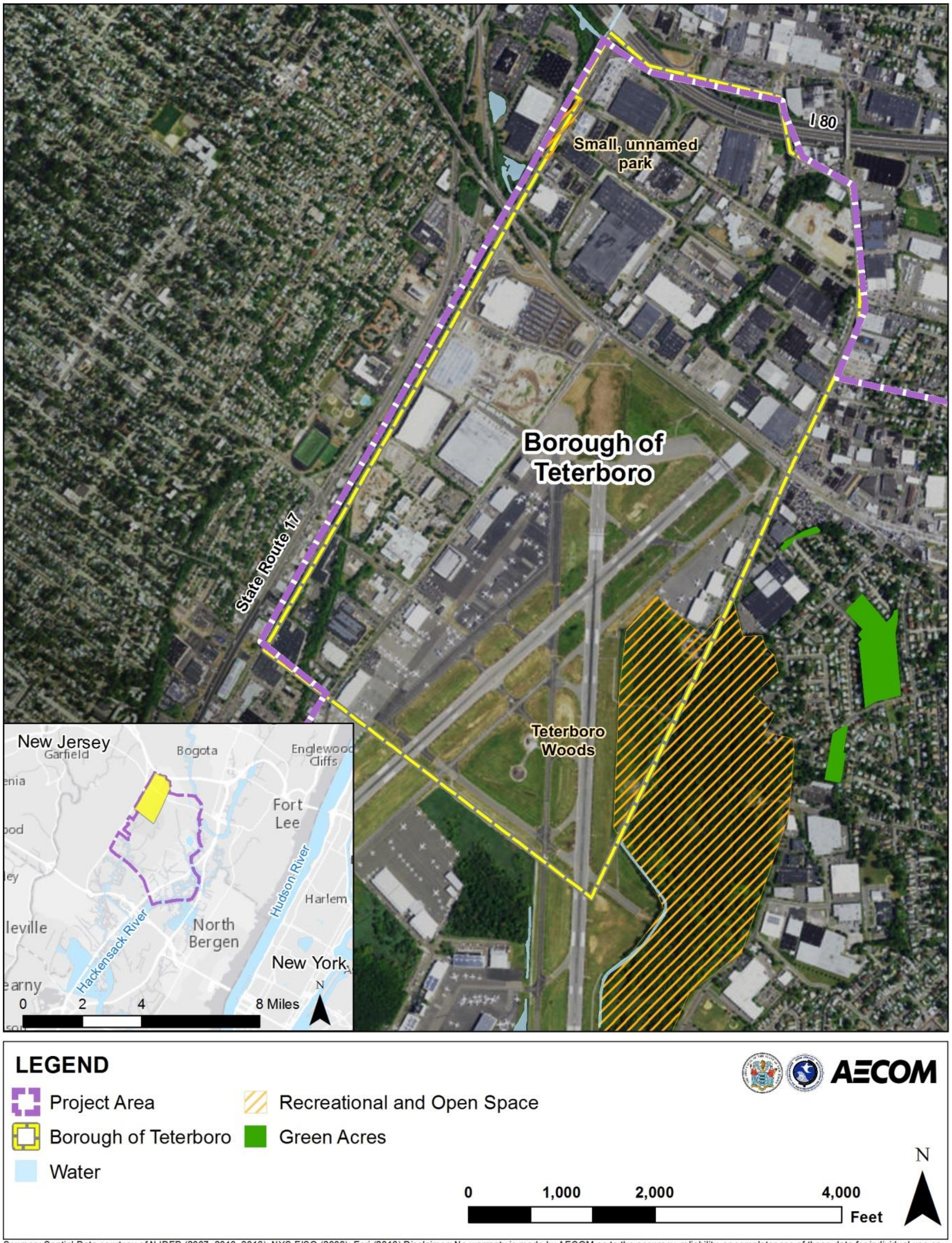

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Figure 3.11-4: Recreational and Open Land in the Borough of Teterboro

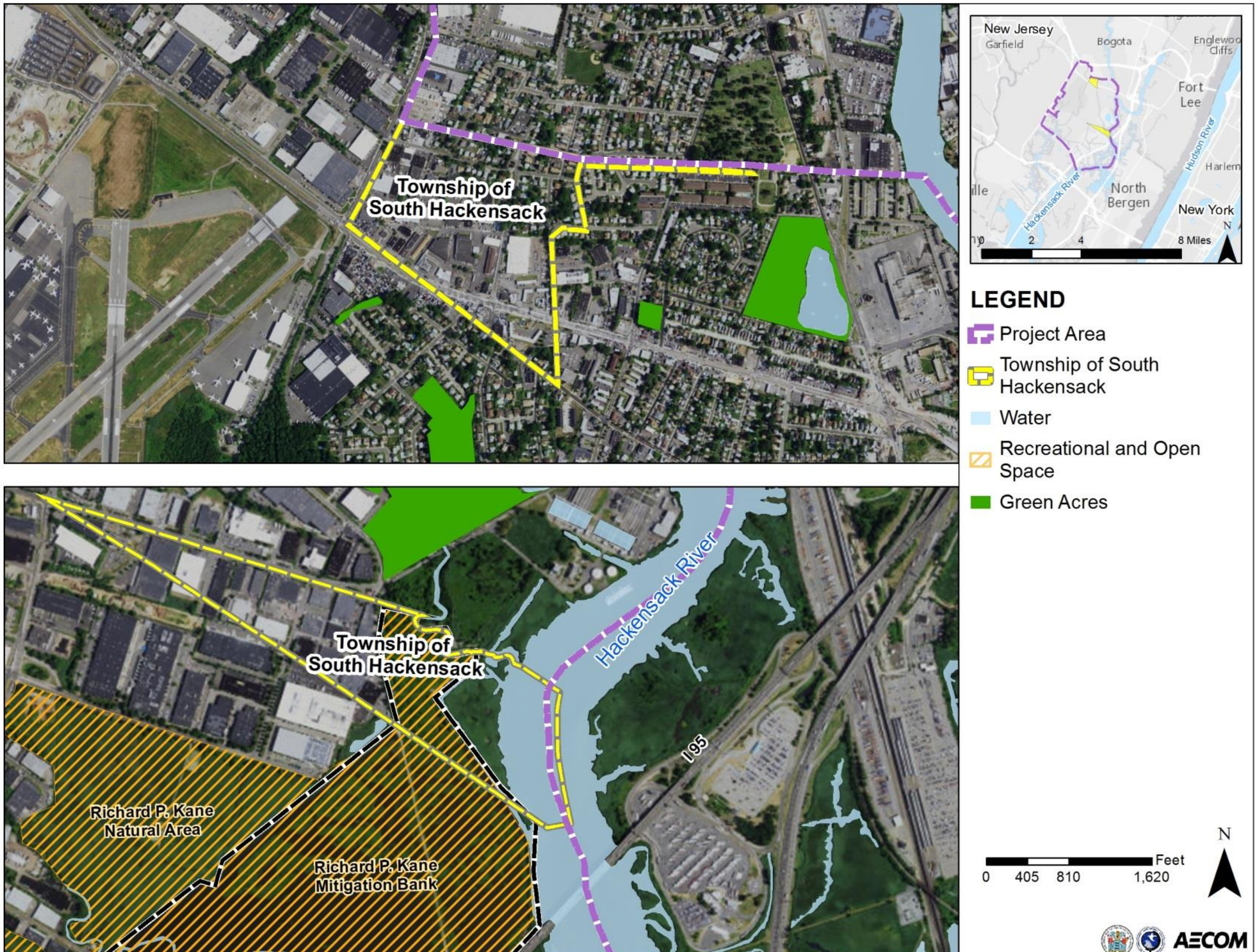

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Figure 3.11-5: Recreational and Open Land in the Township of South Hackensack

3.12 Utilities and Service Systems

3.12.1 Introduction

This section identifies the utility systems present in the Project Area. Specifically, this section addresses sanitary wastewater collection and treatment, water supply and distribution, electricity, natural gas, solid waste, stormwater management, and communication systems (i.e., landline telephone, cable television, and internet). Information gathered through a desktop review of previous reports, publicly available information from utilities providers, and resources available through government agencies resulted in an inventory of utilities systems for and within the Project Area. Critical facility[24] determinations stated herein are in accordance with those in the Bergen County Multi-Jurisdictional All-Hazards Mitigation Plan, which was approved by FEMA on April 13, 2015.

3.12.2 Regulatory Context

There are multiple Federal, State, and local laws and regulations that apply to utility providers within the Project Area. These regulations ensure the maintenance of public health and safety within the community, the provision of necessary and reliable utility systems, and utility providers meet certain standards. **Table 3.12-1** lists the utilities laws and regulations applicable to the Project Area and the Proposed Project. More detailed information on Federal, State, and local regulatory requirements for the Proposed Project is presented in **Appendix B**.

Table 3.12-1: Federal, State, and Local Laws and Regulations Applicable to Utilities and Service Systems

Law/Regulation	Summary of Regulation
Federal Facility Compliance Act of 1992 (Public Law [PL] 102–386)	Amends the Solid Waste Disposal Act and expands the enforcement authority of Federal and State regulators with respect to solid and hazardous waste management at Federal facilities; requires Federal facilities to pay any nondiscriminatory fees or service charges assessed in connection with a Federal, State, interstate, or local solid or hazardous waste regulatory program; waives immunity for Federal facilities under solid and hazardous waste laws by allowing states to fine and penalize for violations.
Public Utility Regulatory Policies Act of 1978 (16 USC 46 §§ 2601 *et seq.*)	Promotes the use of utilities that employ renewable or domestic energy.
Solid Waste Management Act (NJSA 13:1E-1 *et seq.*)	Regulates the collection and disposal of solid waste.
Solid Waste Planning (NJAC 7:26.6)	Establishes procedures that assure the orderly preparation of a solid waste management plan for every solid waste management district.
Utility Accommodation (NJAC 16:25-1.1 *et seq.*)	Regulates utility accommodation for transportation, location, and installation of pipelines, underground electric and communication lines, and overhead power and communication lines.

[24] A critical facility is a structure, service, or facility that is particularly vulnerable to flooding due to its potential to cause harm, damage, or disruption to community persons, properties, or activities if it is destroyed or impaired.

Law/Regulation	Summary of Regulation
Public Utilities (NJSA 48 and NJAC 14)	Regulates the provision of electricity, gas, telecommunication services, water supply, wastewater treatment, and cable television in the State; includes, but is not limited to, the Electric Discount and Energy Competition Act (NJSA 48:3-49 *et seq.*), the Solid Waste Utility Control Act (NJSA 48:13A-1 *et seq.*), and the Underground Facilities Protection Act (NJSA 48:2-73 *et seq.*).
Water and Water Supply (NJSA 58)	Manages the States' water supply; includes, but is not limited to, the Licensing of Water Supply and Wastewater Operators (NJSA 58:11-64 to 58:11-73) and the Water Supply Management Act (NJSA 58:1A-1 *et seq.*).
Meadowlands District Zoning Regulations (NJAC 19:4-4)	Outlines the regulations regarding zoning, construction, and use of buildings and land within the Meadowlands District, including as it pertains to drainage facilities and easements, road improvements, and public water and sewer systems.
Subdivision Regulations (NJAC 19:4-5)	Manages procedures, engineering, and planning standards, rules, and regulations regarding subdivision, including as it pertains to drainage facilities and easements, road improvements, and public water and sewer systems.
Solid Waste Management (Code of the Borough of Little Ferry, Chapter XXII)	Regulates solid waste, yard waste, and recycling in the Borough of Little Ferry.
Water and Sewer (Code of the Borough of Little Ferry, Chapter XXIV)	Regulates sanitary sewer connections, storm sewer connections, and prohibits certain discharges (i.e., stormwater, industrial process waters, etc.) into public sanitary sewers in the Borough of Little Ferry.
Utilities (Revised General Ordinance of the Borough of Moonachie, Chapter XIII)	Regulates solid waste, yard waste, industrial wastes, recycling, sanitary sewer connections, and storm sewer connections in the Borough of Moonachie; prohibits sump pump and other water discharges into public sanitary sewers; regulates fertilizer use to prevent runoff into sanitary or storm sewers.
Water, Sewer, and Waste Disposal (Revised General Ordinance of the Borough of Carlstadt, Chapter XVI)	Regulates solid waste, yard waste, industrial waste, hazardous waste disposal, recycling, sanitary sewer connections, and storm sewer connections in the Borough of Carlstadt; prohibits non-stormwater discharges into stormwater systems.
Sewers and Sewage Disposal (Code of the Township of South Hackensack, Chapter 108)	Regulates sanitary sewer connections and storm sewer connections in Township of South Hackensack; requires permits to be obtained if discharging into a sewer system.
Solid Waste (Code of the Township of South Hackensack, Chapter 186)	Regulates solid waste, recycling, dumpsters and trash cans, and refuse scavenging.

Although not a law or regulation, the New Jersey Energy Master Plan provides guidance for meeting State goals regarding the use of renewable, domestic, and emerging energy technologies and discusses State-wide progress with goal achievement (State of New Jersey 2011). Similarly, the New

Jersey Solid Waste Management Plan provides guidance for satisfying responsibilities required under the State's Solid Waste Management Act, such as enhancing recycling throughout the State, managing garbage, and managing landfills (NJDEP 2006).

3.12.3 Existing Conditions

3.12.3.1 Sanitary Wastewater Collection and Treatment

Within the Project Area, sanitary wastewater is separate from stormwater at all times. There are no combined sewers in the Project Area. However, there are several combined sewers in other nearby municipalities that do convey wastewater through the common sewer mains (BCUA 2016a).

The BCUA is responsible for treating 83 million gallons per day (mgd) of sanitary wastewater for over half a million residents across 47 municipalities in eastern Bergen County, including those that comprise the Project Area (BCUA 2016b). The Little Ferry Water Pollution Control Facility, the primary water treatment plant for the BCUA and a critical facility in the Borough of Little Ferry (Bergen County Office of Emergency Management 2015), serves the Project Area, and is located at the southern end of Mehrhof Road, immediately adjacent to the Hackensack River (**Figure 3.12-1**). The plant has undergone multiple improvements since its construction in 1951, and now has a peak capacity of 109 mgd, although it can successfully treat a flow of 190 mgd before bypass may be necessary (BCUA 2016a). In 2014 (the most recent data available), the average flow was 77.3 mgd, which was a seven percent increase from 2013. However, wet weather led to a peak flow in 2014 of 251 mgd, and no sewage bypasses occurred (BCUA 2016c). Overall, roughly 8 to 10 percent of flow originates from industrial and commercial areas throughout the BCUA service area (BCUA 2016d).

The BCUA owns 108 miles of sewer lines, including both gravity and force mains, which convey wastewater from the municipal collection systems to the treatment facility. There are also nine automatic pumping stations, which are predominately located on the outskirts of the service area, and 166 metering chambers (BCUA 2016a).

Three primary trunk systems, constructed between 1951 and 1972, convey wastewater to the Little Ferry Water Pollution Control Facility (BCUA 2016a). The Overpeck Trunk Sewer, a 60-inch sewer, enters the facility from across the Hackensack River to the east, where it extends to Tenafly and serves the Overpeck Valley (BCUA 2016a). The Hackensack Valley Trunk Sewer, a 96-inch sewer, extends north toward Westwood, paralleling the western bank of the Hackensack River (BCUA 2016a). The Southwest Trunk Sewer, a 48-inch sewer, runs along Moonachie Avenue to about NJ-17 before turning northeast and extending into Hasbrouck Heights (BCUA 2014, BCUA 2016a).

Collected wastewater is treated at the Little Ferry Water Pollution Control Facility. Treated effluent is either provided to the Public Service Electric and Gas (PSE&G) Ridgefield Power Plant to be beneficially reused for cooling purposes, or is discharged into the Hackensack River (BCUA 2016a). Biosolids removed from the sanitary wastewater are stored in tanks and transported to the Passaic Valley Sewage Commission's Yantacaw Treatment Plant in Newark, New Jersey, via truck or barge. In 2014, 56,478,268 gallons of biosolids (which averaged approximately six percent solid) were transferred to the Yantacaw facility. Following further treatment, they are transferred to either the NJSEA (formerly the NJMC) landfill in the Township of Lyndhurst or Amelia Landfill in Virginia (BCUA 2016c).

In addition to the BCUA, the Carlstadt Sewerage Authority (CSA) services the industrial portion of the Borough of Carlstadt bounded between Berry's Creek and Washington Avenue. CSA owns 13 miles of gravity sewers, two miles of force mains, and two pump stations, which deliver the wastewater to the Little Ferry Water Pollution Control Facility (CSA 2016).

Table 3.12-2 identifies the sanitary sewage pump and drain stations that are located within the Project Area.

Table 3.12-2: Pump and Drain Stations Located Within Project Area

Municipality	Infrastructure	Critical Facility?
Little Ferry	Eckel Road Pump Station	Yes
	Main and Franklin Street Pump Station	Yes
	Maiden Lane Drain Station	Yes
	Union Avenue Pump Station	Yes
	Williams Street Drainage Station	Yes
Moonachie	Concord Street Pump Station	Yes
	Moonachie Avenue Pump Station	Yes
	Moonachie Road Pump Station	Yes
Carlstadt	Carlstadt Pump Station (Barrell Avenue)	Yes
	Pumping Station 1 (Jony Drive)	Yes
Teterboro	Sewer and Stormwater Pumping Station	Yes
South Hackensack	Grove Street Sewage Station	Yes
	Huyler Street Pumping Station	Yes

Source: (Bergen County Office of Emergency Management 2015)

3.12.3.2 Water Supply and Distribution

SUEZ Water New Jersey, Inc., a large international conglomerate, is responsible for water supply and distribution in the Project Area (SUEZ 2016a). In New Jersey, SUEZ services about 850,000 residents within Bergen, Hudson, Passaic, Sussex, and Hunterdon Counties (SUEZ 2016a).

SUEZ New Jersey collects water from four primary sources: the Oradell Reservoir, Woodcliff Lake Reservoir, Lake Tappan Reservoir, and Lake DeForest (located in New York). These waterbodies cumulatively hold about 14 billion gallons of drinking water. On occasion, the water supply may be supplemented by the Boonton, Wanaque, and Monksville Reservoirs (SUEZ 2016a). Following collection, the water is transported to Haworth Water Treatment Plant, where it undergoes a complex treatment process including the addition of safe drinking water chemicals and ozone, filtration, and additions of chlorine and ammonia (SUEZ 2016b). The water is then distributed through a network of pipes to individual consumers.

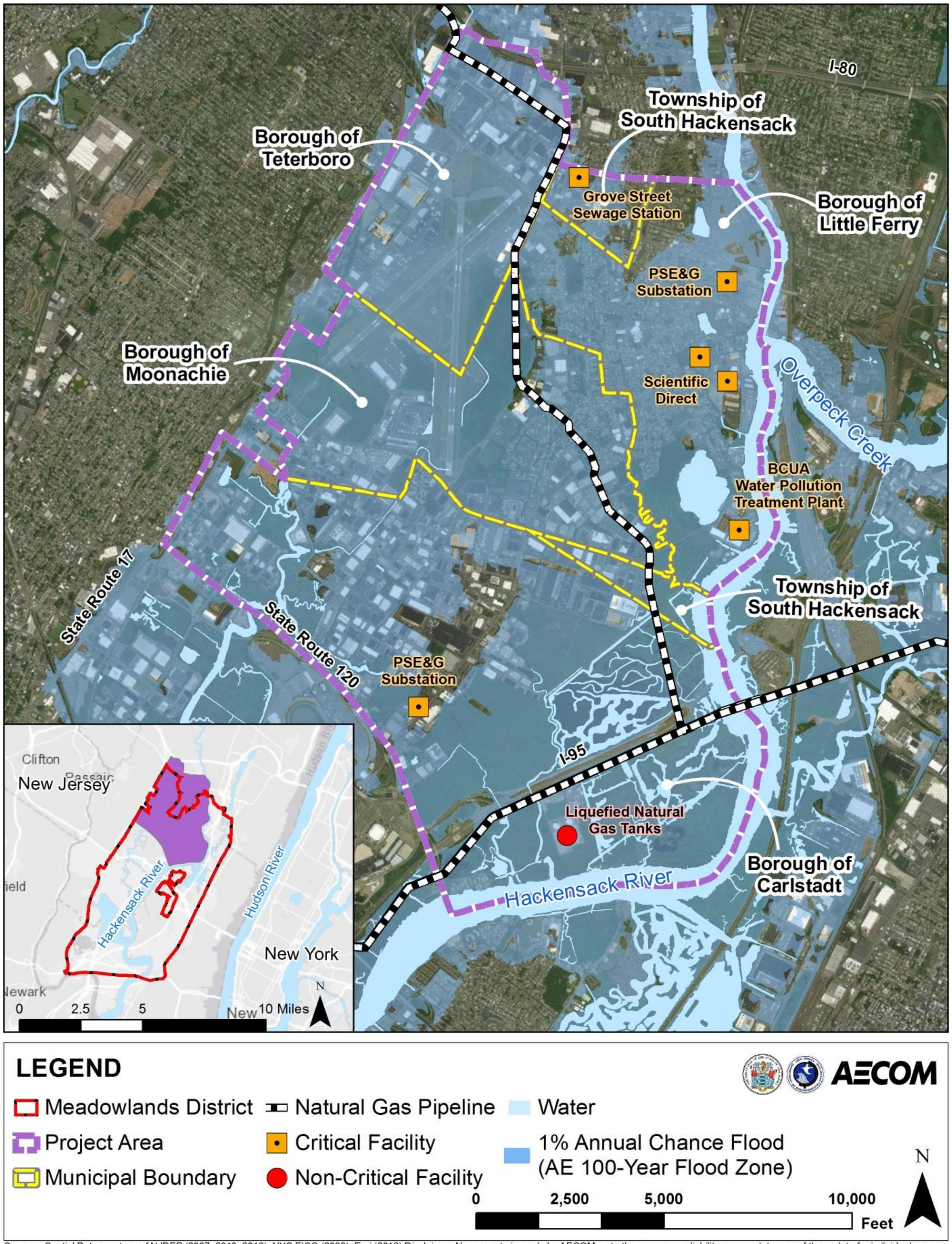

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Figure 3.12-1: Utility Systems Present in the Project Area

The full water distribution network includes reservoir pumping stations, transmission mains (16 inches or larger in diameter), distribution mains, service pipes, and connecting pipes (at least 0.75 inch in diameter). SUEZ New Jersey owns the network down to and including service pipes. Connecting pipes, which transport water from street curbs to individual properties, are owned by the customers (SUEZ 2016c). SUEZ New Jersey owns 2,209 miles of mains and distributes an average of 111 mgd to customers in Bergen and Hudson Counties (SUEZ 2016a). This is roughly a 2.5 percent increase from 2014 (SUEZ 2015).

3.12.3.3 Electricity

PSE&G, a subsidiary of Public Service Enterprise Group, provides electricity to the Project Area. PSE&G is the State's largest public utility, and one of the largest combined gas and electric companies in the nation. It services 2.2 million electric customers in a 2,600-square mile corridor extending from Bergen County to Gloucester County, including 300 communities and the six largest cities in the State (PSE&G 2016a). Electricity is distributed via 46,000 miles of conductors (ranging up to 500 kilovolts) in 1,100 miles of transmission lines (Mackington n.d., PSE&G 2015). The distribution network also includes over 240 substations, 40 switching stations, and 348,000 transformers (Mackington n.d.). A generating station is located in Ridgefield, directly across the Hackensack River from the BCUA Little Ferry Water Pollution Control Facility. **Table 3.12-3** lists the substations located within the Project Area. These substations are also depicted on **Figure 3.12-1**.

Table 3.12-3: Substations Located Within and Near the Project Area

Municipality	PSE&G Facility	Critical Facility?
Little Ferry	Substation on Poplar Ave at Bergen Turnpike	Yes
Carlstadt	Substation on Washington Ave north of Nam Knights Way	Yes

Source: (Bergen County Office of Emergency Management 2015)

Due to the prevalence of overhead power lines in the Project Area, electricity supply can be disrupted by large storm surges (e.g., power outages in the Project Area from Hurricane Sandy lasted for nearly one week; see **Section 1.4.2**) and heavy storms with strong winds. PSE&G is currently undergoing major improvements in resiliency. As a result of damages suffered by Hurricanes Irene and Sandy, the company is undergoing a $1.22 billion renovation program called the Energy Strong Program. As part of this program, PSE&G is protecting, raising, and/or relocating 28 switching and substations in flood-prone areas (PSE&G 2016b, PSEG 2016). The substation in the Borough of Little Ferry is one of those that received improvements (i.e., raising), which were completed in 2016 (PSEG 2016).

3.12.3.4 Natural Gas

Natural gas in the Project Area is imported through a network of pipelines, depicted in **Figure 3.12-1**, owned by Williams and operated as the Transcontinental Gas Pipeline Corporation (Transco) (NJSEA 2004). The Transco system runs from south Texas to the New York City area (USEIA 2016a). Two Transco pipelines traverse the Project Area. One runs in a southwest-northeast orientation through the Project Area along the I-95 corridor. The other runs northwest-southeast from I-80 in Teterboro, to the southwestern side of the BCUA lagoon in the Borough of Little Ferry, to where it meets with the first pipeline in the Borough of Ridgefield at the Vince Lombardi Service Area directly across the Hackensack

River from the Project Area (Williams 2016). These pipelines supply a liquid gas storage facility in the Borough of Carlstadt along the Hackensack River (NJSEA 2004).

PSE&G is responsible for distributing natural gas within the Project Area (NJSEA 2004). PSE&G has a 4,800-mile network of cast iron and unprotected steel distribution pipes that is used to transport the natural gas from the Transco pipelines to their 1.8 million natural gas customers. This network is the largest of any single utility and their customer base grew by 0.3 percent from 2010 to 2014. They sell and transport 2,628 million therms[25] annually, and are expecting a 0.5 percent growth in annual load between 2015 and 2017 (PSE&G 2015).

Over time, cast iron pipelines can begin to degrade, and are susceptible to infusion by floodwater during significant coastal storm surges. In order to address this challenge, as part of the Energy Strong Program, PSE&G also replaced 250 miles of their cast iron gas mains with plastic mains and replaced service lines to individual properties with plastic pipes (PSE&G 2016c). These efforts included work in the Boroughs of Little Ferry and Moonachie, which was completed in 2015 (PSE&G 2016d, 2016e, Sharkey 2016).

3.12.3.5 Solid Waste

The Project Area is within two solid waste districts: BCUA and the NJSEA. BCUA is responsible for solid waste management for all 70 Bergen County municipalities and maintains the Bergen County District Solid Waste Management Plan (BCUA 2016b). NJSEA is responsible for the 14 municipalities within the Meadowlands District and also maintains a Solid Waste Management Plan[26]. Both plans were most recently updated in 2006 following an update to the State Solid Waste Management Plan in 2005 (BCUA 2006, NJSEA 2006a).

Municipalities in the Project Area generally collect solid waste using either their public works departments or a contracted company (NJSEA 2004). Bergen County has adopted an open market strategy, meaning their solid waste may be disposed of at any legal landfill, regardless of location. Prior to the last update to the Bergen County Solid Waste Management Plan, a waste quantification study found that total solid waste[27] in Bergen County was estimated to increase at a rate of approximately 0.7 percent per year, from 943,783 pounds (lbs) in 2006, to an estimated 1,004,194 lbs in 2015 (BCUA 2006). **Table 3.12-4** identifies the solid waste facilities used by BCUA and NJSEA.

Recycling and source reduction is encouraged as the best way to manage solid waste in Bergen County (BCUA 2016e). The municipalities within the Project Area generally either bring recycling material straight to market, or hold it at their Department of Public Works (DPW) yard before bringing it to market (NJSEA 2006a). All municipalities in Bergen County have a curbside residential recycling program, and BCUA provides additional assistance to the municipalities regarding recycling, such as being a liaison to NJDEP, providing educational materials, and facilitating specialized programs to recycle non-traditional materials like tires and batteries (BCUA 2016f).

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[25] One therm is equal to 100,000 British thermal units (Btu). One Btu is the heat required to raise the temperature of one pound of water by 1 °F (USEIA 2016c).

[26] The Hackensack Meadowlands Development Commission, now NJSEA, was established as the only non-county solid waste management district due to the district's long history with dumping, and was therefore specifically directed to provide solid waste facilities within the Meadowlands District to satisfy the needs of the region (NJSEA 2006a).

[27] Total solid waste was defined as the combination of Type-10 and Type-13 solid waste (BCUA 2006). Type 10 solid wastes are municipal waste from household, commercial, and institutional sources. Type 13 solid wastes are bulky waste, such as furniture, appliances, and vehicles.

Table 3.12-4: Solid Waste Facilities Used by BCUA and NJSEA

Facility Name	Location
BCUA and NJSEA Solid Waste Landfills	
NJSEA Keegan Landfill	Kearny, NJ
Solid Waste Transfer Stations in Bergen County and Surrounding Areas	
Waste Management of NJ Inc.	Fairview, NJ & Elizabeth, NJ
I.W.S. Transfer System of NJ Inc.	Garfield, NJ & Jersey City, NJ
Miele Sanitation	Closter, NJ
S&L Zeppetelli	Moonachie, NJ
National Transfer Inc.	Lodi, NJ
EnviroSolutions Inc.	North Arlington, NJ
Lemcor Inc.	Newark, NJ
C&A Carbone Inc.	West Nyack, NY
Advanced Enterprises Recycling	Newark, NJ
Covanta	Totowa, NJ
NJSEA Solid Waste Transfer Stations	
Allegro Transfer Station	Secaucus, NJ
JAM Paper Recycling	Lyndhurst, NJ
J. Pyskaty Disposal Inc.	Secaucus, NJ
Redrock Land Development	Lyndhurst, NJ
Resource Management Technologies	North Bergen, NJ
Waste Management Meadowlands Transfer Station	North Arlington, NJ
S&L Zeppetelli Inc.	Moonachie, NJ
BCUA Resource Recovery Facilities	
Essex County Resource Recovery Facility	Newark, NJ
Union County Resource Recovery Facility	Rahway, NJ

Sources: (BCUA 2015, NJSEA 2006a)

3.12.3.6 Stormwater Infrastructure and Drainage

The Meadowlands District has had substantial historical challenges with stormwater management due to its low elevation and high degree of development. A full description of these challenges is provided in **Section 3.17.3.8**. In the Project Area, stormwater infrastructure includes a combination of stormwater sewers, drainage ditches, berms/levees, tide gates, pump stations, vegetated channels, and detention basins that convey stormwater to the Hackensack River. In order to facilitate drainage during high tides, numerous tide gates and pump stations have been installed within the Project Area. These act to block tidal surges while allowing stormwater to be pumped through the gates (Rutgers University 2007a). Construction and monitoring of tide gates is overseen by the NJSEA (NJSEA 2016).

There are recent reports noting maintenance and upgrade needs for the stormwater management system in the Project Area, as well as the inadequacies of some structures to handle even a 25-year storm (Guo, et al. 2014, NJIT 2014). However, some improvements have been completed, such as the replacement of the West Riser Tide Gate in 2014 (NJDCA 2014). **Table 3.12-5** identifies the stormwater infrastructure present within the Project Area.

Table 3.12-5: Stormwater Infrastructure Located Within Project Area

Municipality	Infrastructure	Critical Facility?
Detention Ponds		
Little Ferry	Indian Lake	No
	Willow Lake	No
Tide Gates		
Little Ferry	DePeyster Creek Tide Gate	No
Moonachie	West Riser Tide Gate	No
Carlstadt	Broad and 20th Street Tide Gate	No
	Waitex Tide Gate	No
	East Riser Tide Gate	No
	Yellow Freight Tide Gate	No
	Dell Road Tide Gate	No
	Peach Island Creek Tide Gate	No
	Palmer Terrace Tide Gate	No
	Bashes Creek Tide Gate	No
	Moonachie Creek Tide Gates Upper	No
Teterboro	Teterboro Tide Gate	No
South Hackensack	Losen Slote Tide Gate	No
Pump Stations		
Little Ferry	Main Street Storm Drainage Pump Station	Yes
	Willow Lake Pump Station	Yes
	DePeyster Creek Tide Gate Pump Station	Yes
	Losen Slote Drain Station	Yes
	Pump Bay Stormwater Pump Station	No
	Unnamed near Mehrhof Pond	No

Municipality	Infrastructure	Critical Facility?
Moonachie	Lincoln Place Pump Station	Yes
	Burger King Pump Station	No
Teterboro	Teterboro Tide Gate Pump Station	No
	Vincent Place Pump Station	No
Ditches		
Multiple Municipalities	Commercial Ditch System	No
	East Riser Ditch System	No
	Industrial Avenue Ditch	No
	West Riser Ditch System	No
Moonachie	Grand Street Ditch	No
	Caesar Place Ditch	No
	Jackson Place Ditch	No
	Lincoln Place Pump Station Ditch	No
	Ryder Ditch	No
	Sova Place Ditch	No
Carlstadt	Eastern Avenue Ditch	No
	Gotham Parkway Ditch	No
	Bashes Creek Ditch System	No
	Moonachie Creek Ditch System	No
	Unnamed by Paterson Plank Road	No
	Veterans Ditch	No

Sources: (Borough of Little Ferry 2005, MERI 2016, NJDEP 2016d, Bergen County Office of Emergency Management 2015)

3.12.3.7 Communication Systems

This subsection identifies the landline telephone, cable television, and internet providers within the Project Area that have associated hard infrastructure. There are three primary providers of communication systems within the Project Area (**Table 3.12-6**). Communications systems without hard infrastructure (such as those that operate via satellite) have been excluded.

Table 3.12-6: Telephone, Television, and Internet Service Provided to Project Area

Municipality/Provider	Landline Telephone	Cable Television	Internet
Little Ferry			
Verizon	x	x	
Time Warner Cable	x	x	x
Optimum		x	x
Moonachie			
Verizon	x	x	x
Time Warner Cable	x	x	x
Comcast		x	
Optimum			x
Carlstadt			
Verizon	x	x	x
Comcast	x	x	x
Optimum			x
Teterboro			
Verizon	x	x	x
Time Warner Cable	x	x	x
Optimum			x
South Hackensack			
Verizon	x	x	x
Time Warner Cable	x	x	x
Optimum		x	x

Sources: (NJBPU 2013, Verizon 2016, TWC 2016, Optimum 2016, Comcast 2016)

3.13 Public Services

3.13.1 Introduction

This section identifies public services and other community facilities present within the Project Area. Specifically, this section will address police departments, fire departments, emergency medical services (EMS), schools, municipal buildings, community facilities, institutional residences, and health care facilities. Critical facility[28] determinations in this document are in accordance with those in the Bergen County Multi-Jurisdictional All-Hazards Mitigation Plan, which was approved by FEMA on April 13, 2015.

3.13.2 Regulatory Context

Several laws and regulations at the State and local levels relate to Public Services. The discussion below focuses on the codes and responsibilities of the police and fire departments with jurisdiction over the Project Area and with the potential to be applicable to the construction or operation of the Proposed Project. Codes and regulations regarding other public services (such as schools and hospitals) do not typically have a connection to the Proposed Project. For example, regulations and rules for a school may cover transportation (i.e., transportation routes for school buses), employment (i.e., who can be employed at a school), or record-keeping (i.e., the maintenance of student records). More detailed information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

Title 53 of the New Jersey Statutes (NJSA 53:1-1 *et seq.*), establishes the legislative framework of the New Jersey State Police and outlines the State police on-the-job duties. Fire station and firefighter duties are outlined in the New Jersey Uniform Fire Code (NJAC 5:70-1 *et seq.*). The Uniform Fire Code further regulates fire safety inspections, fire investigations, and the management of and response to emergency incidents.

Local police codes and ordinances for the Boroughs of Little Ferry (Code of the Borough of Little Ferry, Chapter III), Moonachie (The Revised General Ordinances of the Borough of Moonachie, Chapter III), and Carlstadt (The Revised General Ordinances of the Borough of Carlstadt, Chapter V), and in the Township of South Hackensack (Code of the Township of South Hackensack, Chapter 52), describe the regulations of personal conduct enforceable by the respective police department. Similarly, local fire prevention and protection codes and ordinances for the Boroughs of Little Ferry (Code of the Borough of Little Ferry, Chapter XX), Moonachie (The Revised General Ordinances of the Borough of Moonachie, Chapter XII), and Carlstadt (The Revised General Ordinances of the Borough of Carlstadt, Chapter XIII), and in the Township of South Hackensack (Code of the Township of South Hackensack, Chapter 110), establish the local enforcement of the New Jersey Uniform Fire Code (NJAC 5:70-1 *et seq.*) in the respective borough or township.

3.13.3 Existing Conditions

3.13.3.1 Police Departments

The following discussion identifies all police departments located within the affected municipalities. **Table 3.13-1** summarizes the police departments physically located within the Project Area. Additionally, **Figure 3.13-1** visually depicts the locations of these facilities.

[28] A critical facility is a structure, service, or facility that is particularly vulnerable to flooding due to its potential to cause harm, damage, or disruption to community persons, properties, or activities if it is destroyed or impaired.

Table 3.13-1: Police Departments Located Within Project Area

Municipality	Address	Size of Force	Mutual Aid Agreements	Critical Facility?
Little Ferry	215-217 Liberty Street	24	Assists the Borough of Teterboro	No
Moonachie	70 Moonachie Road	16	Primary law enforcement for the Borough of Teterboro	No

Sources: (Borough of Little Ferry 2016a, Moonachie Police Department 2016, NJSEA 2004, Bergen County Office of Emergency Management 2015)

The Carlstadt Police Department is located at 500 Madison Street, which is approximately 0.6 mile northwest of the Project Area, and supports a 26-member force (Carlstadt Police Department 2016). It has mutual aid agreements with contiguous, in-county municipalities (NJSEA 2004).

Police services in the Borough of Teterboro are primarily handled by the Moonachie Police Department. The Borough of Teterboro does not have a force of its own (Moonachie Police Department 2016). The PANYNJ Police Department provides law enforcement services on site at Teterboro Airport, which is owned and operated by PANYNJ (PANYNJ 2016).

The South Hackensack Police Department is located at 227 Phillips Avenue, which is approximately 0.1 mile north of the Project Area. The department supports a force of 19 full-time personnel and 6 part-time personnel (Township of South Hackensack 2016a).

The Bergen County Sheriff's Office is responsible for providing law enforcement services to Bergen County, New Jersey. Located at 10 Main Street in the City of Hackensack, the Sherriff's Office is approximately 0.8 mile north of the Project Area. With a force of 201 members, the Sherriff's Office patrols all Bergen County roadways and properties, protects Bergen County's judicial proceedings, and provides support services for municipal police departments (Rimbach 2015, Bergen County Sheriff's Office 2015).

3.13.3.2 Fire Departments

The following discussion identifies all fire departments located within the affected municipalities. **Table 3.13-2** summarizes the fire departments physically located within the Project Area. Additionally, **Figure 3.13-1** visually depicts the locations of these facilities.

Table 3.13-2: Fire Departments Located Within Project Area

Municipality	Name	Address	Paid/ Volunteer	Size of Force	Mutual Aid Agreements	Critical Facility?
Little Ferry	Little Ferry Hose Company #1	50 Maple Street	Volunteer	23	Assists Moonachie, Carlstadt, Hasbrouck Heights, Wood-ridge, Wallington	Yes
Little Ferry	Little Ferry Hook & Ladder	124 Main Street	Volunteer	25	Assists Moonachie, Carlstadt, Hasbrouck Heights, Wood-ridge, Wallington	Yes
Moonachie	Moonachie Fire Department	111 Moonachie Road	Volunteer	38	Assists all South Bergen municipalities	Yes
Carlstadt	Carlstadt Fire Department	480 Washington Avenue	Volunteer	24	Assists all South Bergen municipalities	No

Sources: (Borough of Little Ferry 2016b, Little Ferry Hook & Ladder 2016a, Carlstadt Fire Department 2016, NJSEA 2004, Bergen County Office of Emergency Management 2015, Borough of Little Ferry 2016c, Sullivan 2012, Little Ferry Hook & Ladder 2016b)

The Carlstadt Fire Department also has one station at 500 Madison Avenue, which is outside the Project Area and houses most of the department (Carlstadt Fire Department 2016). The Borough of Teterboro does not maintain its own fire department. The Hasbrouck Heights Fire Department provides fire management services for the Borough of Teterboro (Borough of Teterboro 2010).

The South Hackensack Fire Department has two locations: 17 Calicooneck Road, which is approximately 0.1 mile north of the Project Area, and 51 Worth Street, which is approximately 0.3 mile north of the Project Area. In total, the South Hackensack Fire Department is operated by approximately 30 volunteers (Township of South Hackensack 2016b). It has mutual aid agreements with Mid-Bergen County municipalities (NJSEA 2004).

3.13.3.3 Emergency Medical Services

The following discussion identifies all EMS units located within the affected municipalities. **Table 3.13-3** summarizes the EMS units physically located within the Project Area. Additionally, **Figure 3.13-1** visually depicts the locations of these facilities.

Table 3.13-3: EMS Units Located Within Project Area

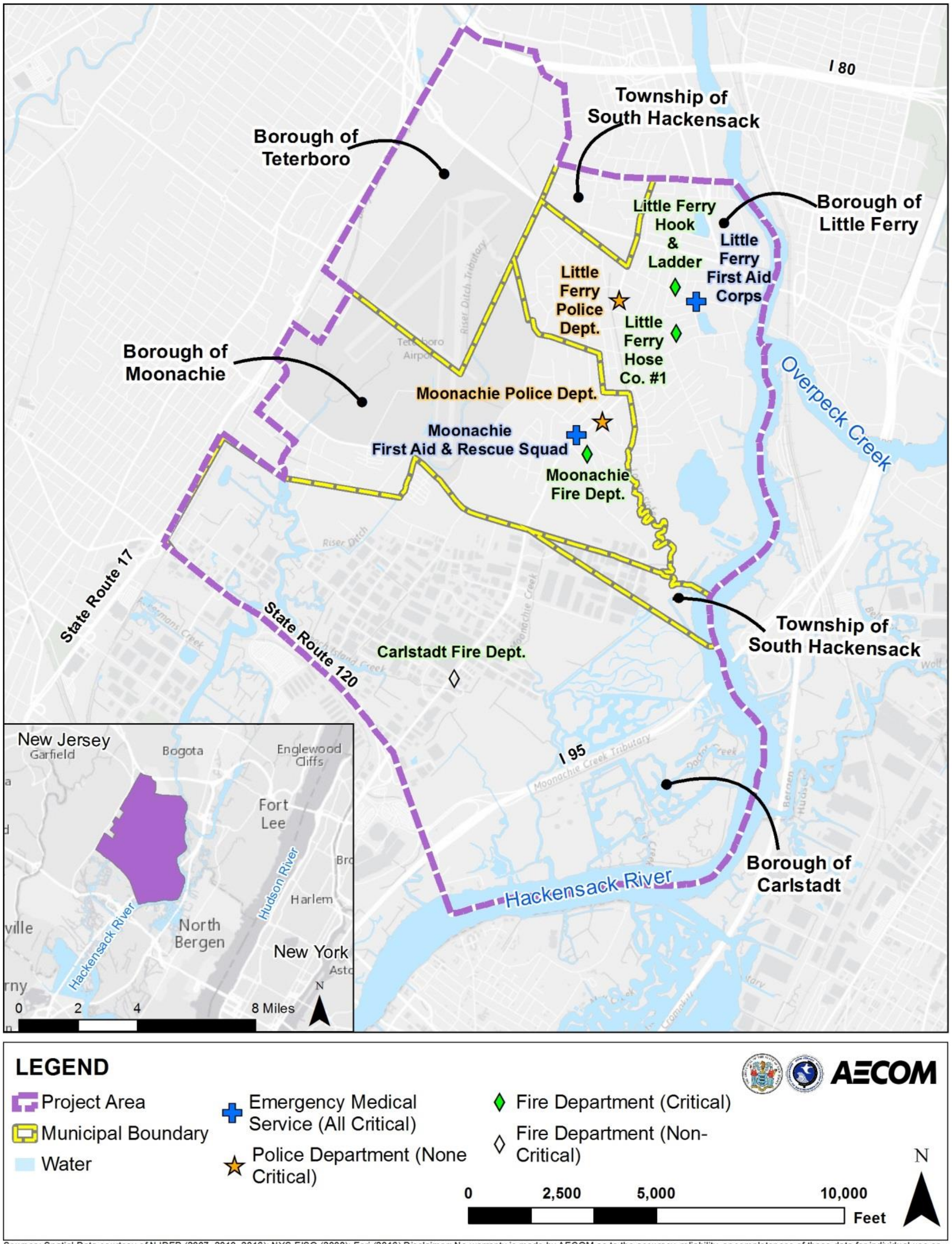
Municipality	Name	Address	Paid/Volunteer	Size of Force	Critical Facility?
Little Ferry	Little Ferry First Aid Corps	95 Main Street	Volunteer	Unknown	Yes
Moonachie	Moonachie First Aid and Rescue Squad	121 Moonachie Road	Volunteer	40	Yes

Source: (Moonachie First Aid & Rescue Squad 2016, Bergen County Office of Emergency Management 2015)

The Carlstadt Volunteer Ambulance Corps is located at 424 Hackensack Street, which is approximately 0.3 mile west of the Project Area (NJSEA 2004). It consists of 24 members (Phalon 2014).

EMS services in the Borough of Teterboro are provided by the Borough of Hasbrouck Heights, which is located outside of the Project Area (NJSEA 2004).

The South Hackensack Ambulance Corps is located 227 Phillips Avenue, which is approximately 0.1 mile north of the Project Area. It has a roster of 29 individuals, and is supplemented by DPW staff during working hours due to limited volunteer availability (Township of South Hackensack 2016c).



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.13-1: Police Departments, Fire Departments, and Emergency Medical Services in the Project Area

3.13.3.4 Schools

There are seven schools located within the Project Area, whose locations are visually depicted in **Figure 3.13-2. Table 3.13-4** summarizes the enrollment information for the schools. None of the schools in the Borough of Carlstadt or in the Township of South Hackensack are located within the Project Area.

Table 3.13-4: Schools Located Within Project Area

Municipality	Name	Address	Grades Taught	Student-Teacher Ratio	Student Population (2014-2015)	% Change in Student Population From 2013-2014 to 2014-2015 School Year	Critical Facility?
Little Ferry	Little Ferry Nursery School	165 Liberty Street	Pre-Kindergarten	NA	57	NA	Yes
Little Ferry	Early Learners Child Care	201 Redneck Avenue	Pre-Kindergarten - 8	NA	156	NA	Yes
Little Ferry	Memorial Middle School	130 Liberty Street	Pre-Kindergarten - 8	14:1	782	0%	Yes
Little Ferry	Washington Elementary School	123 Liberty Street	Kindergarten - 1	12:1	198	-10%	Yes
Moonachie	Robert L. Craig School	20 West Park Street	Pre-Kindergarten - 8	10:1	285	1%	Yes
Moonachie	Teterboro School of Aeronautics	80 Moonachie Avenue	Undergraduate	NA	NA	NA	No
Teterboro	Bergen County Technical High School	504 US Route 46 West	9 - 12	10:1	667	2%	Yes
Teterboro	Jersey College School of Nursing	546 US Route 46	Undergraduate	NA	1,600	NA	No
Teterboro	North Street School	200 North Street	6 – 12	NA	NA	NA	No

Sources: (NJDOE 2015a, 2015b, 2015c, 2015d), (Little Ferry Nursery School 2015), (Early Learners Child Care Center 2010), (Teterboro School of Aeronautics 2008), (Jersey College School of Nursing 2016), (BCSSSD 2016), (Bergen County Office of Emergency Management 2015)
NA: Information is not available.

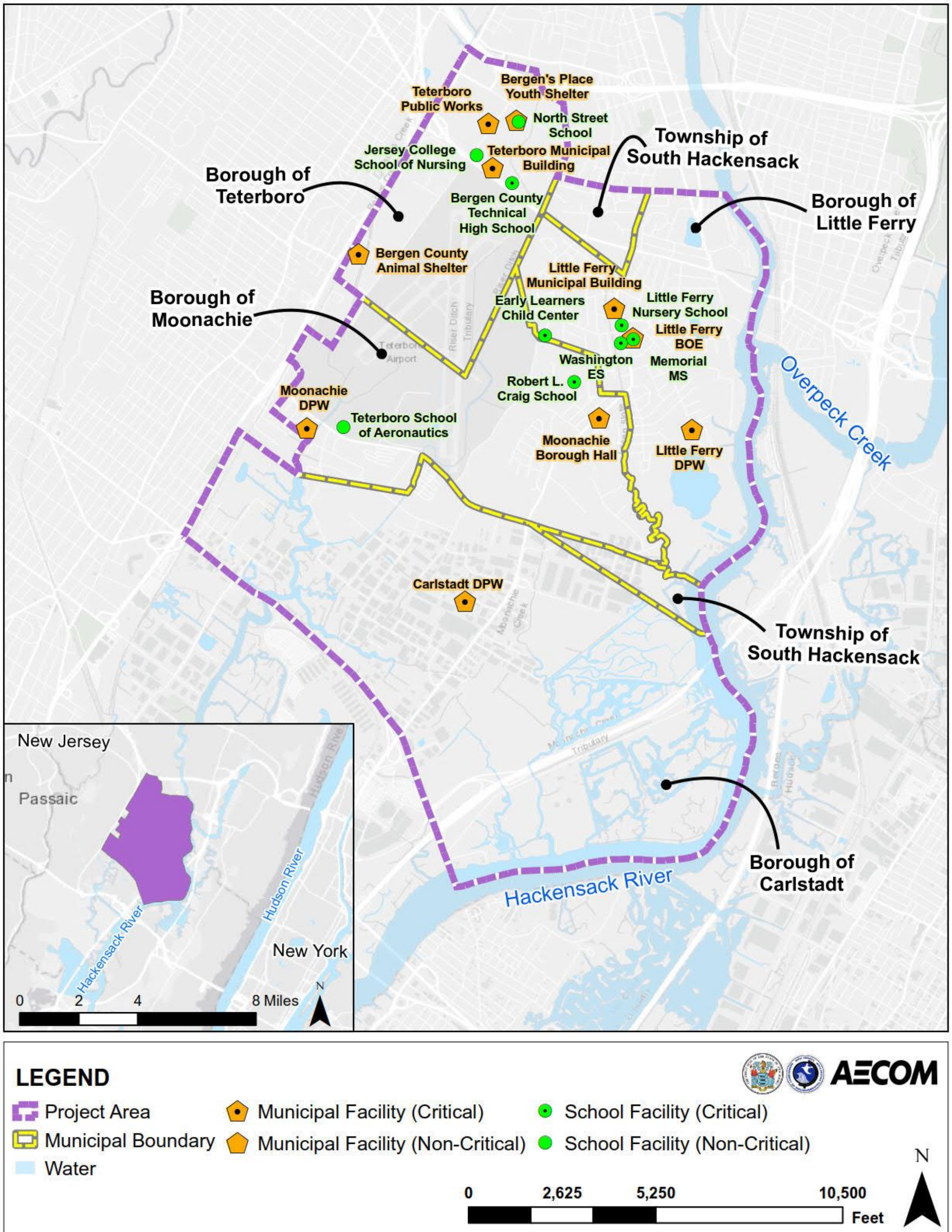
3.13.3.5 Municipal Buildings

With the exception of the Township of South Hackensack, all other municipalities have one or more municipal buildings located within the Project Area. **Table 3.13-5** identifies these buildings and their locations. Additionally, **Figure 3.13-2** visually depicts the locations of these facilities.

Table 3.13-5: Municipal Buildings Located Within Project Area

Municipality	Type of Building	Address	Critical Facility?
Little Ferry	Municipal Building	215-217 Liberty Street	Yes
Little Ferry	Department of Public Works	179 Mehrhof Road	Yes
Little Ferry	Board of Education	130 Liberty Street	No
Moonachie	Borough Hall	70 Moonachie Road	Yes
Moonachie	Department of Public Works	7 Willow Street	Yes
Carlstadt	Department of Public Works	105 Kero Road	Yes
Teterboro	Municipal Building	510 US Route 46	Yes
Teterboro	Public Works Facility	250 Hollister Road	Yes
Teterboro	Bergen County Bergen's Place Youth Shelter	200 North Street	Yes
Teterboro	Bergen County Animal Shelter	100 United Lane	Yes

Source: (Bergen County Office of Emergency Management 2015)



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.13-2: Schools and Municipal Buildings within the Project Area

3.13.3.6 Community Facilities

Several community centers, churches, and libraries are located within in the Project Area. **Table 3.13-6** identifies these facilities and their uses. Additionally, **Figure 3.13-3** visually depicts the locations of these facilities.

Table 3.13-6: Community Facilities Located Within the Project Area

Municipality	Name	Address	Additional Information	Critical Facility?
Little Ferry	Little Ferry Public Library	239 Liberty Street	Over 30,000 volumes available (NJSEA 2004). Part of Bergen County Cooperative Library System, which integrates the abilities of 77 libraries in Bergen, Essex, Hudson, and Passaic Counties for their residents.	Yes
Little Ferry	Little Ferry Senior Center	95 Main Street	NA	No
Little Ferry	Meadowlands Family Success Center	100 Washington Avenue	Community center focused on fostering connections between families by providing information and life skills training, parent-child activities, recovery/support services, and other family-oriented services.	No
Little Ferry	St. Margaret's of Cortana Church	31 Chamberlain Avenue	Catholic denomination	Yes
Little Ferry	Dongsan Alliance Church of NJ	210 Washington Avenue	Korean culture; Baptist denomination	No
Little Ferry	Evangel Christian Church	165 Main Street	Nondenominational	No
Moonachie	Moonachie Senior Center/Civic Center	125 Moonachie Road	On-site assisted living and senior citizens housing facility	No
Moonachie	First Presbyterian Church	221 Moonachie Road	Presbyterian denomination	No
Teterboro	North Jersey Vineyard Church	370 North Street	Nondenominational	No
Teterboro	Aviation Hall of Fame of New Jersey	400 Fred Wehran Drive	Exhibits historic air and space artifacts, aircraft, fine art, models, photographs, and a research library containing over 300 volumes.	No

Sources: (BCCLS 2016, Meadowlands Family Success Center 2016, Aviation Hall of Fame of NJ 2016, Bergen County Office of Emergency Management 2015)

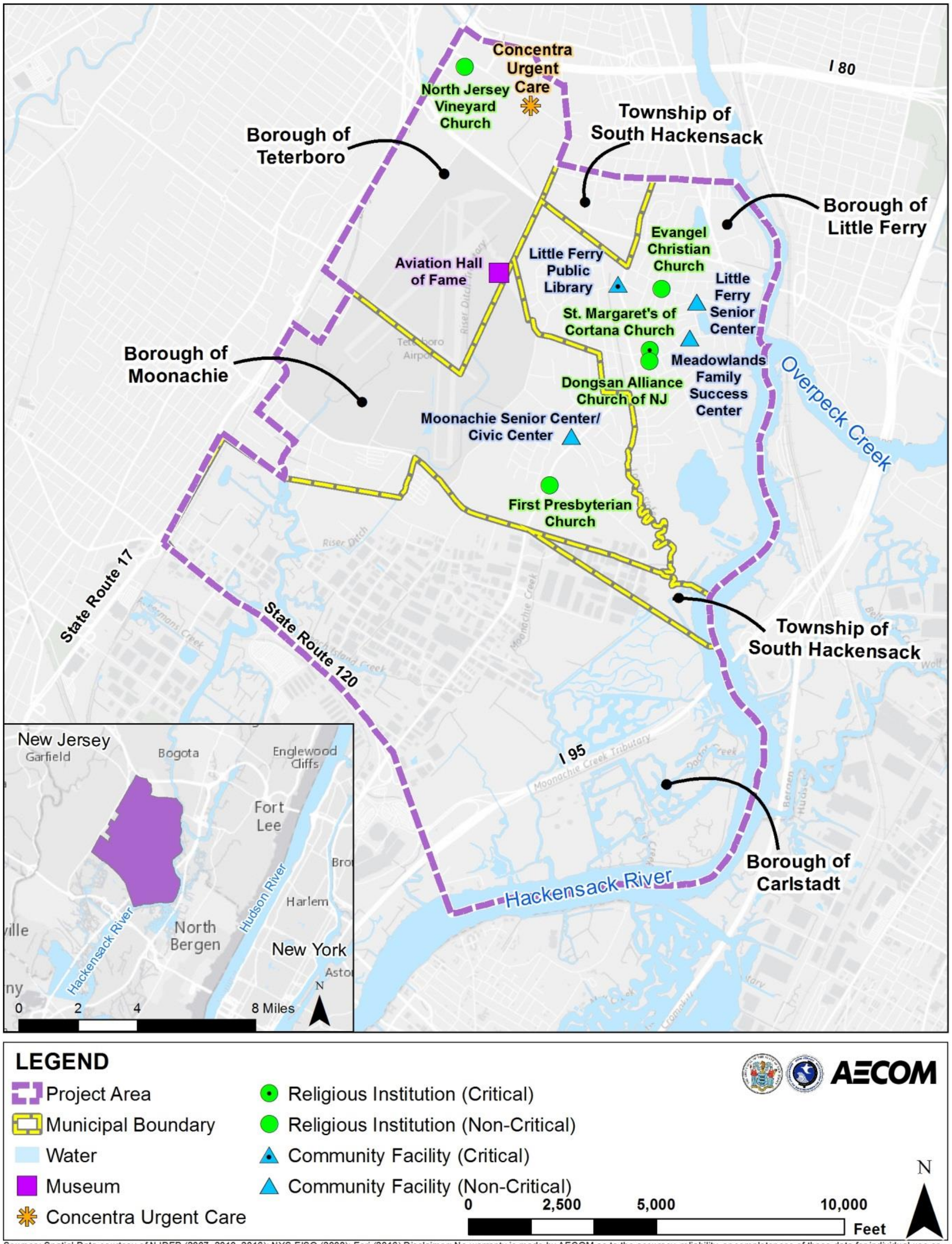
3.13.3.7 Institutional Residences

Institutional residences include nursing homes, jails, juvenile detention facilities, and mental hospitals. There are no institutional residences located within the Project Area. The nearest jail is the Bergen County Jail, which is located approximately one mile north of the Project Area in Hackensack. The nearest juvenile detention facility is the Hudson County Juvenile Detention Facility, which is located approximately two miles south of the Project Area in Secaucus. The nearest nursing home is the CareOne at Wellington facility approximately 1.5 miles north of the Project Area in the City of Hackensack.

3.13.3.8 Healthcare Facilities

Concentra Urgent Care is the only healthcare facility in the Project Area, and is located at 150 North Street in the Borough of Teterboro (see **Figure 3.13-3**). This facility treats minor health concerns, such as cold and flu symptoms, asthma, sinus and respiratory infections, earaches, sore throats, minor cuts, broken bones, and muscular strains and sprains (Concentra Operating Corporation 2016). There is another Concentra Urgent Care Facility in the Town of Secaucus, immediately south of the Project Area.

The nearest hospital, the Hackensack University Medical Center, is located approximately one mile north of the Project Area in the City of Hackensack. It is a complex that includes medical centers, a children's hospital, a women's hospital, a cancer center, and other healthcare facilities. It serves the northern New Jersey and New York metropolitan areas, and provides 775 beds (HUMC 2016). The Meadowlands Hospital Medical Center is approximately two miles south of the Project Area in the Town of Secaucus. This hospital serves Hudson and southern Bergen Counties, and provides 230 beds (MHMC 2016).



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.13-3: Community and Healthcare Facilities within the Project Area

3.14 Biological Resources

3.14.1 Introduction

This section describes the biological resources within the Project Area that have the potential to be affected as a result of implementing the Proposed Project. Biological resources include terrestrial habitats and wildlife; aquatic habitats and wildlife, including Essential Fish Habitat (EFH); and special status species and species of conservation concern.

Biological resources data presented in this section were compiled, reviewed, and synthesized from a number of sources, including local, county, State, and Federal agencies, and non-governmental organizations. These sources are referenced herein. Additionally, Project Area-specific biological resources data were collected in the field by the Project team in 2016 and 2017 to supplement existing information. **Appendix J** provides a detailed discussion regarding the research and survey methodologies used to develop this section.

3.14.2 Regulatory Context

A number of Federal and State laws and regulations identify the conservation and protection of biological resources. **Table 3.14-1** provides a summary of the primary laws and regulations applicable to the Proposed Project. More detailed information on Federal, State, and local regulatory requirements for the Proposed Project is presented in **Appendix B**.

Table 3.14-1: Summary of Federal and State Laws and Regulations

Law/Regulation	Project Context
Federal Policies and Regulations	
Bald and Golden Eagle Protection Act (BGEPA) (16 USC §§ 668-668c)	Projects requiring Federal authorization must coordinate with the USFWS regarding known locations of bald and golden eagle nests in the vicinity while implementing avoidance and minimization measures.
Clean Water Act (CWA) of 1972 (33 USC §§ 1251 *et seq*.)	Projects that include temporary or permanent disturbance to streams and/or wetlands must coordinate with the USACE to provide information on aquatic habitats and special status species relevant to the Section 404 authorization.
Endangered Species Act (ESA) of 1973 (16 USC §§ 1531 *et seq*.)	Section 7 of the ESA requires coordination and/or informal/formal consultation with the USFWS and NOAA's NMFS, as necessary, to determine the potential impacts on protected plants and animals.
Fish and Wildlife Coordination Act of 1934 (16 USC §§ 661 *et seq.*)	Requires coordination with relevant Federal and State agencies to ensure that wildlife conservation receives equal consideration and coordination with other water resource development programs.

Law/Regulation	Project Context
Lacey Act (16 USC §§ 3371-3378; 18 USC § 42); Federal Noxious Weed Act of 1974 (7 USC §§ 2801 et seq.); Plant Protection Act (7 USC § 7701); and the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 USC §§ 4701 *et seq*.)	Various laws established or containing provisions specifically to manage the importation and spread of noxious and invasive species.
Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC §§ 1801-1882)	The 1996 Amendments to the MSA established provisions to protect and enhance EFH for Federally managed marine and anadromous fish species through coordination with NMFS and assessment of EFH in a project area.
Migratory Bird Treaty Act (16 USC §§ 703-712)	Implements protection of native migratory and nongame birds through coordination with the USFWS and implementation of avoidance and minimization measures.
Hazardous Wildlife Attractants on or Near Airports (FAA AC No. 150/5200-33B)	Provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports.
State of New Jersey Policies and Regulations	
Endangered Plant Species List Act (NJSA 13:1B-15.151 *et seq*.) and the Endangered Plant Species Program Rules (NJAC 7:5C)	Establishes an official State list of endangered plants separate from the threatened and endangered species designated under NJAC 7:25.
New Jersey Endangered and Nongame Species Conservation Act of 1973 (NJSA. 23:2A *et seq*.) and Division of Fish and Wildlife Rules (NJAC 7:25)	Promotes the conservation of species designated by the State of New Jersey as threatened and endangered.

3.14.3 Existing Conditions

The entire State of New Jersey, including the Project Area, lies within the Eastern Broadleaf Forest (Oceanic) Province as defined by the US Forest Service (USFS). Diverse topography and temperate deciduous forests containing mixed mesophytic vegetation characterize this Province (USFS 2016).

The Meadowlands District, in which the Project Area is located, is among the largest remaining coastal wetland ecosystems in the Hudson-Raritan Estuary system. Approximately 5,800 acres of estuarine wetlands are within the Meadowlands' 8,400-acre complex of wetlands and waterways (USFWS 2007). Major habitat types of the Meadowlands District within the Project Area include the mainstem of the Hackensack River; a variety of brackish tidal creeks, canals, and ditches; salt marshes; impounded brackish and freshwater marshes; non-tidal wetlands and hardwood swamps; woodlands and meadows; and industrial, commercial, and residential areas that include roads, dikes, and berms.

Prior to European settlement in the 17th century, the Meadowlands District was largely a tidal freshwater system consisting of large expanses of freshwater emergent wetlands and Atlantic white cedar swamp. Colonial-era settlers converted many of these wetlands to farmland. The flows of the Hackensack and Passaic Rivers were altered by the construction of dams for millponds, construction of the Morris Canal, and other municipal water supply projects. As freshwater flows decreased, the waters in the area became more saline and brackish tidal marshes formed. Over the past 100 years, expanses of these tidal marshes have been drained and/or filled in attempts to control mosquitoes, for industrial and commercial uses, and for the creation of landfills (Kiviat and MacDonald 2002).

The following sections summarize the habitats and wildlife of the Project Area, focusing on both terrestrial and aquatic environments, as well as species of concern that are protected at the Federal or State level. To supplement existing information, the Project team conducted Project Area-specific surveys for various resources beginning in late summer/early fall 2016. Biological resources surveyed included plants, birds, mammals, reptiles, amphibians, fish, and benthic invertebrates. Species were surveyed through a variety of methods and tools, including sight surveys, camera traps, nocturnal surveys, track plates, snow tracking, trapping (e.g., rock minnow traps and box traps), and grab sampling. The locations of these surveys are depicted in the figures in this section. The results of the studies are discussed in the sections below; detailed survey results and methodologies are provided in **Appendix J**.

The Project team also conducted a vegetation survey of existing plant communities within the Project Area in support of habitat characterization during which they identified nearly 300 species of plants and 18 habitat communities. Both vegetated (e.g., forests, meadows, swamps) and non-vegetated (e.g., buildings, levees, human-made ditches, and transportation infrastructure) areas occur within the landscape mosaic of the Project Area (**Figure 3.14-1**). **Table 3.14-2** identifies the mapped habitats and acreages in the Project Area. **Appendix J** provides a detailed list of plants identified.

Table 3.14-2: Mapped Habitats and Acreages in the Project Area

Habitat	Acres	Habitat	Acres
Common reed marsh	474	Rich mesophytic forest (variant)*	<1
Ditch/intermittent stream	6	Shallow emergent marsh	10
Floodplain/riparian forest remnant	54	Shallow emergent marsh (tidal)	692
Landfill	5	Successional old field	27
Mowed lawn & lawn w/ tree	336	Successional shrubland	124
Open water & impoundments	18	Mid-reach Stream	11
Red maple blackgum swamp (variant)*	20	Urban fill/ structure	16
Red maple-hardwood forest (variant)*	83	Urban woodlot	86
Red maple-sweetgum forest (variant)*	110	Young field	11

Notes: * Variants are habitats that have been previously cleared, but have now become vegetated to resemble identified forested communities.

3.14.3.1 Terrestrial Resources

Terrestrial Habitats

Terrestrial communities within the Project Area provide habitat for many wildlife species, including migratory birds. These habitats also provide important ecosystem services to the surrounding area, such as providing aquifer recharge and supporting nutrient cycling. Many terrestrial communities or habitat types within the Project Area include the juxtaposition of natural settings and the “built environment,” and are characterized by floristic and faunal assemblages adapted to urban landscapes. Habitats within the Project Area were identified in accordance with those described in Ecological Communities of New York State (Edinger, et al. 2014)[29]. These habitat areas are herein referred to as Edinger Communities, and have been grouped by general habitat categories (**Table 3.14-3**). Detailed descriptions of the Edinger communities found in the Project Area are provided below.

Table 3.14-3: Terrestrial Habitats and Corresponding Ecological Communities Identified in the Project Area

Habitat Type	Category	Edinger Community
Terrestrial Habitats	Forested Uplands	Floodplain / Riparian Forest Remnant
		Rich mesophytic forest (variant)
		Urban Woodlot
	Scrub/Shrub Uplands	Successional Shrublands
	Herbaceous Uplands	Mowed Lawn and Mowed Lawn with Trees
		Successional Old Field
		Successional Young Field

Forest Communities

Forested areas occur along the headwaters of rivers and streams and in isolated pockets surrounded by development throughout the Project Area. Many of the forest communities are floodplain forest communities or some variant remnants of more expansive floodplain forests historically found along the Hackensack River and its tributaries. In more recent history, the area has been urbanized and industrialized and forested tracts have been fragmented by development, leading to the colonization of invasive species and alteration of floodplain hydrology. Isolated forested areas are no longer subject to periodic riverine flooding and the species composition reflects these conditions.

Floodplain/Riparian Forest Remnant

Floodplain forest is a broadly defined and diverse community occurring on low terraces of river floodplains and deltas. These forest communities are periodically flooded but are generally dry throughout the year. In the Project Area, this community is located within the floodplains of tributaries and creeks, such as Losen Slote and the East Riser Ditch, as well as remnant isolated communities that still contain the characteristic floodplain species and were historically part of a floodplain community, such as those found along the West Riser Ditch and in Losen Slote Creek Park. Depending on the elevation and hydrologic contributions, these communities may be dominated by jurisdictional wetlands or uplands subject to periodic flooding. Some of these floodplain forests occupy unbuildable areas between open waters and uplands, some of which were created by the placement of historic fill. As

[29] The Project Area is located within 3 miles of New York State with similar species and communities found in southern New York State and around the New York City area.

such, some of these communities are vegetated with disturbance-tolerant vegetation or native species with broad hydrologic tolerances. Species typically found in these communities include blackgum (*Nyssa sylvatica*), eastern cottonwood (*Populus deltoids*), black cherry (*Prunus serotina*), pin oak (*Quercus palustris*), crack willow (*Salix fragilis*), sweet pepperbush (*Clethra alnifolia*), arrowwood (*Viburnum dentatum*), and poison ivy (*Toxicodendron radicans*). Several variants of this community are present in the Project Area and include other species such as red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), red chokeberry (*Aronia arbutifolia*), and pink azalea (*Rhododendron periclymenoides*). A total of 54 acres of the project area were mapped with this cover type.

Rich mesophytic forest

A canopy with a relatively large number of codominant trees characterizes this hardwood or mixed forest. Canopy codominants include five or more of the following species: northern red oak (*Quercus rubra*), red maple, white ash (*Fraxinus americana*), American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), black cherry, cucumber tree (*Magnolia acuminata*), and black birch (*Betula lenta*). This forest has a well-developed shrub layer and herbaceous layer. Approximately one acre was mapped as this community type.

Urban Woodlot

An area dominated by woody species of trees with a canopy >30 feet in height. Woodlots may be fringe remnants of larger wooded tracts or wooded areas that have development along roadsides, within jug handles/roundabouts or between buildings, roads and railways. Woodlots are often small in size and offer limited ecological value to wildlife. Characteristic trees are often naturalized, non-native species such as Norway maple (*Acer platanoides*), white mulberry (*Morus alba*), and tree-of-heaven (*Ailanthus altissima*). Approximately 86 acres of the project area were mapped as this covertype.

<u>Shrubland Communities</u>

Scrub/shrub habitats are located along roads, on vacant lots, and on other open land areas that are both maintained and unmaintained. Woody shrubs, forbs, and herbaceous vegetation dominate scrub/shrub communities. Saplings and trees may also be present, but are not dominant within the overall community structure. Within the Project Area these communities were typically located in vacant lots and open uplands adjacent to wetland areas.

Successional Shrubland

This community occurs on cleared and disturbed sites with at least 50 percent cover of shrubs. Within the Project Area, this upland community was variable and found east of Teterboro Airport along the East Riser Ditch and along the Hackensack River in the Borough of Little Ferry. This community has many codominant species. Species composition included Amur honeysuckle, arrowwood, eastern baccharis (*Baccharis halimifolia*), blackberry (*Rubus allegheniensis*), white snakeroot (*Ageratina altissima*), Indian hemp (*Apocynum cannabinum*), lateflowering thoroughwort (*Eupatorium serotinum*), bull thistle (*Cirsium vulgare*), seaside goldenrod (*Solidago semervirens*), Japanese knotweed (*Fallopia japonica*), Virginia creeper (*Parthenocissus quinquefolia*), poison ivy, and common reed (*Phragmites australis*) in the subcanopy. Maples, green ash (*Fraxinus pennsylvanica*), pin oak, Callery pear, crack willow, and black locust were observed in the canopy. Within the Project Area, 124 acres were mapped as this covertype.

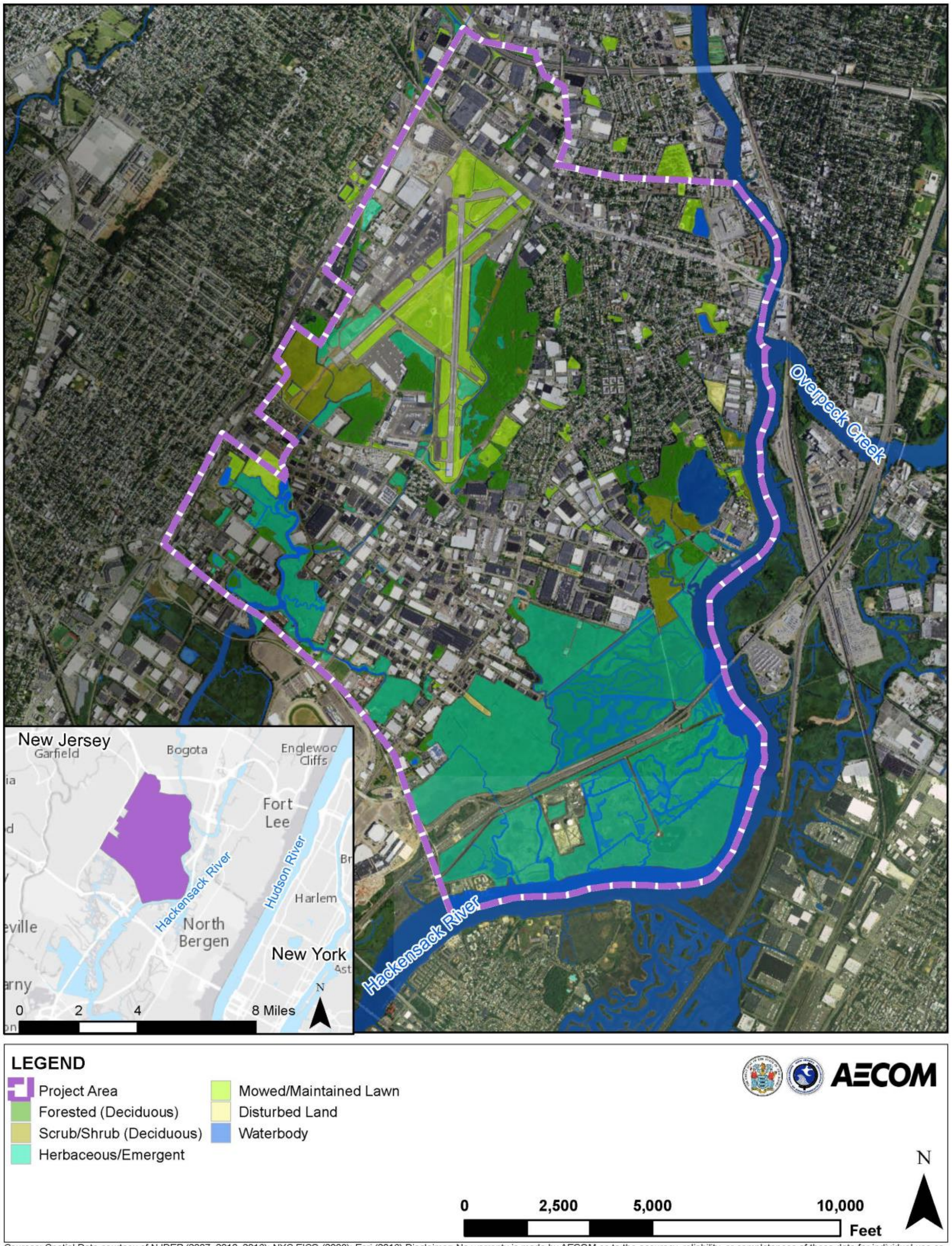


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Figure 3.14-1: Habitat Communities Identified in the Project Area

Herbaceous Uplands

Herbaceous upland communities are typically found in maintained or recently disturbed areas. Within the Project Area, these communities are typically found along roads, vacant lots, maintained recreation areas, and at Teterboro Airport.

Mowed Lawn and Mowed Lawn with Trees

These communities are located within residential and commercial areas throughout the Project Area, as well as unpaved airport runways dominated by mowed grasses, such as those found at Teterboro Airport. The mowed lawn community may include up to 30 percent tree cover and the mowed lawn with trees community can include between 30 and 50 percent tree cover. Tree species are generally ornamental or native species. Within the Project Area, these communities were dominated by maintained grasses (*Poa* spp.), spotted sandmat (*Chamaesyce maculate*), ground ivy (*Glechoma hederacea*), bird's-foot trefoil (*Lotus corniculatus*), and English plantain (*Plantago lanceolata*). Tree species included willow oak (*Quercus phellos*) and sweetgum. This was one of the most common habitat types in the Project Area. A total of 336 acres was classified as Mowed Lawn and Mowed Lawn with Trees.

Successional Old Field

This community occurs in areas that are infrequently maintained or recently abandoned. Forbs and grasses typically dominate this community. Within the Project Area, this community is found along the outskirts of Teterboro Airport and in Losen Slote Creek Park, and was dominated by lateflowering thoroughwort, tearthumb (*Persicaria perfoliata*), butterfly milkweed (*Asclepias tuberosa*), common boneset (*Eupatorium perfoliatum*), spotted beebalm (*Monarda punctate*), coneflower (*Rudbeckia* sp.), American black elderberry (*Sambucus nigra*), and Amur peppervine (*Ampelopsis brevipedunculata*). A total of 27 acres of this covertype was mapped within the Project Area.

Young Field

This community usually occurs in an area that was recently disturbed and is dominated by grasses. The field is usually occupied by less than 50 percent woody stems. A total of 11 acres of this covertype was mapped within the Project Area.

Non-vegetated Upland Areas

Non-vegetated upland areas are found throughout the highly developed interior portions of the Project Area and include building exteriors, bridges, towers, unpaved lots, paved lots and roadways, railroad embankments, road and pipeline berms, dikes, and dredged material placement areas. Non-vegetated areas providing exposed substrate may be important habitat for nesting turtles and migrating shorebirds. Structures such as buildings and bridges forming the "built environment" provide a variety of habitat for certain bird and mammal species.

Terrestrial Wildlife

The Meadowlands District includes a mix of residential, commercial, industrial, and natural areas that are typically fragmented due to existing transportation and utility rights-of-way. Though fragmented and highly disturbed, the existing natural habitats continue to provide refuge for a variety of wildlife species, including many rare species (USFWS 2007). Wildlife use the Meadowlands District for breeding and nesting, cover, forage, and stopover habitat. Habitat is present for permanent residents, summer and winter residents, as well as spring and fall migratory species. A majority of the wildlife species found in the Project Area, aside from avian (bird) species, are residents and typically do not migrate in and out of the area. As identified by Kiviat and MacDonald (2002) in their review of the biodiversity of the Meadowlands District, the Project Area is particularly suitable as wildlife habitat because it contains:

- A large complex of undeveloped habitats in an urban-industrial area;
- Abundant surface waters with diverse hydrology (i.e., tidal and non-tidal, fresh, and brackish);
- A variety of habitats ranging from open estuarine waters to dry fill and rock;
- Extensive areas of marsh, wet meadow, and upland meadow habitat with minimal direct human intrusion;
- Dense stands of common reed and other plant communities that have low visibility and low penetrability, thus providing concealment and shelter for animals nesting, roosting, or foraging;
- Abundance of certain foods, including common reed, for muskrats (*Ondatra zibethicus*); small rodents and small birds for raptors; insects, spiders, and midges for small birds; benthic macroinvertebrates for dabbling ducks, shorebirds, and small fish; small fish for piscivorous fish, turtles, and birds; and fiddler crabs for turtles and birds;
- Reduced levels of hunting, trapping, and fishing activities that could affect non-target species and prey species as well as legally harvested species; and
- Low levels of predation, competition, and herbivory (e.g., deer grazing), providing ecological refuge for certain species.

Birds

The Project Area offers a wide variety of habitats for migrant and resident bird species to utilize for breeding, nesting, and foraging. Recent studies and Project Area-specific surveys have documented over 220 bird species in and around the Project Area. Permanent resident species, which include species expected to remain in the Project Area throughout the year, include American bittern (*Botaurus lentiginosus*), pied-billed grebe (*Podilymbus podiceps*), great blue heron (*Ardea herodias*), ruddy duck (*Oxyura jamaicensis*), mallard (*Anas platyrhynchos*), gadwall (*Anas strepera*), blue-winged teal (*Anas discors*), green-winged teal (*Anas carolinensis*), song sparrow (*Melospiza melodia*), and raptors, such as northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), bald eagle (*Haliaeetus leucocephalus*), and others. These species use existing habitats for cover, foraging, breeding, and nesting. Summer residents that breed and nest in the Project Area include least bittern (*Ixobrychus exilis*), osprey (*Pandion haliaetus*), killdeer (*Charadrius vociferous*), least tern (*Sterna antillarum*), marsh wren (*Cistothorus palustris*), common yellowthroat (*Geothlypis trichas*), red-winged blackbird (*Agelaius phoeniceus*), swamp sparrow (*Melospiza georgiana*), bobolink (*Dolichonyx oryzivorus*), and brown thrasher (*Toxostoma rufum*). These species are also common migrants throughout the Project Area. Winter residents and migrants in the Project Area include the bufflehead (*Bucephala albeola*), hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*), lesser scaup (*Aythya affinis*), and northern shoveler (*Anas clypeata*). Twelve raptor species have been identified in the Project Area consisting of migrant and resident species. Many of these species nest in the Project Area and 37 potential raptor stick nests were observed during raptor nest surveys. No nests were observed as active at the time of survey.

Figure 3.14-2 identifies the avian survey sites that were chosen due to their locations in representative habitat types found in the Project Area. **Appendix J** contains a detailed description of the methodology used to complete avian surveys and a comprehensive list of avian species identified in or near the Project Area.

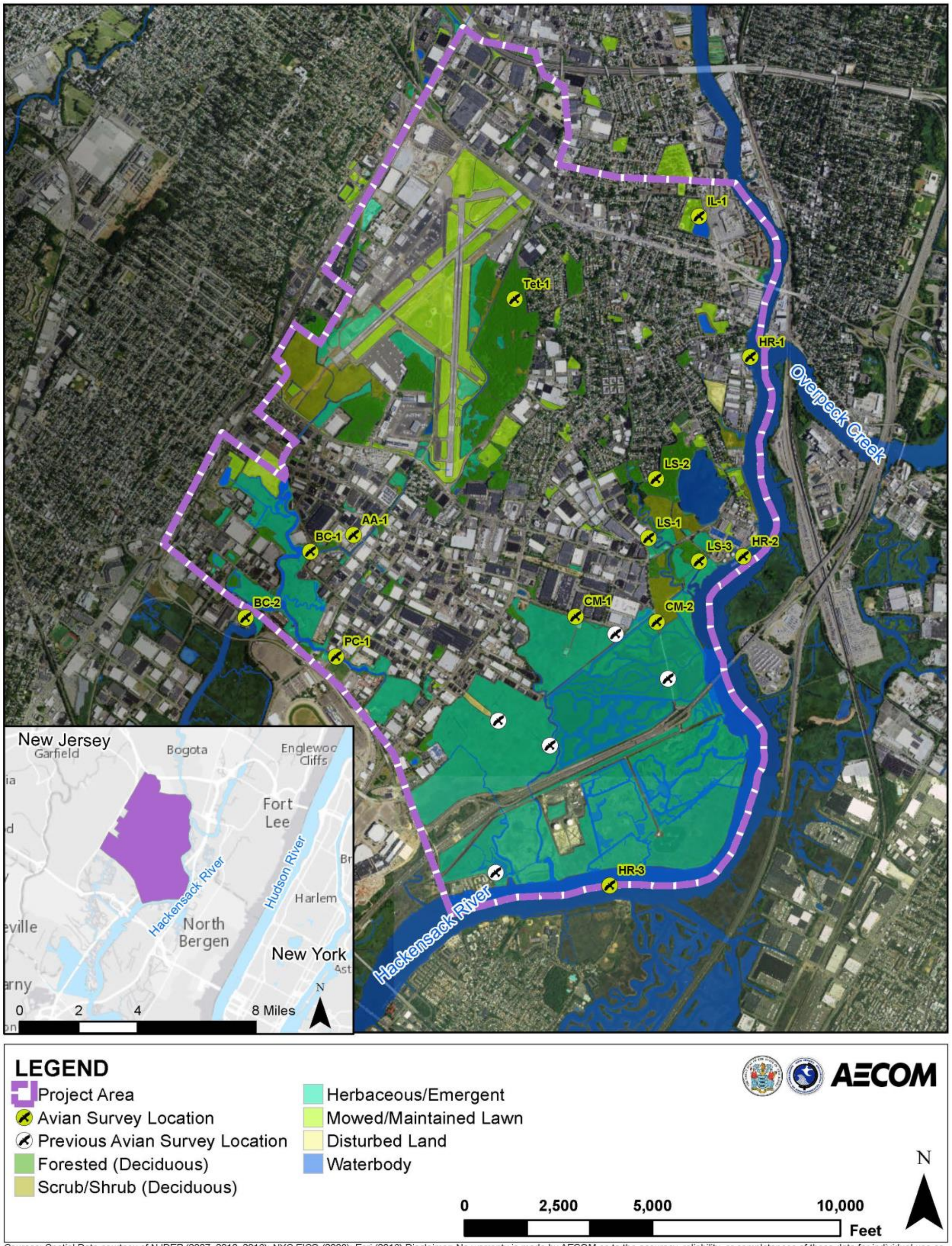

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Figure 3.14-2: Avian Survey Locations in the Project Area

Mammals

A Project Area-specific mammal survey was conducted as part of this analysis to supplement previous mammal studies conducted in the Meadowlands District. **Figure 3.14-3** identifies the specific locations in the Project Area that were surveyed for mammals, and **Appendix J** contains a detailed description of the methodology used to complete the surveys. In general, mammal species observed in the Project Area were small mammal species common to suburban and/or disturbed environments. They included species such as eastern grey squirrel (*Sciurus carolinensis*), eastern cottontail rabbit (*Sylvilagus floridanus*), red fox (*Vulpes vulpes*), white-tailed deer (*Odocoileus virginianus*), and Virginia opposum (*Didelphis virginiana*). Some of these mammals are important prey species for other mammals, raptors, and some reptiles. In addition, bats were observed throughout the Project Area. Habitats near Losen Slote and the woods near Teterboro Airport likely support both resident and migratory bats. A full list of mammal species identified in or near the Project Area is provided in **Appendix J**.

Amphibians

Few amphibians have been documented in the Meadowlands District and the Project Area, in part because few studies have been conducted and also because the Meadowlands District does not provide a wide range of habitats with appropriate size and diversity to support various amphibian species. Most of the amphibians found in northern New Jersey prefer freshwater. However a few species, including the Atlantic Coast leopard frog (*Lithobates sphenocephalus*), can tolerate slightly brackish waters.

The Project Area provides limited habitat for amphibians due to expanses of brackish tidal marshes, limited uplands, relatively dry conditions due to high sun exposure (i.e., limited tree cover), fragmented habitats with few corridors, a history of contamination (refer to **Section 3.20.3**), and substantial barriers to dispersal such as brackish marshes, tidal creeks and rivers, roads, and other development. The scarcity of natural upland soils and high-quality, fresh surface waters also likely contributes to the low species richness of amphibians. **Figure 3.14-4** identifies the locations of amphibian survey sites. No amphibians were observed during the Project Area-specific surveys; however, a list of amphibian species observed in or near the Project Area during past studies is provided in **Appendix J**. These include such species as the American bullfrog (*Lithobates catesbeianus*), American toad (*Anaxyrus americanus*), gray treefrog (*Hyla versicolor*), green frog (*Lithobates clamitans melanota*), and Atlantic Coast leopard frog, among others (Kiviat and MacDonald 2002, Kiviat 2011).

Reptiles

Previous studies in the Meadowlands District have documented a total of 18 reptile species. During the Project Area-specific surveys, three reptile species were observed in open water habitats, including the painted turtle (*Chrysemys picta*), red-eared slider (*Trachemys scripta elegans*), and common snapping turtle (*Chelydra serpentine*). One reptile species, a garter snake (*Thamnophis sirtalis*), was observed near Losen Slote in freshwater wetland habitat. Other reptile sightings included snapping turtles and painted turtles at the Teterboro Airport. **Figure 3.14-4** identifies the locations of survey sites. **Appendix J** contains a detailed description of the methodology used to complete reptile surveys and a comprehensive list of reptile species identified in or near the Project Area.

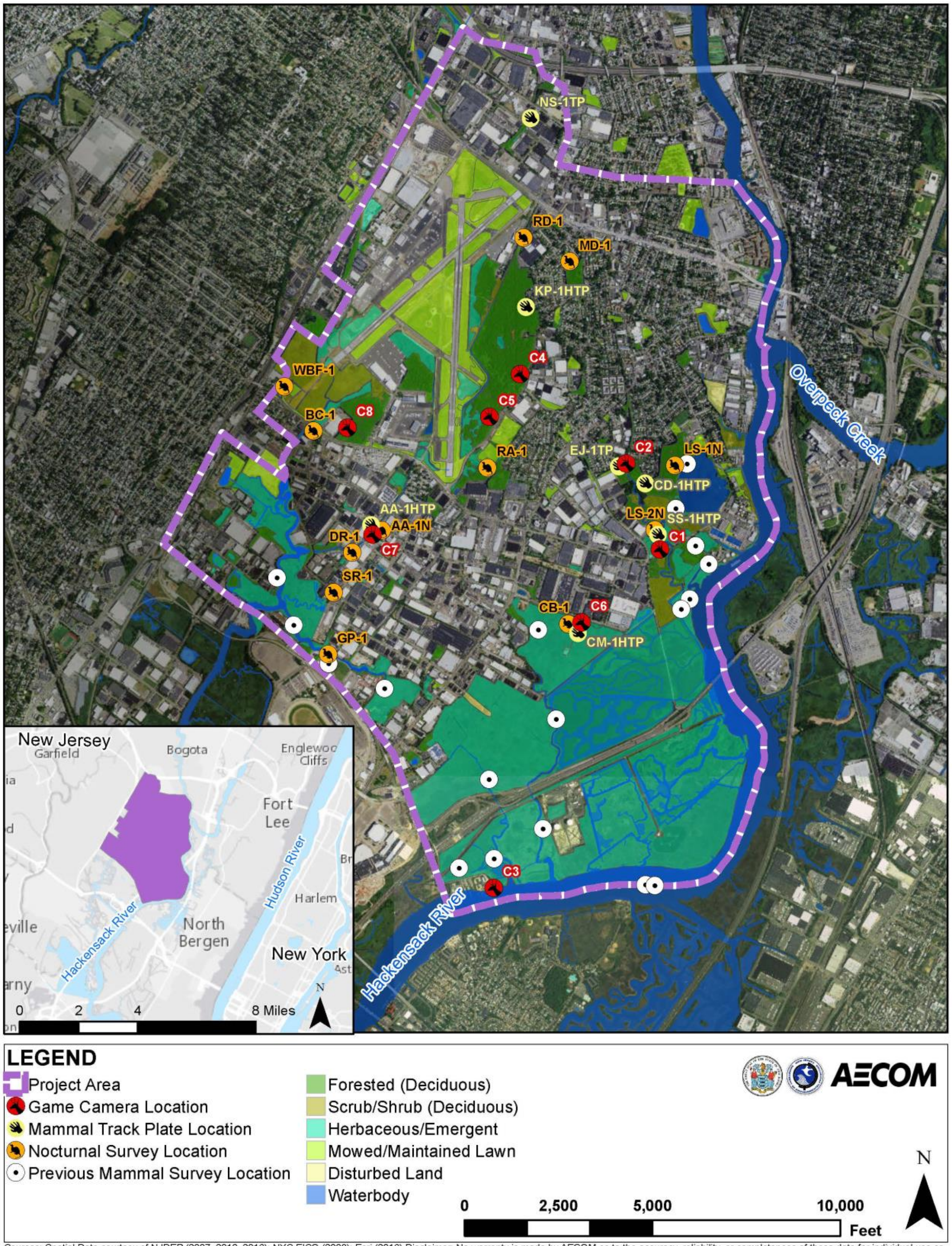

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Figure 3.14-3: Mammal Survey Locations in the Project Area

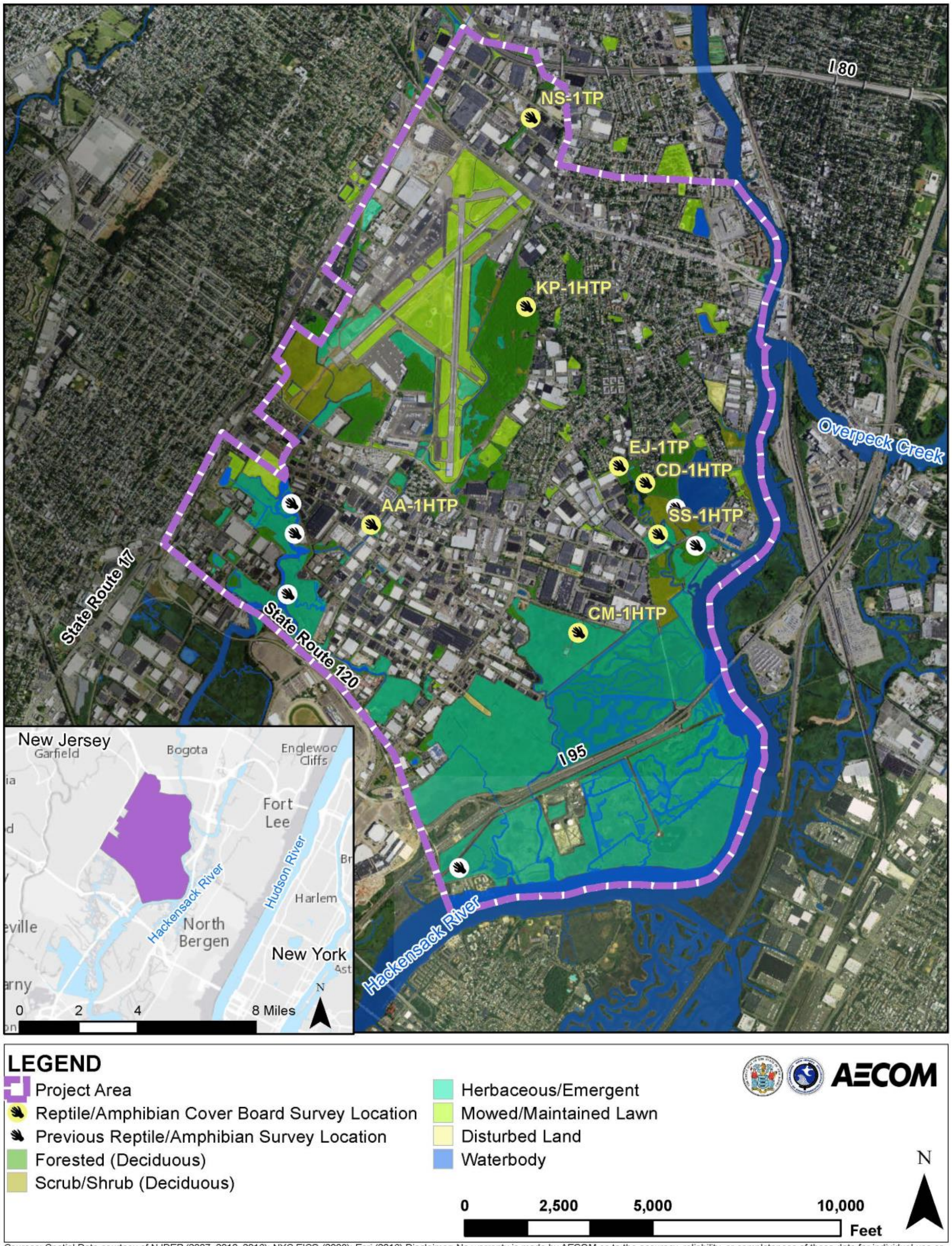

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Figure 3.14-4: Herpetofauna Survey Locations in the Project Area

Invertebrates

The findings of several butterfly, dragonfly/damselfly, and moth surveys completed in the Meadowlands District indicate that a number of species have been documented. A study completed by Kiviat and Barbour (2007) indicated that 49 different species were identified in the Meadowlands District, with additional species listed by the NJSEA (see **Appendix J**). No additional terrestrial invertebrate surveys were conducted in support of this analysis.

3.14.3.2 Aquatic Resources

Aquatic resources include the estuarine and freshwater habitats and aquatic wildlife documented to occur within the Meadowlands District and specifically within the Project Area. More information on wetlands within the Project Area can be found in **Section 3.16.3.3.**

Aquatic Habitats

Aquatic habitats include shallow and open-water estuarine areas, such as open waters, and the intertidal mudflats associated with the Hackensack River and its tributaries. Aquatic habitats in the Project Area also include brackish and freshwater tidal and non-tidal freshwater wetlands and marshes. Aquatic wildlife includes the characteristic organisms that occupy these habitats on either a permanent or a nearly permanent basis, depending on their individual life history requirements. For the purposes of this document, aquatic wildlife primarily includes fish, marine mammals, and benthic invertebrates.

Aquatic communities or habitat types within the Project Area represent a gradient, or continuum, of flooded conditions, ranging from the permanently inundated open waters of the Hackensack River to the intertidal mudflats and regularly flooded tidal wetlands along tributaries and the intermittently flooded high marsh areas. Also included within aquatic habitats in the Project Area are human-made open water ponds and impoundments. Many of these habitats have been disturbed or fragmented. **Table 3.14-4** provides an outline of habitat categorization and the following sections provide detailed descriptions of communities found in the Project Area, as outlined in the Ecological Communities of New York State (Edinger, et al. 2014).

The functions and values of wetlands and watercourses were evaluated using the Evaluation for Planned Wetlands (EPW) method (Bartoldus, et al. 1994) and the Stream Visual Assessment Protocol (SVAP) (NRCS 1988). Based on the EPW, wetlands in the Project Area are generally highly functional for shoreline bank erosion control, sediment stabilization, and improving water quality, and have low value for fish and wildlife habitat. While this is also true for common reed marsh communities, they scored lower for each wetland function and value than other wetland habitat communities. Based on stream evaluations using SVAP, all but one of the watercourses received a poor rating. The lower reach of Losen Slote is the only watercourse evaluated that received a fair rating, with scores only slightly higher than other watercourses. Losen Slote, when compared to other watercourses, received high ratings for the following assessment elements: channel condition, hydrologic alteration, and riparian zone. These features received high rating because they were least degraded or most stable in their condition, in accordance with the SVAP protocols. Further discussion of the EPW and SVAP techniques, preliminary results, and detailed scoring information are provided in **Appendix L**.

Table 3.14-4: Aquatic Habitats and Corresponding Ecological Communities Identified in the Project Area

Habitat Type	Category	Edinger Community
Aquatic Habitats	Forested Wetlands	Red Maple Hardwood Swamp (Variant)
		Red Maple-Blackgum Swamp (Variant)
		Red Maple-Sweetgum Swamp (Variant)
	Scrub/Shrub Wetlands	Salt Shrub
		Shrub Swamp
	Salt Marsh	Low Salt Marsh
		Estuarine Common Reed Marsh
		High Salt Marsh
	Freshwater Emergent Wetlands	Shallow Emergent Marsh
		Common Reed Marsh
	Open Water	Tidal River
		Unconfined River
		Ditch/Artificial Intermittent Stream
		Quarry Pond

Forested Wetlands

Red maple, blackgum, sweetgum, and pin oak typically dominate the forested wetlands within the Project Area. These communities are located near rivers and ponds and in low-lying areas that are poorly drained. Many of the forested wetland communities were identified near Teterboro Airport and Losen Slote Creek Park.

Red Maple Hardwood Swamp (Variant)

This hardwood community is a broadly defined; the hydrology varies from permanently saturated to the surface to seasonally flooded/wet with hummocks and hollows. In any one stand, red maple is either the only canopy dominant or it is codominant with one or more hardwoods. A total of 83 acres of this covertype was mapped within the Project Area.

Red Maple-Sweetgum Swamp (Variant)

This hardwood community is found along the eastern boundary of Teterboro Airport and typically occurs in poorly drained areas and may be interspersed with upland forest communities. Sweetgum is generally the dominant tree species, or is codominant with red maple. Within the Project Area, this community was generally codominated by red maple and sweetgum, and in some cases pin oak. Blackgum was also generally present in this community but not dominant. Sweet pepperbush, buttonbush (*Cephalanthus occidentalis*), arrowwood, briar (*Smilax* sp.), and poison ivy typically occupy the subcanopy. A total of 110 acres of this covertype was mapped within the Project Area.

Red Maple-Blackgum Swamp (Variant)

This is a coastal maritime community occurring in poorly drained basins and occasionally between watercourses and uplands. Species typically dominating the tree canopy include blackgum and red maple. Within the Project Area, this community was found near the West Riser Ditch to the south of

Teterboro Airport and typically consisted of red maple and blackgum with sweetgum, along with northern white oak (*Quercus alba*), northern red oak, and sassafras (*Sassafras albidum*). Sweet pepperbush and arrowwood, as well as swamp doghobble (*Eubotrys racemosa*), dominated the shrub layer. Highbush blueberry (*Vaccinium corymbosum*) was also present. A total of 20 acres of this covertype was mapped within the Project Area.

Scrub/Shrub Wetlands

Assemblages of shrub and sapling species dominate scrub/shrub wetland communities. These communities can be interspersed with canopy trees and herbaceous emergent species, and are often found in transition areas between herbaceous wetlands and uplands. Both saline and freshwater scrub/shrub communities occur within the Project Area. Scrub/Shrub Wetlands were often mapped as successional shrublands (**Table 3.14-3**). Forms of successional shrublands (wetlands) within the project area include the following:

Salt Shrub

This coastal community extends from high salt marsh communities to uplands with higher elevation. In the Project Area, this community was found along the Hackensack River in the Borough of Little Ferry and was dominated by shrubs, saplings, and herbaceous species including eastern baccharis, Jesuit's bark (*Iva frutescens*), purple loosestrife (*Lythrum salicaria*), and goldenrods (*Solidag*o spp.). Sugar maple, gray birch (*Betula populifolia*), eastern cottonwood, river birch (*Betula nigra*), and quaking aspen (*Populous tremuloides*) were also present in this community.

Shrub Swamp

This inland wetland type is broadly defined and generally dominated by tall shrubs. It may occur around open water features and between wetlands and upland areas. Within the Project Area, shrub swamp communities are found along the West Riser Ditch southwest of Teterboro Airport and along Losen Slote in Losen Slote Creek Park. These communities are dominated by common reed, sumac (*Rhus* sp.), fox grape, silky dogwood (*Cornus ammomum*), black berry, box elder (*Acer negundo*), and black elderberry (*Sambucus canadensis*). Dominant trees and saplings include tree-of-heaven and cottonwood, among others.

Salt Marsh

Salt marshes consist of herbaceous emergent vegetation tolerant of saline or brackish conditions. These communities were found throughout the Project Area following European colonization, but have been lost to development in recent history. These communities are dominated by native and non-native invasive species, and are found in estuarine and freshwater settings. Vegetation composition is dependent on salinity and hydrological regime.

Low Salt Marsh

This marsh community is exposed to semidiurnal tides and extends from mean sea level to mean high tide. It is dominated by smooth cordgrass (*Spartina alterniflora*). Cordgrass marshes are prevalent throughout the southern portion of the Project Area along the Hackensack River. These areas have recently been restored from common reed marshes into native cordgrass marshes for the purposes of developing mitigation banks and projects.

Estuarine Common Reed Marsh

This tidal marsh community has been disturbed by hydrological alterations or changes to the marsh configuration, which provided an opportunity for invasive species to colonize. Common reed is dominant in this community. It establishes in tidal freshwater, brackish marsh, and saltmarsh settings. Native plants may also be present, but the dominance of common reed precludes this marsh from being identified as an estuarine natural community. Within the Project Area, the estuarine common reed marsh community is common and consists of monotypic stands of common reed. This community is generally located to the north of the New Jersey Turnpike, west of Moonachie Creek, and north of the Kane Mitigation Bank. Until the recent development of mitigation banks along the Hackensack River, most low salt marsh communities consisted of common reed marshes.

High Salt Marsh

This marsh community occurs in a zone extending from mean high tide up to the limit of spring high tides. It is periodically flooded by spring high tides and flood tides. High salt marsh typically consists of a mosaic of patches that are mostly dominated by a single graminoid species. The dominant species in many large areas are either saltmeadow grass (*Spartina patens*) or smooth cordgrass.

Freshwater Emergent Wetlands

These systems consists of non-tidal, perennial wetlands characterized by emergent vegetation. The system includes wetlands permanently saturated by seepage, permanently flooded wetlands, and wetlands that are seasonally or intermittently flooded (these may be seasonally dry) if the vegetative cover is predominantly hydrophytic and the soils are hydric.

Shallow Emergent Marsh

This is a freshwater marsh meadow community that is permanently saturated or seasonally flooded with depths ranging from 6 inches to 3.3 feet. In the Project Area, this community is found along Losen Slote Creek and the Hackensack River at the BCUA property, and is dominated by common reed, sweetscent (Pluchea odorata), purple loosestrife, touch-me-not (*Impatiens* sp.), Pennsylvania smartweed (*Persicaria pennsylvanica*), and tall goldenrod (*Solidago altissima*).

Common Reed Marsh

This inland palustrine marsh community has been disturbed by draining and filling and is common along highways and railroads. Common reed is the dominant species and groundwater and precipitation drive the hydrology in this community. Native plants may also be present, but the dominance of common reed precludes this marsh from being identified as a palustrine natural community. Within the Project Area, the common reed marsh community consists of monotypic stands of common reed. This community is generally located in inland areas along freshwater creeks and impoundments, such as Berry's Creek, East Riser Ditch, and Losen Slote. In some cases, this community is found adjacent to estuarine watercourses and wetlands, but is isolated from tidal flows by berms, dikes, and tide gates.

Open Water Communities

Open water communities consist of freshwater and estuarine rivers, streams, ponds, and impoundments. These features are found throughout the Project Area, but are most common near the southern portion of the Project Area along the Hackensack River.

Tidal River

This is an aquatic community that is continually flooded and lacks emergent vegetation. Depths and salinity can be variable and are dependent on tidal fluctuations. Tidal rivers occur throughout the Project Area and include the Hackensack River and its major tidal tributaries, providing foraging habitat, spawning areas, and migration corridors for a variety of estuarine, freshwater, and migratory fish and macroinvertebrate species. Within the Project Area, deep estuarine open water is present within the Hackensack River mainstem, as well as in tributaries such as Losen Slote Creek, Moonachie Creek, and Berry's Creek.

Unconfined River

These streams typically have base level sections of streams with a very low gradient. These rivers are typically dominated by runs with interspersed pool sections and few short, distinct riffles, if any. Unconfined rivers usually have clearly distinguished meanders (i.e., high sinuosity) and well developed natural levees, are in unconfined valleys, and are most typical of the lowest reaches of stream systems.

Ditch/Artificial Intermittent Stream

This aquatic community is artificially constructed for the purposes of draining adjacent lands. Water levels are variable and depend on precipitation and groundwater levels. Non-native or invasive species such as purple loosestrife, common reed, and reed canary grass (*Phalaris arundinacea*) are often dominant. Artificial ditches within the Project Area include East Riser Ditch and West Riser Ditch, among other smaller unnamed ditches. No vegetation was present within these features.

Open Water Impoundment (Quarry Pond)

This aquatic community occurs in excavated basins created as part of quarrying operations. The sides are generally steep and water levels fluctuate with precipitation. Mehrhof Pond, Indian Lake, and Willow Lake are freshwater ponds found in the Project Area. These ponds are former clay pits that filled with freshwater after the fall of the brick industry in the area (USFWS 2007). These ponds are surrounded by parklands. Mehrhof Pond is surrounded by native grasslands, wet meadow areas, and palustrine forested wetlands.

Aquatic Wildlife

Fish

Considerable studies of the fish populations in the Hackensack River and associated marshes have been documented over the last 50 years. To supplement existing information, a fish survey was conducted in the small drainage ditches and streams within the Project Area. **Figure 3.14-5** identifies the locations of the current survey sites and select previous studies. **Appendix J** contains a detailed description of the methodology used to complete the surveys.

Most of the small streams in the Project Area have been channelized and/or are affected by human-caused disturbances, and the fish survey data suggest a prevalence of disturbance-tolerant species. The dominant fish species found in the Hackensack River in the Project Area is mummichog (*Fundulus heteroclitus*). Bluegill (*Lepomis macrochirus*), pumpkin seed (*Lepomis gibbosus*), and bullhead catfish (*Ameiurus* sp.) have also been identified. Dominant fish species observed in the tidal creeks of the Project Area include mummichog and western mosquitofish (*Gambusia affinis*). Other fish species observed include bluegill, pumpkin seed, goldfish (*Carassius auratus*), yellow bullhead (*Ameiurus natalis*), common carp (*Cyprinus carpio*), green sunfish (*Lepomis cyanellus*), and brown bullhead (*Ameiurus nebulosus*). Some fish collected in the Berry’s Creek drainage were observed to have tumors and lesions on their bodies. A full list of fish species identified in or near the Project Area is provided in **Appendix J**.

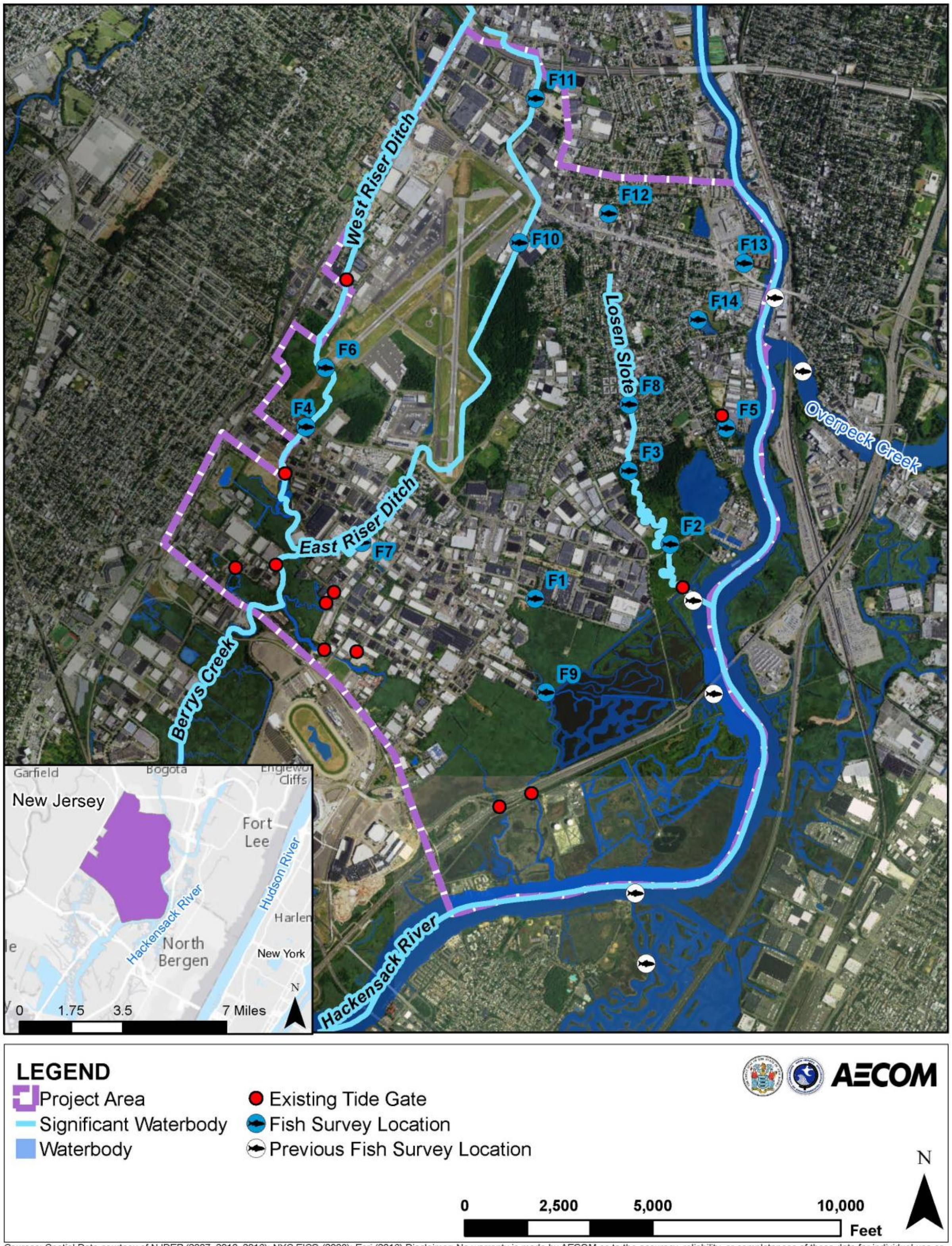

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Figure 3.14-5: Fish Survey Locations in the Project Area

Marine Mammals

Marine mammal sightings are uncommon in the Hackensack River and its tributaries, as the river's degraded water quality and low salinity levels are not preferred conditions for these species, although anecdotal sightings have occurred. According to a 2010 news report, a pod of dolphins was observed in the Hackensack River to the north of the Project Area, and a dead porpoise was observed in 2006 in New Milford's French Creek, a tributary of the Hackensack River located north of the Project Area (Star-Ledger 2010). A harbor seal sighting in the Hackensack River was recorded in 2013; the animal was resting on a dock at the River Barge Park in Carlstadt (Winters 2013). The amount of press and public interest these sightings generate is indicative of the rarity of marine mammal presence and occurrence in the Hackensack River and in the Project Area.

Benthic Invertebrates

The benthic community consists of a wide variety of small aquatic invertebrates (such as worms and snails) which live burrowed into or in contact with the substrate. Sediment grain size, chemistry, and physical properties determine benthic community composition. Benthic organisms can provide information about local environmental conditions because they are slow moving or sedentary, live and feed on the sediment, and cannot avoid exposure. The abundance, diversity, and composition of benthic species and their relative pollution tolerance are indicators of habitat quality. Benthic invertebrates are an important part of the estuarine system because they provide a food source for foraging fish and birds.

The majority of benthic invertebrate taxa present within the Meadowlands District are considered tolerant of a wide range of environmental conditions, including polluted substrates and surface waters (Weis and Weis 2003). A Project Area-specific survey of benthic invertebrate populations was conducted in 2016 as part of this analysis. **Figure 3.14-6** identifies the locations of survey sites. A comprehensive list of benthic invertebrates identified in or near the Project Area, as well as the Project Area-specific survey methodology, is provided in **Appendix J**.

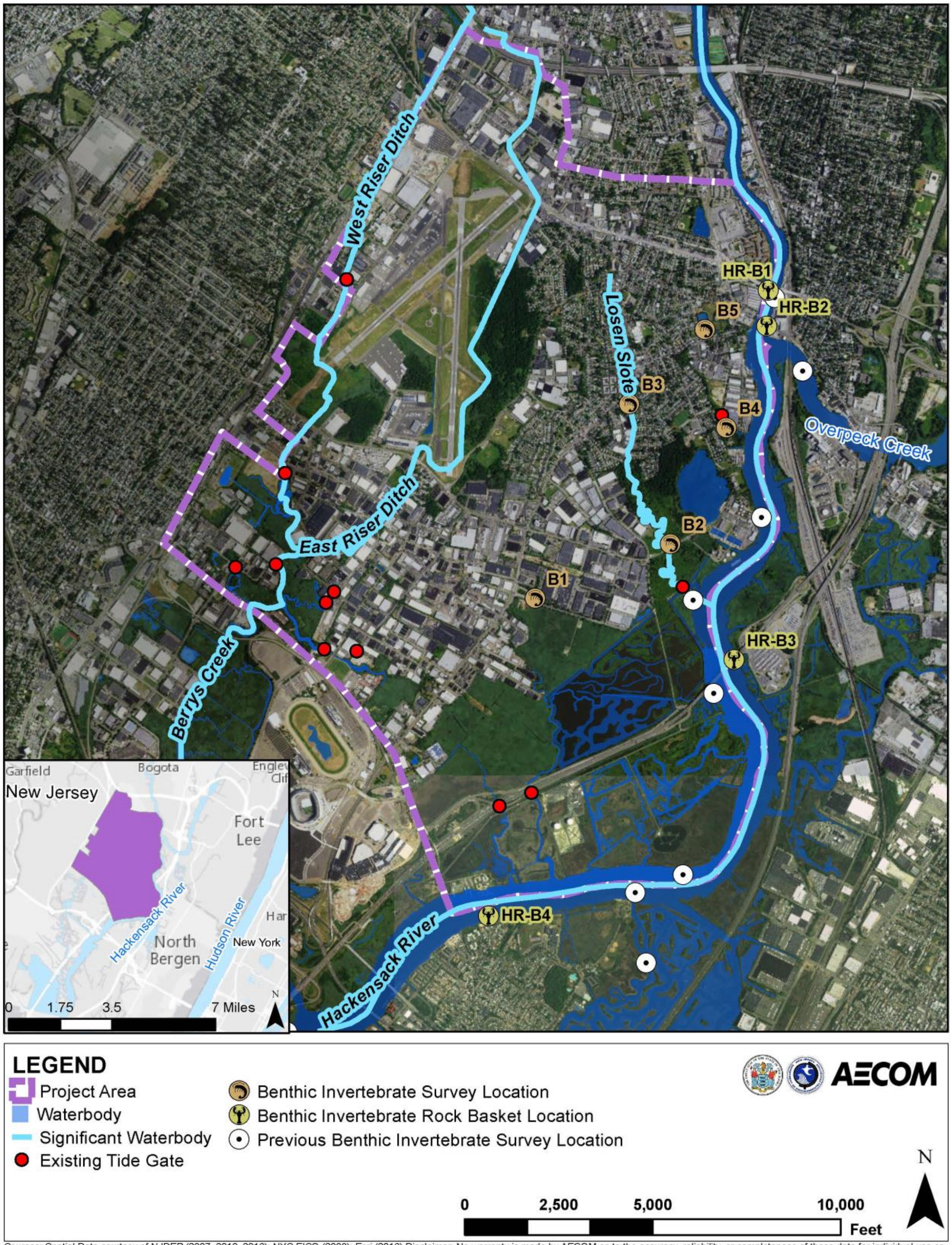

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Figure 3.14-6: Benthic Invertebrates Survey Locations in the Project Area

Essential Fish Habitat

EFH is defined under the MSA, as amended, as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH designations emphasize the importance of habitat protection to healthy fisheries and serve to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. EFH includes both the water column (including its physical, chemical, and biological growth properties) and the underlying substrate (including sediment, hard bottom, and other submerged structures). Under the EFH definition, necessary habitat is that which is required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. EFH is designated for a species' complete lifecycle, including spawning, feeding, and growth to maturity, and may be specific for each life stage (e.g., eggs, larvae, adult). EFH designations have been defined for specific life stages based on their occurrence in tidal freshwater, estuarine, and marine waters.

Certain EFH-managed species designated within the Hudson-Raritan Estuary would not be expected to occur in the Project Area (i.e., the upper portion of the tidal Hackensack River) because they occur only in the seawater salinity zone (i.e., an area with salinity greater than or equal to 25 parts per thousand). Species with designated EFH in the lower Hackensack River but with an unspecified salinity zone, such as cobia (*Rachycentron canadum*), king mackerel (*Scomberomorus cavalla*), and Spanish mackerel (*Scomberomorus maculatus*), are unlikely to occur in the study area given their affinity for warmer, highly saline waters. The following species with designated EFH within the Hudson-Raritan Estuary have life stages that can occur in the range of salinities present in the tidal Hackensack River portion of the Project Area:

- Atlantic butterfish (*Peprilus triacanthus*)
- Atlantic sea herring (*Clupea harengus*)
- Black sea bass (*Centropristis striata*)
- Bluefish (*Pomatomus saltatrix*)
- Clearnose skate (*Raja eglanteria*)
- Little skate (*Leucoraja erinacea*)
- Red hake (*Urophycis chuss*)
- Summer flounder (*Paralichthys dentatus*)
- Windowpane flounder (*Scophthalmus aquosus*)
- Winter flounder (*Pseudopleuronectes americanus*)
- Winter skate (*Leucoraja occellata*)

Three of these species – bluefish, summer flounder, and winter flounder – have been reported in fish surveys of the tidal Hackensack River (Bragin, et al. 2005). Juvenile bluefish are seasonally abundant (July through October) in the Hackensack River, and feed on forage species, such as mummichog (Bragin, et al. 2005, Candelmo, et al. 2010). Winter flounder spawn inshore (i.e., within tidal estuaries) and are one of the few estuarine fish species with large, adhesive, demersal eggs. Winter flounder spawn in the Hudson-Raritan Estuary between February and April when water temperatures are below 59°F, and generally prefer water depths of less than 20 feet over sand, mud, and gravel substrate (Pereira et al. 1999). After eggs are discharged by females, they are dispersed by tidal currents and adhere to bottom sediments. The likelihood of winter flounder spawning in the reach of the Hackensack River within the Project Area is low. Bragin et al. (2005) collected nine winter flounder during their survey of the Hackensack River between 2001 and 2003, and 38 were collected in a survey in 1987 and 1988. Four summer flounder were collected during the 2001 to 2003 survey, and only one was collected during the 1987 to 1988 survey. Nearly all individuals were collected well to the south of the Project Area during both surveys. Bragin et al. (2005) did not identify the Hackensack River as potential spawning grounds for winter flounder; summer flounder and bluefish spawn offshore, and juveniles enter estuaries during mid-summer.

In addition to the EFH-managed species, regulatory agencies often request inclusion of the following NOAA-trust resources species, non-managed, migratory, or forage fish species in impact assessments:

- Alewife (*Alosa pseudoharengus*)
- American shad (*Alosa sapidissima*)
- Atlantic menhaden (*Brevoortia tyrannus*)
- Atlantic silverside (*Menidia menidia*)
- Atlantic sturgeon (*Acipenser oxyrhynchus oxyrhynchus*)
- Atlantic tomcod (*Microgadus tomcod*)
- Bay anchovy (*Anchoa mitchilli*)
- Blueback herring (*Alosa aestivalis*)
- Shortnose sturgeon (*Acipenser brevirostrum*)
- Striped bass (*Morone saxatilis*)
- White perch (*Morone americana*)

Other NOAA trust resource species, including quahog or hard clam (*Mercenaria mercenaria*) and horseshoe crab (*Limulus polyphemus*), have not been documented within the Project Area.

An EFH Assessment Report has been prepared to assess potential impacts of the Proposed Project on EFH and EFH species and to facilitate coordination with NMFS regarding MSA compliance (see **Appendix Q**). Following review of this EFH Assessment Report, NMFS provided a letter dated September 26, 2018, stating that it adequately assesses potential impacts to NOAA resources, and provided four conservation recommendations for implementation. In accordance with the MSA, the NJDEP provided a detailed response (dated October 4, 2018) to NMFS indicating that it would adopt these four conservation recommendations to the extent practicable. Due to the lack of detailed design and construction specifications at this stage, any conservation recommendations later deemed infeasible would be replaced with similar measures that achieve the same end. Consultation correspondence between the NJDEP and NMFS is provided in **Appendix A**.

Table 3.14-5 presents a summary of designated EFH-managed species and their life stages within the tidally influenced portions of the Hackensack River, including the Project Area. This information was obtained from the EFH designation table for the Hudson River/Raritan/Sandy Hook Bays, New York/New Jersey Estuary from the NMFS Guide to Essential Fish Habitat Designations in the Northeastern United States (NMFS 2016a).

Table 3.14-5: Summary of Designated Essential Fish Habitat Managed Species and Life Stages within Tidally Influenced Portions of the Hackensack River

Common Name	Species Name	Eggs	Larvae	Juveniles	Adults	Spawning Adults
Atlantic butterfish	*Peprilus triacanthus*	NA	M	M,S	M,S	NA
Atlantic mackerel	*Scomber scombrus*	NA	NA	S	S	NA
Atlantic sea herring	*Clupea harengus*	NA	M,S	M,S	M,S	NA
Black sea bass	*Centropristis striata*	NA	NA	M,S	M,S	NA
Bluefish	*Pomatomus saltatrix*	NA	NA	M,S	M,S	NA
Clearnose skate	*Raja eglanteria*	NA	NA	x	x	NA
Cobia	*Rachycentron canadum*	x	x	x	x	NA
Little skate	*Leucoraja erinacea*	NA	NA	x	x	NA
King mackerel	*Scomberomorus cavalla*	x	x	x	x	NA
Red hake	*Urophycis chuss*		M,S	M,S	M,S	NA
Scup	*Stenotomus chrysops*	S	S	S	S	NA
Spanish mackerel	*Scomberomorus maculatus*	x	x	x	x	NA
Summer flounder	*Paralichthys dentatus*		F,M,S	M,S	M,S	NA
Windowpane flounder	*Scophthalmus aquosus*	M,S	M,S	M,S	M,S	M,S
Winter flounder	*Pseudopleuronectes americanus*	M,S	M,S	M,S	M,S	M,S
Winter skate	*Leucoraja occelata*	NA	NA	x	x	NA

F = Includes tidal freshwater salinity zone (0.0 ppt - 0.5 ppt).
M = Includes mixing water/brackish salinity zone (0.5 ppt - 25.0 ppt). The Project Area is within this zone.
S = Includes the seawater salinity zone (>25.0 ppt).
ppt = parts per thousand.
x = Designated EFH but no salinity zone specified.
Source: (NMFS 2016a)

Atlantic and shortnose sturgeon are both State and Federally endangered species with principal spawning grounds located in the brackish and freshwater tidal portions of the Hudson River (Bain 1997). While the Hackensack River and its tributaries have not been identified as spawning habitat for either sturgeon species, it is possible that adults of either species could traverse the tidal portion of the Hackensack River during migration. Early life stages (i.e., eggs, larvae, juveniles) would not be present in the Project Area and it is highly unlikely that either species would use the Project Area as spawning habitat, as both species typically spawn in large aggregations (Bain 1997). While anecdotal reports of Atlantic and shortnose sturgeon sightings in the Hackensack River have been documented as recently as 2006 near Secaucus, New Jersey (Carola 2006), the NMFS, in their response to the EFH consultation letter for the Proposed Project, indicated that, “There are no ESA-listed species under NMFS jurisdiction present in the Hackensack River. As such, it will not be necessary for NMFS to be a cooperating agency for ESA review.” This conclusion, including a statement that Section 7 consultation under the ESA is not necessary, was reiterated upon submission of the EFH Assessment Report.

Copies of these responses from NMFS, dated April 28, 2016, and August 30, 2018, respectively, are provided in **Appendix A**.

3.14.3.3 Existing Threats to Aquatic and Terrestrial Habitats

Habitat degradation, habitat loss, species invasions, habitat fragmentation, contaminant uptake and sequestration, and loss of biodiversity are the primary threats to aquatic and terrestrial habitats and resources in the Meadowlands District. Unused dams and inoperable tide gates degrade habitat and impair passage for anadromous species into upper reaches of the watershed (Durkas 1992). Invasive plants are an important concern in the Project Area, where common reed dominates thousands of acres. Invasive plants are often effective colonizers in disturbed habitats, out-competing native flora under stressed conditions. This threat is potentially exacerbated within the Project Area by extensive hydrologic alterations and habitat fragmentation and loss associated with residential, commercial, industrial development, and transportation infrastructure.

The NJDEP compiled a report of the 27 “most problematic invasive species” in the state (Snyder and Kaufman 2004). Of those 27 species, 20 were identified in the Project Area. A list of invasive species present in the Project Area, based on recent research, is provided in **Appendix J**.

In addition to invasive common reed, several other non-native plant species represent a potential threat to wetland habitats in the Project Area. Purple loosestrife has invaded freshwater marshes, wet fields, and drainage ditches throughout the region. Within the Project Area, established populations have been documented in Teterboro Woods and along Losen Slote Creek (USFWS 2007). Purple loosestrife often displaces native wetland plants. Dense stands may also alter hydrology, nutrient cycling, and the distribution and abundance of native insects and wildlife. Japanese knotweed, another invasive plant species, is established at a number of wetlands and riparian areas throughout the Meadowlands District, including locations within the Project Area (USFWS 2007). Similar to purple loosestrife, Japanese knotweed displaces native riparian species and alters the distribution and abundance of native insects and wildlife. Tree-of-heaven occurs throughout the Meadowlands District. This introduced species is recognized for its tolerance to air pollution; it is abundant in many metropolitan areas of the US. Typical habitats colonized by tree-of-heaven include abandoned fields and lots, roadsides, and coastal dunes; it is common along wetland/upland edges throughout the Meadowlands District (USFWS 2007, Kiviat and MacDonald 2002).

Many freshwater aquatic species common to freshwater ponds and lakes in the Meadowlands District, and in the upper freshwater tidal portion of the Hackensack River, are non-native, introduced from the Great Lakes and Mississippi River drainages during the late 19th century. Examples include largemouth bass (*Micropterus salmoides*), common carp, and bluegill (Strayer 2006). A non-native clam species (*Macoma balthica*) was collected during benthic invertebrate surveys of the Hackensack River, but is not currently reported to be displacing native species or rapidly increasing in abundance (Bragin et al. 2009). Additionally, 34 invasive or non-native fish and wildlife species were present in New Jersey in 2014, according to a survey conducted by the New Jersey Invasive Species Strike Team, including one bird, two crustaceans, 10 fish, 14 insects, two mammals, and five mollusks (NJISST 2014). Of these species, 16 are likely to occur in the Project Area.

Contamination of upland and wetland soils, as well as vegetation and biota, is a substantial concern throughout the Meadowlands District as a result of decades of industrial activity. Of specific concern is mercury contamination within Berry’s Creek. Over several decades, the production of mercury compounds at the former Ventron/Velsicol site resulted in the disbursement of mercury into the natural environment. Mercury can mobilize through erosion, groundwater transport, volatilization, and transformation, and through uptake by plants and biota. Natural attenuation of mercury occurs through uptake by saltmarsh vegetation and sediment accumulation. The physical movement of contaminants, such as mercury, through erosion or groundwater transport is known as translocation.

In addition to mercury, biotic uptake of other metals, such as chromium, polychlorinated dibenzo-p-dioxins (dioxins or PCDDs), polychlorinated dibenzofurans (furans or PCDFs), and polychlorinated biphenyls (PCBs), remains a concern to aquatic resources in the Project Area. Dioxins and furans are recognized as carcinogens and endocrine disrupters in a wide range of aquatic biota, as well as higher-level receptors (including mammals and humans). PCBs can cause histopathological lesions, immune system suppression, and reproductive and developmental abnormalities in fish and other aquatic biota, as well as in fish-eating birds and mammals (USFWS 2015). A study of chromium uptake in blue crabs (*Callinectes sapidus*) included sampling in Berry's Creek. Elevated levels of chromium were found in crab tissues; crabs collected within the Project Area were more likely to have higher concentrations of chromium in comparison to crabs collected downriver because of increased bioavailability of metals in lower-salinity waters (Konsevick and Reidel 1993). NJDEP has issued fish consumption advisories, specifically in response to elevated mercury, PCBs, and 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) concentrations, for several fish and shellfish species present in the Hackensack River (USFWS 2015), including within the Project Area.

3.14.3.4 Federal and State-Listed Species and Species of Concern

Federally-Listed Species

The ESA of 1973 describes several protected status categories for plants and animals designated by the USFWS and the NMFS. A federally listed endangered species is defined as an animal or plant species in danger of extinction throughout all or a significant portion of its range. A federally listed threatened species is an animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range. A Federal candidate species is a plant or animal species that is currently undergoing a status review for potential listing as endangered or threatened. When a candidate species is found to warrant listing as endangered or threatened, the species becomes "proposed" before a final listing as endangered or threatened is made.

Based on a review of the Information for Planning and Conservation Report (IPaC) obtained for the Proposed Project from the USFWS website, no federally listed threatened or endangered species are known to inhabit the Project Area. In addition, the NMFS responded that no listed species under their jurisdiction are present in the Hackensack River or its tributaries. A copy of this response letter, dated April 28, 2016, is provided in **Appendix A**.

The USFWS (2007) listed the Appalachian grizzled skipper (*Pyrgus wyandot*), an endangered butterfly, as present in the Hackensack River watershed. This indicates that this species could be present in the Project Area. This species is an Appalachian Mountain specialist found in open, sparsely grassed and barren areas that are close to oak or pine forests (NJDEP 2016e). This habitat is not present in the Project Area and the USFWS did not identify this species as present in the Project Area according to the IPaC Report.

Atlantic sturgeon and shortnose sturgeon are the only two federally listed fish species that could potentially be present within the Project Area. Both species are federally listed as endangered. While the Hackensack River and its tributaries have not been identified as spawning or foraging habitat for either sturgeon species, occasional, anecdotal reports of sturgeon in the river do occur. For example, a possible sturgeon observation was reported near Mill Creek Point in Secaucus, New Jersey in July 2006 (Carola 2006).

State-Listed Species

The NJDEP's Endangered and Non-game Species Program defines state-listed endangered species as those species whose prospects for survival in New Jersey are in immediate danger because of a loss or change in habitat, over exploitation, predation, competition, disease, disturbance, or contamination. State-listed threatened species are defined as those species that may become endangered if conditions surrounding them begin to, or continue to, deteriorate. For birds, the State status may be different for breeding (nesting) versus non-breeding populations. Over the years, 31 state-listed endangered and threatened species and dozens of special concern species have been documented in the Meadowlands District. Federally and state-listed species documented in the Project Area are listed in **Table 3.14-6**.

Two state-listed endangered plant species were identified within or adjacent to the Project Area: eastern redbud (*Cercis canadensis*) and floating marshpennywort (*Hydrocotyle ranunculoides*). Two individuals of the eastern redbud were observed in the Project Area; however, due to their position in the landscape, it is believed these individuals were introduced (i.e., planted and/or escaped). Eastern redbud are now commonly available in nurseries. The floating marshpennywort was observed just outside the project boundaries within the headwaters of the West Riser Ditch.

In New Jersey, the term "Species of Special Concern" applies to species that warrant special attention because of evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming a threatened species. Overall, the state-listed endangered, threatened, and special concern species documented in the Meadowlands District include one mammal, 61 birds, and three turtles.

Of the 61 species of listed birds, 31 species have been identified in the Project Area using one or more habitat types. In tidal creek and marsh habitats, 20 species were identified; 12 were identified using palustrine forested wetlands and deciduous forests; and eight were identified using freshwater ponds and adjacent wet meadows and woodlands (Mizrahi, et al. 2007). During Project Area-specific avian surveys, 25 state-listed species were identified, including 10 state-listed threatened and endangered bird species. These species were observed in the large restored marsh complexes in the southeast portion of the Project Area. No federally listed species were observed during Project Area-specific avian surveys.

A request was sent to the New Jersey Natural Heritage Program (NJNHP) for recent records of special status species within the vicinity of the Project Area, and a response was received on September 29, 2016 (**Appendix A**). Special status species identified with known occurrences in the Project Area include nine bird species and one turtle species. State-listed endangered birds within the immediate vicinity of the Project Area include the bald eagle, northern harrier, and peregrine falcon (*Falco peregrinus*). State-listed threatened birds within the immediate vicinity of the Project Area include the cattle egret (*Bubulcus ibis*) and the yellow-crowned night-heron (*Nyctanassa violacea*). Special concern birds include the barn owl (*Tyto alba*), glossy ibis (*Plegadis falcinellus*), little blue heron (*Egretta caerula*), and snowy egret (*Egretta thula*). Although not a state-listed endangered, threatened, or special concern species, the northern diamondback terrapin (*Malaclemys terrapin terrapin*) is identified by the NJNHP as a species tracked by the NJDEP Endangered and Nongame Species Program, within the immediate vicinity.

3.14.3.5 Existing Threats to Special Status Species

Existing threats to special status species throughout the Meadowlands District, and specifically within the Project Area, include:

- Continued habitat degradation/loss as a result of habitat fragmentation associated with transportation infrastructure (i.e., road, rail, and aviation), and commercial, industrial, and residential development;
- Contaminant input and mobilization through terrestrial and wetland food webs;
- Eutrophication and loss of wetlands; and
- The effects of current and future species invasions, resulting in increased competition; predation of nests, eggs, and nestlings; predation of juveniles and adults; and disease vectors.

As with habitat for common aquatic and terrestrial wildlife species, invasive plants are an important concern for the maintenance of wildlife biodiversity and habitat for special status species in the Project Area. Soil and sediment contamination is also a common concern in the Project Area due to the current and historical industrial nature of this part of New Jersey. Both threats are discussed above in **Section 3.14.3.3**.

Table 3.14-6: Endangered, Threatened, and Special Concern Species of the Meadowlands District

Common Name	Scientific Name	Federal Status[1]	State Status[1] (Breeding/ Nonbreeding)	Nesting [2, 3]	Observed During 2016-2017 Field Surveys
Birds					
American bittern	*Botaurus lentiginosus*	NL	E/SC	No	No
American kestrel	*Falco sparverius*	NL	T/T	Yes	Yes
Bald eagle	*Haliaeetus leucocephalus*	NL	E/T	No	Yes
Barn owl	*Tyto alba*	NL	SC/SC	Yes	No
Black skimmer	*Rynchops niger*	NL	E/E	No	Yes
Black-billed cuckoo	*Coccyzus erythropthalmus*	NL	SC/S	No	No
Blackburnian warbler	*Dendroica fusca*	NL	SC/S	No	No
Black-crowned night-heron	*Nycticorax nycticorax*	NL	T/SC	No	Yes
Black-throated blue warbler	*Setophaga caerulescens*	NL	SC/S	No	Yes
Black-throated green warbler	*Setophaga virens*	NL	SC/S	No	Yes
Blue-headed vireo	*Vireo solitaries*	NL	SC/S	No	No
Bobolink	*Dolichonyx oryzivorus*	NL	T/SC	No	Yes
Broad-winged hawk	*Buteo platypterus*	NL	SC/S	No	No
Brown thrasher	*Toxostoma rufum*	NL	SC/S	Yes	No
Canada warbler	*Cardellina canadensis*	NL	SC/S	No	Yes
Caspian tern	*Hydroprogne caspia*	NL	SC/S	No	No
Cattle egret	*Bubulcus ibis*	NL	T/SC	No	No
Cerulean warbler	*Setophaga cerulean*	NL	SC/SC	No	No
Cliff swallow	*Petrochelidon pyrrhonota*	NL	SC/S	No	Yes

Common Name	Scientific Name	Federal Status[1]	State Status[1] (Breeding/ Nonbreeding)	Nesting[2, 3]	Observed During 2016-2017 Field Surveys
Common nighthawk	*Chordeiles minor*	NL	SC/SC	No	No
Common tern	*Sterna hirundo*	NL	SC/S	No	Yes
Cooper's hawk	*Accipiter cooperii*	NL	SC/S	No	Yes
Eastern meadowlark	*Sturnella magna*	NL	SC/SC	No	No
Glossy ibis	*Plegadis falcinellus*	NL	SC/S	No	No
Grasshopper sparrow	*Ammodramus savannarum*	NL	T/SC	No	No
Great blue heron	*Ardea herodias*	NL	SC/S	No	Yes
Henslow's sparrow	*Ammodramus henslowii*	NL	E/E	No	No
Horned lark	*Eremophila alpestris*	NL	T/SC	Yes	No
Least bittern	*Ixobrychus exilis*	NL	SC/SC	Yes	No
Least flycatcher	*Empidonax minimus*	NL	SC/S	No	Yes
Least tern	*Sternula antillarum*	NL	E/E	Yes	No
Little blue heron	*Egretta caerulea*	NL	SC/SC	No	Yes
Long-eared owl	*Asio otus*	NL	T/T	No	No
Nashville warbler	*Oreothlypis ruficapilla*	NL	SC/S	No	No
Northern goshawk	*Accipiter gentilis*	NL	E/SC	No	No
Northern harrier	*Circus cyaneus*	NL	E/SC	Yes	Yes
Northern parula	*Setophaga americana*	NL	SC/S	No	Yes
Osprey	*Pandion haliaetus*	NL	T/S	Yes	Yes
Peregrine falcon	*Falco peregrinus*	NL	E/SC	Yes	Yes
Pied-billed grebe	*Podilymbus podiceps*	NL	E/SC	Yes	Yes

Common Name	Scientific Name	Federal Status[1]	State Status[1] (Breeding/ Nonbreeding)	Nesting[2, 3]	Observed During 2016-2017 Field Surveys
Red-headed woodpecker	*Melanerpes erythrocephalus*	NL	T/T	No	No
Red knot	*Calidris canutus*	T	NA/E	No	No
Red-shouldered hawk	*Buteo lineatus*	NL	E/SC	No	No
Roseate tern	*Sterna dougallii*	E	E/E	No	No
Sanderling	*Calidris alba*	NL	NA/SC	No	No
Savannah sparrow	*Passerculus sandwichensis*	NL	T/S	Yes	Yes
Sedge wren	*Cistothorus platensis*	NL	E/E	No	No
Semi-palmated sandpiper	*Calidris pusilla*	NL	NA/SC	No	No
Sharp-shinned hawk	*Accipiter striatus*	NL	SC/SC	No	Yes
Short-eared owl	*Asio flammeus*	NL	E/SC	No	No
Snowy egret	*Egretta thula*	NL	SC/S	No	Yes
Spotted sandpiper	*Actitis macularius*	NL	SC/S	Yes	Yes
Tricolored heron	*Egretta tricolor*	NL	SC/SC	No	Yes
Upland sandpiper	*Bartramia longicauda*	NL	E/E	No	No
Veery	*Catharus fuscescens*	NL	SC/S	No	No
Vesper sparrow	*Pooecetes gramineus*	NL	E/SC	No	No
Whimbrel	*Numenius phaeopus*	NL	NA/SC	No	No
Winter wren	*Troglodytes hiemalis*	NL	SC/S	No	No
Wood thrush	*Hylocichla mustelina*	NL	SC/S	Yes	Yes
Worm-eating warbler	*Helmitheros vermivorum*	NL	SC/S	No	No
Yellow-crowned night-heron	*Nyctanassa violacea*	NL	T/T	Yes	No

Common Name	Scientific Name	Federal Status[1]	State Status[1] (Breeding/ Nonbreeding)	Nesting [2, 3]	Observed During 2016-2017 Field Surveys
Mammals					
Northern long-eared bat	*Myotis septentrionalis*	T	T	PR	No
Reptiles					
Eastern box turtle	*Terrapene carolina*	NL	SC	PR	No
Northern diamondback terrapin	*Malaclemys terrapin terrapin*	NL	NL	PR	No
Spotted turtle	*Clemmys guttata*	NL	SC	PR	No
Wood turtle	*Glyptemys insculpta*	NL	T	PR	No
Fish					
Atlantic sturgeon	*Acipenser oxyrhynchus*	E	E	M	No
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	M	No

(NJSEA 2015)
[1] Federal and State Status designations:
E = endangered
NL = not listed
T = threatened
SC = special concern
S = stable
NA= no designation for breeding status
[2] M = Migrates through the Meadowlands District during spring and/or fall
[3] PR = Permanent resident

3.15 Geology and Soils

3.15.1 Introduction

This section provides an overview of the geology, topography, soils, and stratigraphy within the Project Area; information on the hydrology in the Project Area is not included in this section and can be found in **Section 3.17**. The information provided within this section on the Project Area is based on desktop analysis findings and has not been validated through field reconnaissance. Geological resources consist of surface and subsurface materials and their properties. Principal geologic factors influencing the ability to support structural development are seismic properties (i.e., potential for subsurface shifting, faulting, or crustal disturbance), soil stability, and topography.

Topography is the change in elevation over the surface of a land area. An area's topography is influenced by many factors, including human activity, underlying geologic material, seismic activity, climatic conditions, and erosion. A discussion of topography typically encompasses a description of surface elevations, slope, and distinct physiographic features (e.g., mountains) and their influence on human activities.

The term soil, in general, refers to unconsolidated materials overlying bedrock or other parent material. Soil structure, elasticity, strength, shrink-swell potential, and erodibility all determine the ability for the ground to support man-made structures. Soils typically are described in terms of their complex type, slope, physical characteristics, and relative compatibility or constraining properties with regard to particular construction activities and types of land use. There are several soil classification systems for engineering and environmental purposes. Soil classification is based on particle size, organic content, and water content as determined by visual inspection and engineering tests such as sieve tests and Atterberg Limits. The most widely used classification system is the Unified Soil Classification System as documented in the *Standard Practice for Classification of Soils for Engineering Purposes* (ASTM 2011). Other common classification systems include the Wentworth Scale, the Burmister Soil Classification Naming System (Burmister 1958), the US Comprehensive Soil Classification System, and the American Association of State Highway and Transportation Officials system (ASTM 2015).

Stratigraphy of a region characterizes the layers of rock and soil that have been deposited over time in a geochronological order. These layers (strata) chronicle the geologic processes that led to the deposition of these materials.

3.15.2 Regulatory Context

The New Jersey Soil Erosion and Sediment Control Act of 1975 (NJSA 4:24-39 *et seq.*) was established to protect the environment from land disturbances associated with urban development in the State. Soil erosion can become a serious problem during development work, including building construction, excavation of trenches, and other earth-moving activities, especially after severe stormwater runoff events. Left unchecked, soil erosion, and the subsequent sediment deposition, could pollute the waters of the State and cause damage to other environmentally sensitive natural resources. Therefore, the Act establishes standards for the control of erosion and sedimentation that must be followed during any major land-disturbance project, including the preparation of a Soil Erosion and Sediment Control Plan for projects disturbing 5,000 SF or more (New Jersey State Soil Conservation Committee 2014). More detailed information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

3.15.3 Existing Conditions

The Project Area, located within the Meadowlands District, is part of the lower Hackensack Valley. The Hackensack Valley and the encompassing Meadowlands are prone to chronic flooding due to geological setting, multiple glaciation events resulting in scouring and eroding of the valley, complexity of tidal influence, anthropogenic activities, and inadequate storm management systems.

3.15.3.1 Bedrock Geology

The geology of New Jersey is commonly divided into four regions, known as Physiographic Provinces, whose boundaries separate distinctive rock formations, rock structures, and landforms. The four geologic regions of New Jersey consist of (from north to south): Valley and Ridge Province, Highlands Province, Piedmont Province, and the Coastal Plain Province (New Jersey Geological Survey 1999). The Meadowlands District is located within the Piedmont Province in northeastern New Jersey in the Hackensack Valley, a subdivision of the greater Newark Basin. Low rolling plains interrupted by northeast trending ridges and uplands define the Piedmont province. Late Triassic- and early Jurassic-aged (230 to 190 million years old) sedimentary rocks underlie the lowlands while the ridges and uplands are underlain by Jurassic-aged igneous rocks (Dalton 2003).

The Newark Basin was formed during the initial stages of the rifting of the Pangaea supercontinent and the consequent opening of the Atlantic Ocean during the late Triassic. Rifting at the surface caused large crustal blocks to drop downward forming basins throughout eastern North America. Regionally, erosion of older rocks from the Paleozoic and Precambrian ages (approximately 260 million years and older) at higher elevations led to the deposition of continental sediments into the newly formed Newark Basin. These sediments subsequently formed consolidated rocks such as red siltstones, sandstones, and conglomerates (New Jersey Geological Survey 1999).

The bedrock underlying the Meadowlands District is part of the Passaic Formation, which is composed of sedimentary rocks. However, during the deposition of the Passaic Formation sediments, periods of volcanic activity led to the development of less prevalent igneous formations (**Figure 3.15-1**). The rock formations known as Laurel Hill and Little Snake Hill in the Meadowlands District are the result of magma intrusion from one of these volcanic events. The magmatic plume that formed Laurel Hill and Little Snake Hill is also associated with the formation of the Palisade Sill and the Watchung Mountains (Kiviat and MacDonald 2002).

In late Triassic, during the latter stages of the rifting of the Pangaea supercontinent, the Earth's crust faulted and tilted the sedimentary and igneous rocks in the Newark Basin. The subsequent differential weathering of the siltstone and mudstone of the Passaic Formation, in contrast to the weathering-resistant igneous ridges to the east and west, formed a flood valley trending northeast and dipping 15 to 20 degrees to the northwest (USACE 1995).

3.15.3.2 Surficial Geology

During the Pleistocene Epoch (approximately 2.6 million to 12,000 years ago), the Earth underwent a series of ice ages; the last of these, the Wisconsinan Glaciation, lasted from approximately 85,000 to 11,000 years ago. This glaciation affected the Hackensack River Valley, covering the valley and surrounding area with an approximately 4,000-foot thick ice sheet that extended south of the Meadowlands District (Stone, et al. 2002). As the glacier advanced, it eroded soil and rock and carried it southward. The eroded material (a mixture of clay, silt, sand, gravel, cobbles, and boulders), called glacial drift, was deposited on the land as the ice sheet advanced southward. Glacial drift deposited under the advancing ice was compacted by the weight of the ice and formed deposits called glacial till. As the glacier retreated, some of the glacial drift deposits formed ridges called moraines that acted as dams blocking natural drainages. One such moraine was responsible for the formation of Lake Hackensack, which formed between the Palisades Sill and Watchung Mountains. The water from the melting ice sheet carried particles of sand, silt, and clay to Lake Hackensack, where they formed thin, alternating layers called varves on the lake bottom (USACE 2002a). As global temperature rose, vast amounts of glacial meltwater emptied into the world's oceans and the subsequent global rise in mean sea level led to the erosion of the moraine dam that formed the southern boundary of Lake Hackensack. As the moraine eroded, the lake eventually drained, leaving behind discontinuous layers of silt and fine sand on the former lake bottom (NJSEA 2007).

As the ice sheets continued to melt and recede northward, the Earth's crust (which was compressed from the weight of the ice sheet) rebounded back to its pre-glacial elevation. In spite of the crustal rebound, the rising sea level flooded the Hackensack Valley and deposited organic-rich layers of peat and mineral soils that formed marshlands, as illustrated in **Figure 3.15-2** (USACE 2002a).

3.15.3.3 Topography

The geomorphology, or configuration of landforms, in the Meadowlands District is a reflection of its geologic history, as described in previous sections. The geologic history and current marshlands result in nearly flat topography with elevation differences of less than 100 feet (USACE 1995).

Within approximately 95 percent of the Meadowlands District, elevations range from approximately 0 to 10 feet (NAVD 88). Adjacent areas to the east and west of the Meadowlands reach elevations of approximately 250 feet (MERI 2014). The accelerated urbanization and industrialization of the region during recent times, as shown in **Figure 3.15-3**, has seen portions of the southern section of the Meadowlands District reach elevations up to 10 feet (NAVD 88) as a result of former landfill operations and creation of man-made land for regional networks of highways and rail (Goodman 1995). Due to low topography, the Meadowlands District is considered to have a low incidence of landslides.

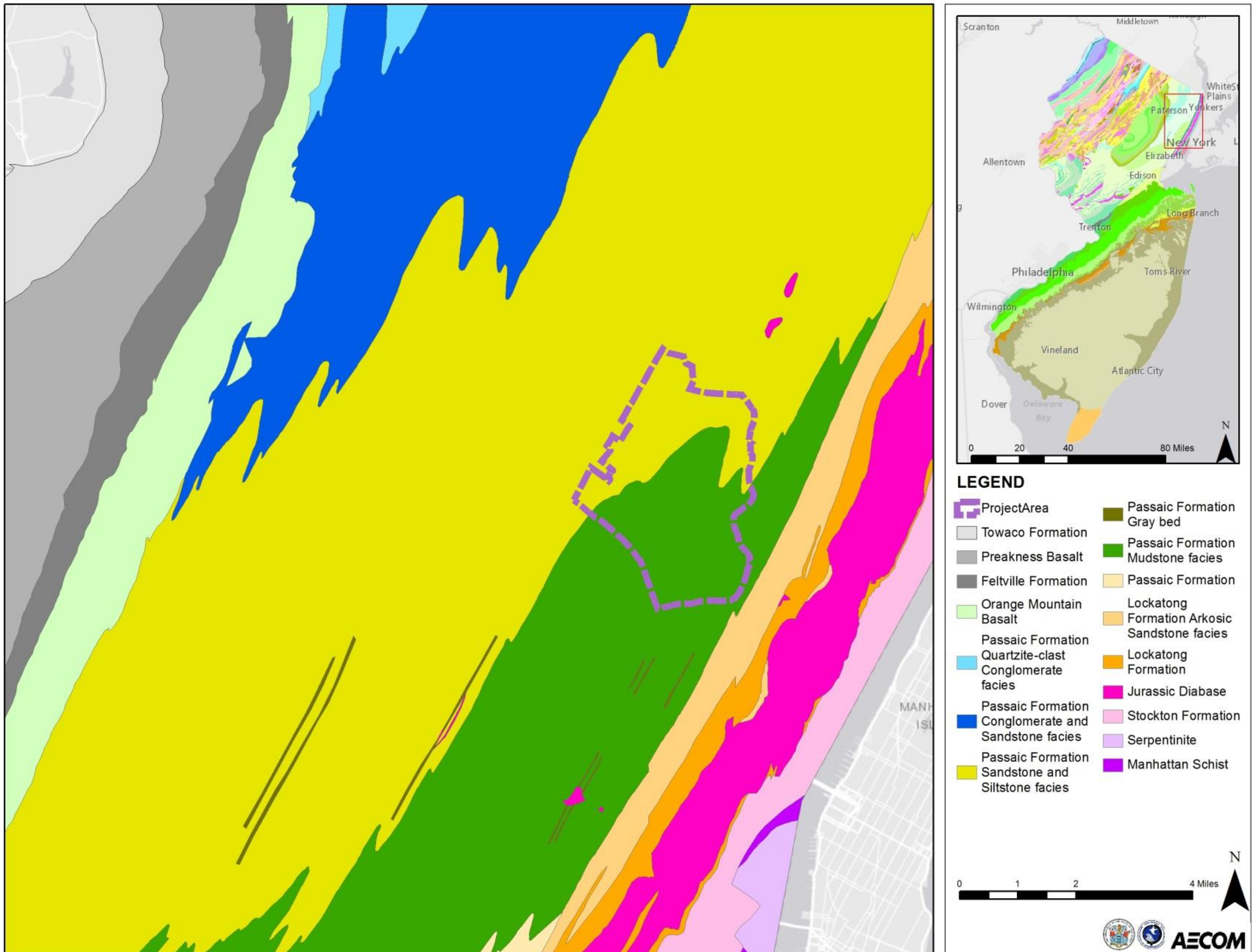

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Figure 3.15-1: Bedrock Geology within the Project Area and the Surrounding Region

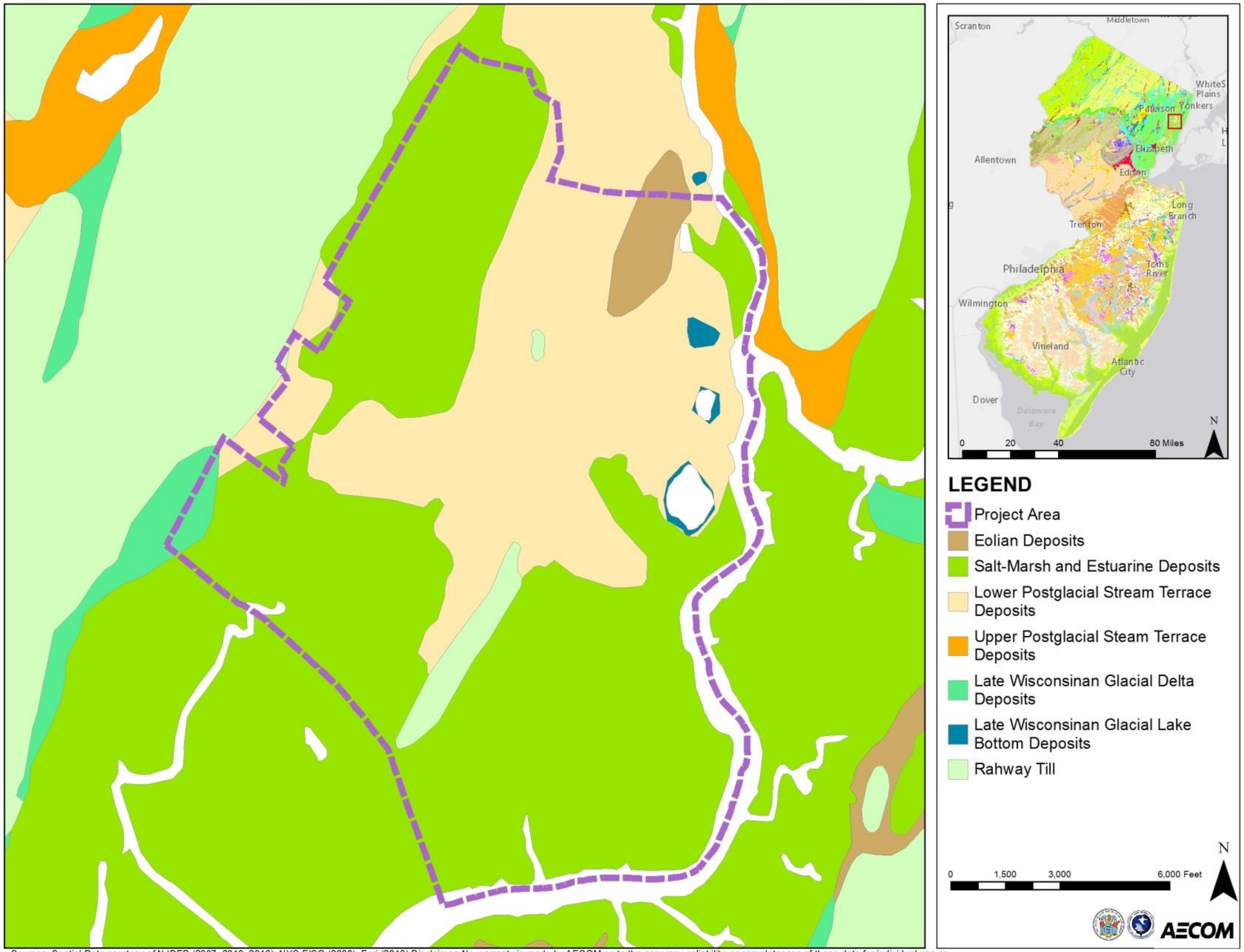

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Figure 3.15-2: Surficial Geology within the Project Area and the Surrounding Region

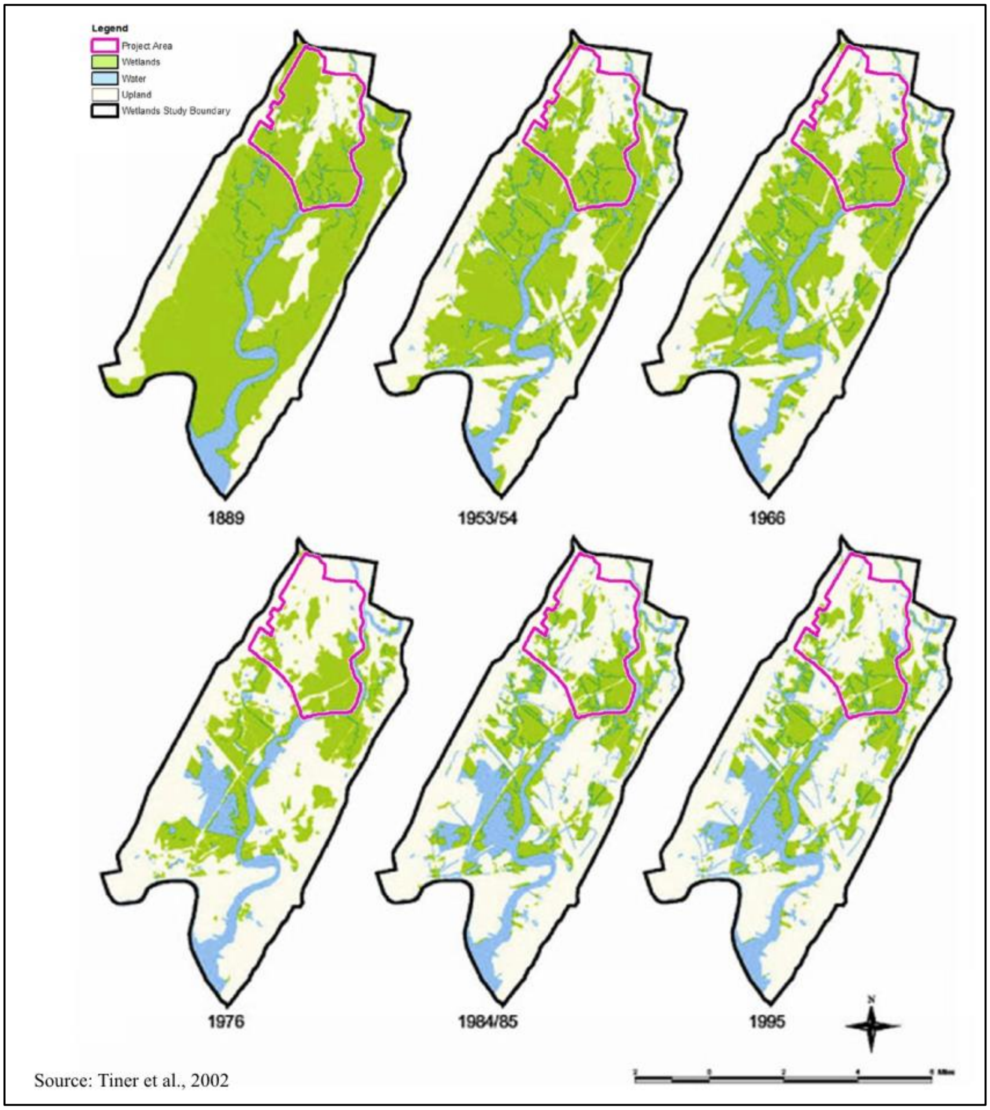
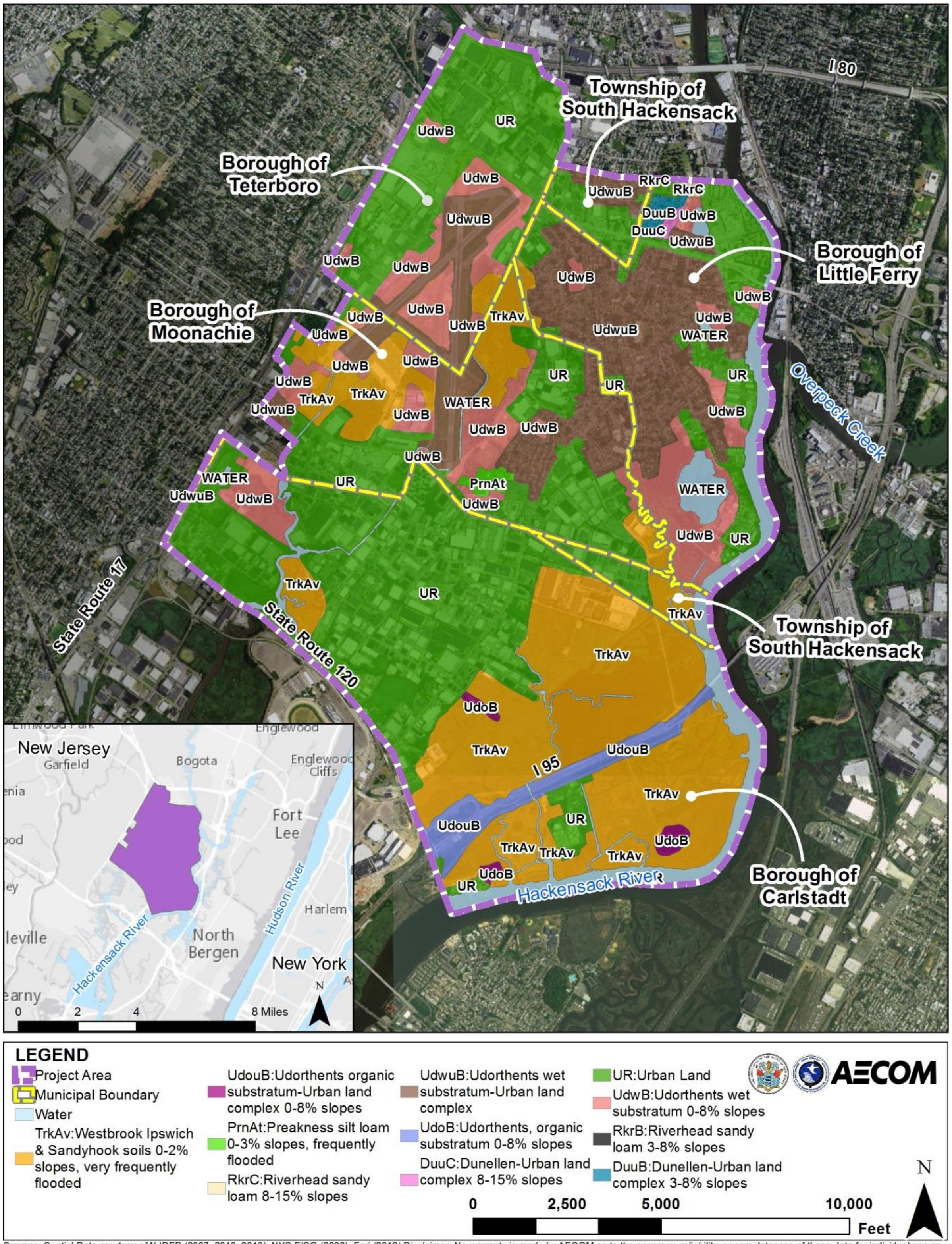


Figure 3.15-3: Sequence of Maps Illustrating the Extent of Wetlands and Uplands in the Project Area and Overall Meadowlands District from 1889-1995

3.15.3.4 Soils

Soil forms from an existing parent material at the land surface and its composition is related to various factors such as geology, topography, surrounding vegetation, and climate. In the Project Area, the Natural Resources Conservation Service (NRCS) Bergen County Soil Survey characterizes the soils in the Meadowlands District as Udorthents (UdoB, UdouB, UdwB and Ud); Urban Land (UR); Sulfaquents-Sulfihemists (TrkAv), also known as Tidal Marsh soils; and a small percentage of accessory soils (DuuB, Duuc, PrnAt, RkrB, and RkrC) (Goodman 1995, USDA NRCS 2008) (**Figure 3.15-4**). For a detailed description of soil types found in the Project Area, see **Appendix K**.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.15-4: Soil Types within the Project Area

3.15.3.5 Stratigraphy

The surficial strata in the Meadowlands District mainly consist of fill, marsh deposits, varved silt and clay, glacial till, and bedrock (**Figure 3.15-5** and **Figure 3.15-6**). These materials are found discontinuously throughout the region, in varying thicknesses and evenly mixed in some instances. The stratigraphy of the Meadowlands District (top to bottom) is described below.

Fill

Due to urbanization of the area in recent history, a layer of fill consisting of sand, gravel, wood, plastic, concrete, glass, brick, refuse, stones, boulders, and various miscellaneous materials was deposited for residential, commercial, and industrial development. This layer ranges from approximately 2.5 to 15 feet in thickness (NJSEA 2007).

Tidal Marsh

The tidal marsh deposits consist of peat and organic silt and clays. Peat is comprised of aquatic plant logs, roots, and stumps accumulated over time while organic silt and clay contain decomposed organic matter in a matrix of inorganic soil particles. The soil in this stratum is highly compressible and has very low plasticity, ranging from less than 3 to more than 15 feet in thickness (USACE 2002a). Plasticity is defined as the water-content boundary of a soil between the plastic and semi-solid states (ASTM 2011). A soil of low plasticity will exhibit a rough texture and dull smear, while a soil of high plasticity will exhibit a slick, waxy smear surface.

Silt and Fine Sand

Silt and fine sand compose a discontinuous thin layer of mineral material with a maximum thickness of 20 feet that underlies the tidal marsh deposits (Joseph S. Ward, Inc. 1962).

Varved Clay and Silt

The varved clay and silt stratum consists of thin, alternating layers of fine sand, clay, and silt ranging from 0 to 200 feet in thickness and underlies the tidal marsh deposits (USACE 1995, NJSEA 2007). The top layer of this stratum, ranging from 3 to 5 feet, is very stiff due to periods of extreme drying and stress following the natural draining of Lake Hackensack. The stratum gradually softens with increasing depth (USACE 2002a).

Glacial Till

Glacial till consists of clay, silt, sand, gravel, cobbles, and boulders. This layer is encountered in varying thickness ranging from less than 4 feet to more than 30 feet and generally underlies the varved clay and silt stratum (USACE 2002a, NJSEA 2007).

Bedrock

The shales, sandstones, and siltstones of the Passaic Formation underlie the glacial till. The surface layer of the bedrock is typically weathered and fractured. Bedrock is encountered at approximately 10 feet to more than 265 feet below grade and has a maximum thickness of 6,000 feet (USACE 1995). There are isolated areas in the Meadowlands District where sedimentary and igneous diabase bedrock outcrops are found at or above sea level (Widmer 1959). In the western portion of the Project Area, bedrock is encountered at depths ranging from approximately 100 feet to 263 feet below grade. The bedrock is predominantly sandstone along the western and northern boundaries of the Project Area and transitions to mudstone facies in the central and southeastern portions of the Project Area. In sharp contrast to the west, the depth to bedrock in the middle and central portions of the Project Area ranges from 10 feet to 96 feet below grade. The depth to bedrock is encountered at increasingly shallower depths traversing from west to east toward the Hackensack River. The bedrock in the middle and eastern portion is mostly mud rock with isolated pockets of sandstones, as illustrated in **Figure 3.15-6** (Widmer 1959).

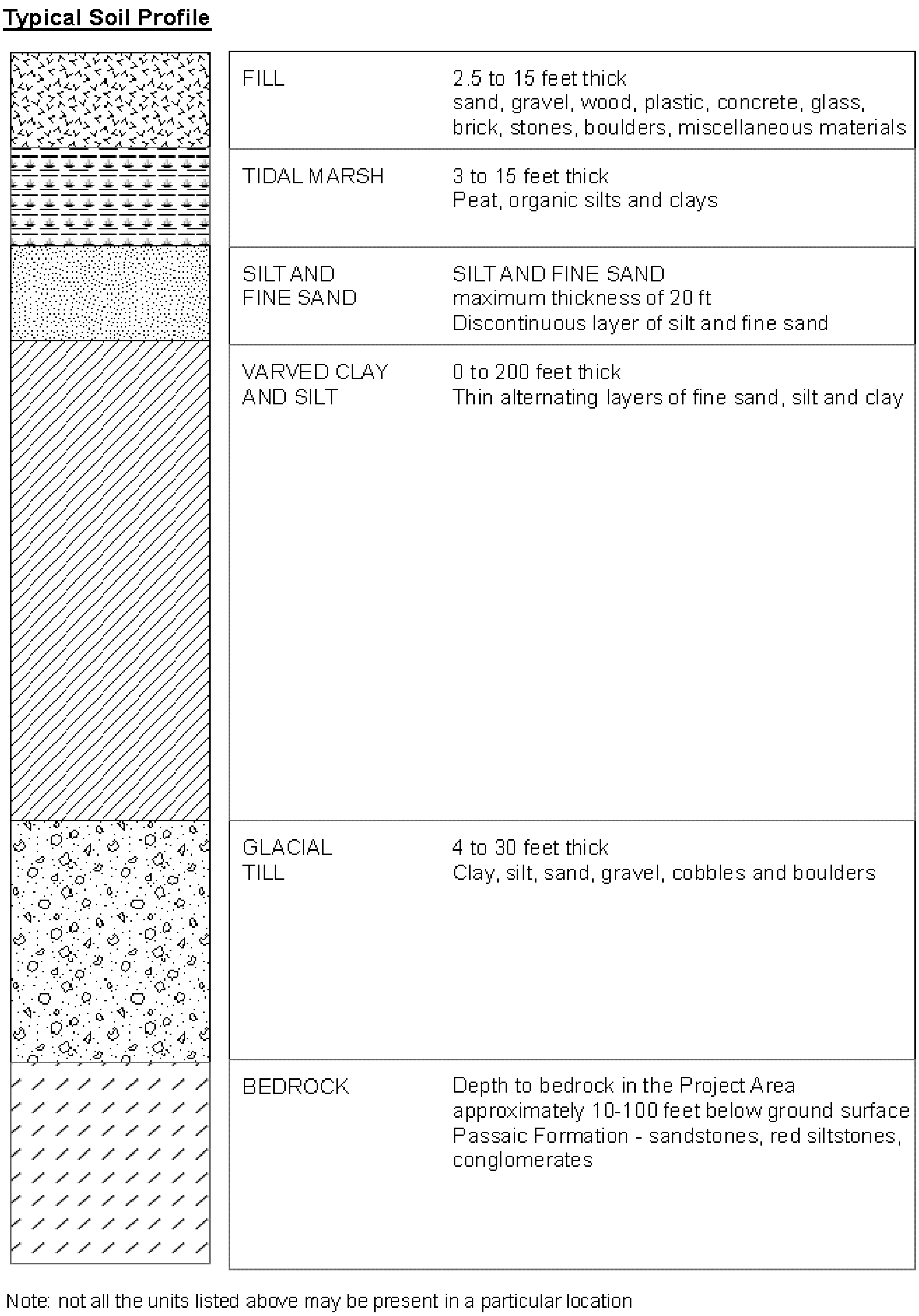
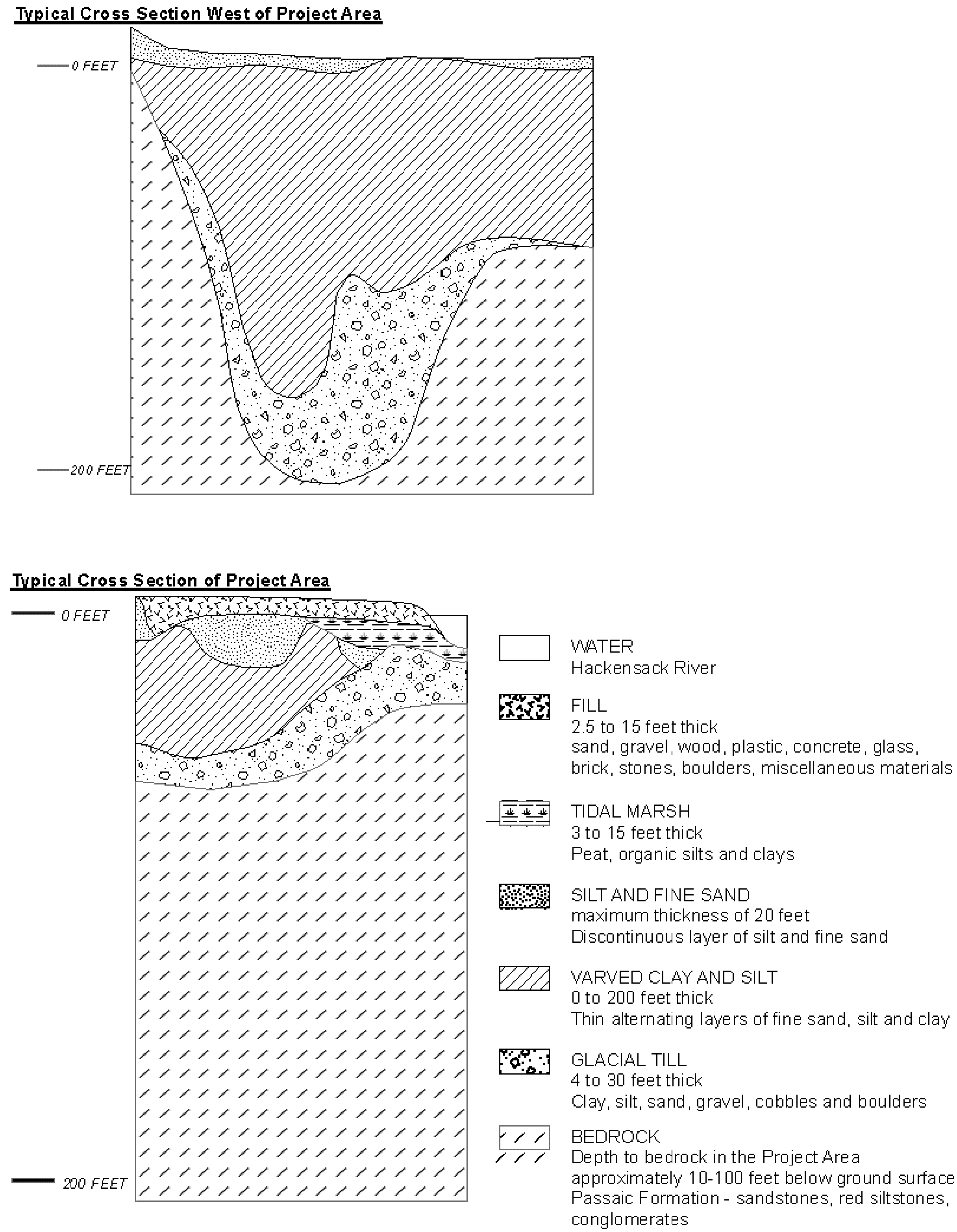


Figure 3.15-5: Typical Soil Profile in the Project Area



Source: Paleodrainage History of the Hudson Estuary, Lovegreen, 1974.

Figure 3.15-6: Stratigraphic Cross-section Illustrating Depth to Bedrock in the Project Area

3.16 Water Resources, Water Quality, and Waters of the United States

3.16.1 Introduction

This section describes the existing water resources, water quality, and WOUS within the Project Area. WOUS are regulated waters protected under the Federal Clean Water Act (CWA), and include all tidal waters, and waters which are currently used, historically used, or may have future use in interstate or foreign commerce. Wetlands are protected as a subset of WOUS under Section 404 of the CWA. In the Project Area, all tidal waterbodies and wetlands that are hydrologically connected to tidal waterbodies, as well as non-tidal waterbodies and wetlands within the NJ Meadowlands District, are regulated as WOUS. Water resources in the Project Area include portions of the Hackensack River and its tributaries, including Losen Slote, Moonachie Creek, Bashes Creek, Peach Island Creek, West Riser Ditch, East Riser Ditch, DePeyster Creek, and Berry's Creek; ponds; and several large wetland complexes (see **Figure 3.16-1**).

The Project Area is an urbanized watershed that was, and continues to be, impacted by ongoing residential, commercial, and industrial development. Much of this development has taken place in areas within the FEMA-designated 100-year floodplain and along tributaries to the Hackensack River, which has increased the amount of pollutants entering these water resources. This section presents the regulatory context and then discusses designated uses and existing conditions for the water resources within the Project Area, including wetlands, groundwater, and surface waters. Recent water and sediment quality data from the Project Area are summarized to serve as a baseline for assessing potential impacts of the Build Alternatives and No Action Alternative on water resources in **Section 4.17**.

3.16.2 Regulatory Context

The protection of water resources is identified in a number of Federal and State laws and regulations. A summary of the primary laws and regulations applicable to the Proposed Project are included in **Table 3.16-1**. More detailed information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

Table 3.16-1: Summary of Federal and State Laws and Regulations

Law/Regulation	Project Context
CWA of 1972 (33 USC § 1251 *et seq.*)	To restore and maintain the chemical, physical, and biological integrity of WOUS, including wetlands, projects must comply with any potential discharge to navigable waters under Sections 301, 302, 303, 306, 307, and 316 (b) of the CWA. This act also requires coordination with the USACE and NJDEP in accordance with Sections 404 and 401 of the CWA, respectively.
EO 11990 (*Protection of Wetlands*)	This order requires that Federal agencies must avoid undertaking This order requires that Federal agencies must avoid undertaking or providing assistance for new construction in wetlands unless there is no practical alternative to such construction and the Proposed Project includes all practicable measures to minimize harm to the wetland.

Law/Regulation	Project Context
Rivers and Harbors Act of 1899 (33 USC § 403)	Section 10 of this act requires authorization from the USACE or US Coast Guard (USCG) to ensure project activities do not adversely affect the navigability or other uses of navigable waters.
Freshwater Wetlands Protection Act (NJSA 13:9B-1 *et seq*.) and Freshwater Wetlands Protection Act Rules (NJAC 7:7A)	This act describes the activities that may or may not be conducted in and adjacent to wetlands and State open waters. However, per NJSA 13:9B-6, activities under the jurisdiction of the NJSEA (i.e., the Meadowlands District) do not require a freshwater wetlands permit and are not subject to transition area requirements.
Safe Drinking Water Act of 1974 (42 USC §§ 201, 300(f) *et seq*.)	This law protects the quality of drinking water in the US, whether from aboveground or underground sources, and establishes minimum standards to protect tap water and requires all owners or operators of public water systems to comply with these primary (health-related) standards. This law does not apply to this Proposed Project as drinking water within the Project Area does not use the local Newark Group aquifers and instead is supplied by reservoirs in northern New Jersey and Rockland County, New York. The Project Area is not located in a Sole Source Aquifer.
New Jersey Ground Water Quality Standards (NJAC 7:9C)	These standards provide classifications and threshold levels, which are used to assess groundwater quality within the Project Area.
New Jersey Surface Water Quality Standards (NJAC 7:9B)	These standards provide contaminant threshold levels, which are used to assess surface water quality within the Project Area.
New Jersey Water Pollution Control Act (NJSA 58:10A-1 *et seq*.) and the New Jersey Pollutant Discharge Elimination System Rules (NJAC 7:14A)	The New Jersey Pollutant Discharge Elimination System (NJPDES) Program is the primary component of the Water Pollution Control Act and assures the proper treatment and discharge of wastewater and stormwater from a variety of facilities and activities.
New Jersey Stormwater Management Rules (NJAC 7:8)	The State administers Stormwater Management Rules, such as the required components of regional and municipal stormwater management plans, and establishes stormwater management design and performance standards for any new (proposed) development.
Tidelands Act (NJSA 12:3)	The NJDEP's tidelands regulations apply to lands that are currently and formerly flowed by the mean high tide of a natural waterway. Projects must obtain permission from the State and pay a fee to conduct any work within tidelands.
Water Supply Allocation Permits Rules (NJAC 7:19)	These regulations apply to the diversion of water, the management of water quantity and quality, the issuance of permits, and water supply issues.

Law/Regulation	Project Context
Flood Hazard Control Act Rules (NJAC 7:13-11.2)	This section sets forth the design and construction standards for regulating proposed activities in a riparian zone.
Well Construction and Maintenance; Sealing of Abandoned Wells (NJAC 7:9D)	These rules govern the requirements and standards for the permitting, construction, and decommissioning of wells. This includes the construction of monitoring wells.
Meadowlands District Zoning Regulations (NJAC 19:4-1.1 *et. seq.*)	These regulations govern the land use development and zoning compliance of the Meadowlands District, consistent with the carrying capacity of the land and the preservation of critical wetland areas in accordance with the Master Plan of the NJSEA, while preserving the ecological balance between natural and open areas and development.

3.16.3 Existing Conditions

3.16.3.1 Surface Water

The surface water resources of the Meadowlands District are dominated by one of the largest tidal wetland complexes within the Hudson-Raritan Estuary, encompassing approximately 5,800 acres of estuarine wetlands (USFWS 2007). Major open waters and wetland types within the Project Area include: estuarine shallow and deep water; estuarine emergent wetlands (e.g., saline or salt marsh, brackish marsh); riverine waters; pond/lakes; freshwater emergent wetlands; and freshwater forested/shrub wetlands, as shown in the USFWS National Wetlands Inventory (NWI) map (**Figure 3.16-1**) and the NJDEP Wetlands map (**Figure 3.16-2**).

Major tributaries that flow to the Hackensack River from the Project Area include Losen Slote, Moonachie Creek, Bashes Creek, Peach Island Creek, West Riser Ditch, East Riser Ditch, DePeyster Creek, and Berry's Creek. Draining the central and west sides of the Project Area are the West Riser Ditch, East Riser Ditch, Peach Island Creek, and other tributaries that flow to Berry's Creek and Berry's Creek Canal, conveying drainage to the Hackensack River. These tributaries also convey waters to and from the adjacent wetland areas. **Figure 3.16-3** identifies the location of the major open water drainages and tributaries of the Hackensack River, as well as drainage control structures (tide gates, dams) within the Project Area. A number of the creeks and drainages in the Project Area have control structures and pump houses in place to control the tidal influences and associated flooding from the Hackensack River. **Table 3.16-2** summarizes the major waterbodies within the Project Area.

Table 3.16-2: Major Waterbodies in the Project Area

Waterbody	Length (miles)	Direction of Flow
Hackensack River – Ridgefield Park above Overpeck Creek to Mouth at Newark Bay [1]	14.6	South to Newark Bay
Berry's Creek – Junction of West Riser Ditch to Mouth at Hackensack River	5.0	Southeast to Hackensack River
East Riser Ditch - Head to Mouth at Berry's Creek	4.2	South to Berry's Creek
West Riser Ditch – Head to Mouth at Berry's Creek	3.0	South to Berry's Creek
Peach Island Creek – Head to Mouth at Berry's Creek	1.0	West to Berry's Creek
Moonachie Creek – Head to Mouth at Hackensack River	2.2	East to Hackensack River
Bashes Creek – Head to Mouth at Hackensack River	1.3	East to Hackensack River
DePeyster Creek – Head to Mouth at Hackensack River	0.6	East to Hackensack River
Losen Slote Creek – Head to Mouth at Hackensack River	2.3	Southeast to Hackensack River

[1] This includes the portion of the Hackensack River adjacent to the Project Area, from the northern point of the Project Area to the mouth at Newark Bay. The Hackensack River extends further north to the head at Sweet Swamp in West Haverstraw, New York.

The hydrology of the Project Area, as well as the entire Meadowlands District, is characterized by extensive man-made changes to tidally influenced drainages. This is due to the historic construction of dikes, tide gates, dams, berms, and roadways, and the subsequent failure of water control structures along the Hackensack River (Kiviat and MacDonald 2004). The Oradell Dam, constructed in 1922, along with water supply withdrawals from the Oradell Reservoir, curtail freshwater inputs into the lower Hackensack River, increasing tidal effects and facilitating the movement of saline waters further upriver. As many as 30 flood control structures, including tide gates and culverts, are located along the Hackensack River and its tributaries in the vicinity of the Project Area. **Figure 3.16-3** shows only the tidal control structures within the Project Area. Remnants of former or non-functioning tide gates are visible in several other tributaries (e.g., Mill Creek, Penhorn Creek) (USFWS 2007). A distinctive physical feature of tidal wetlands within the Meadowlands District is the lack of typical tidal creek drainage patterns due to man-made ditching and draining. Over time, landowners have filled and developed many ditched wetland areas, diminishing flood storage capacity and shoreline stabilization functions (Kiviat and MacDonald 2002).

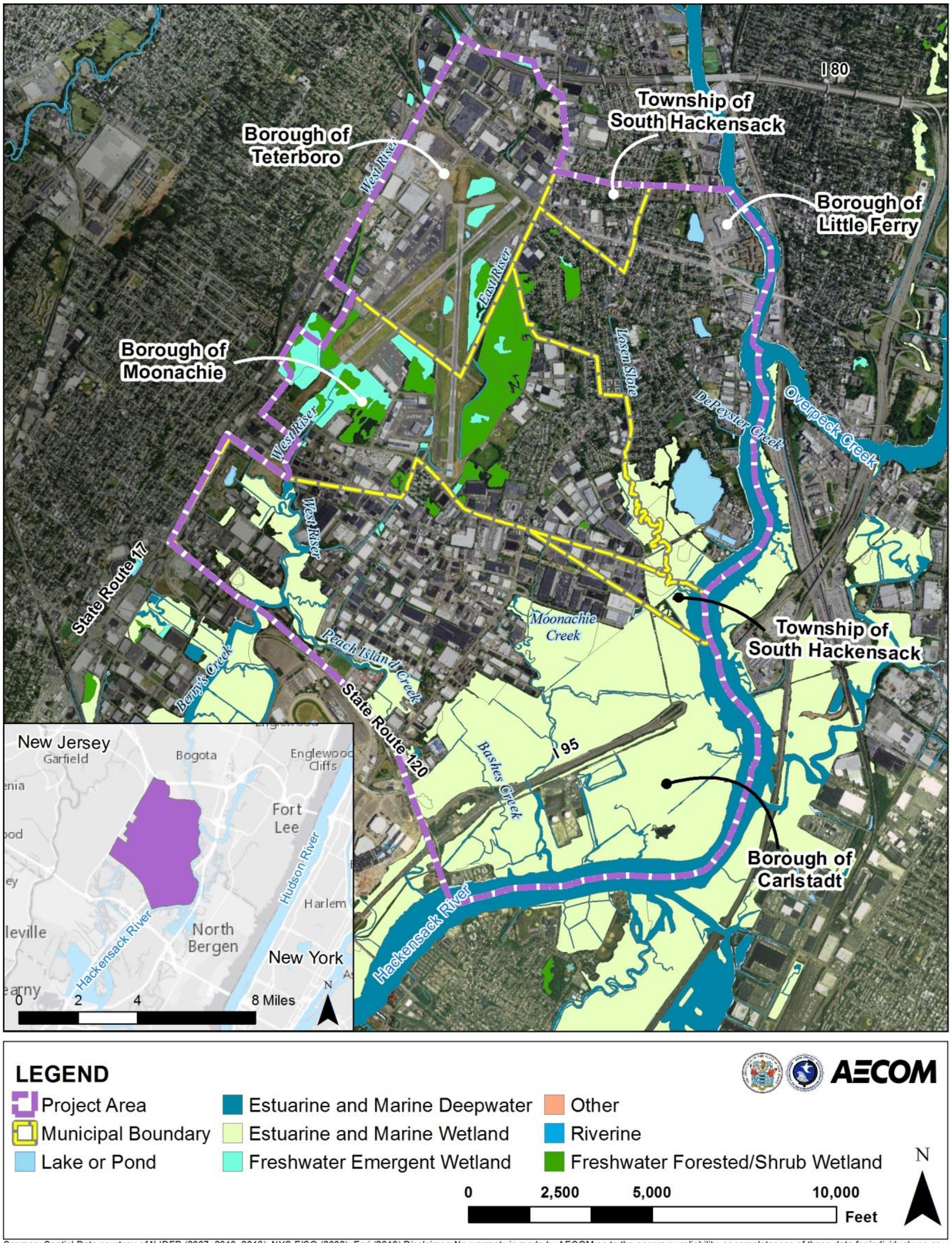


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Figure 3.16-1: USFWS NWI Map

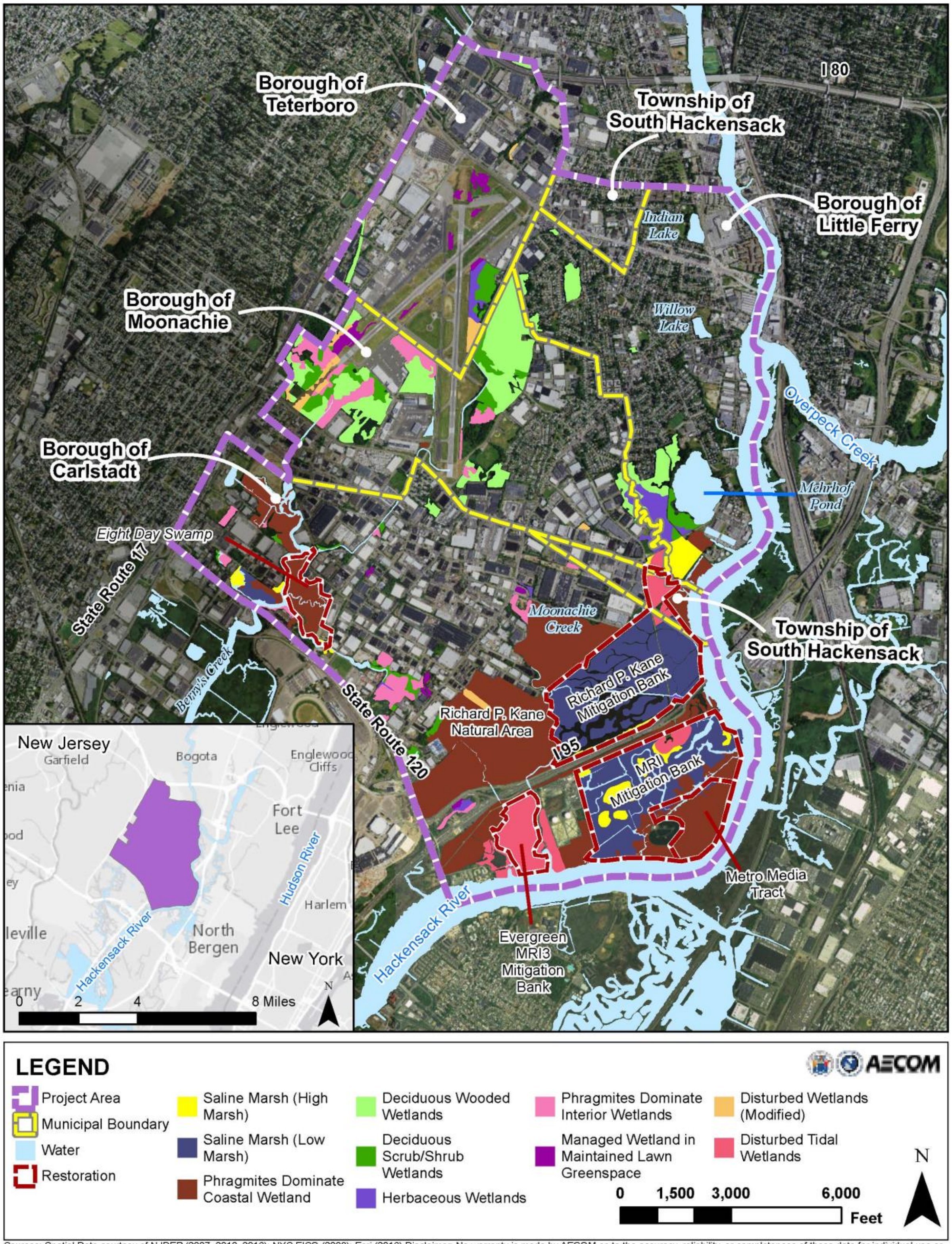

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Figure 3.16-2: NJDEP Wetlands and Open Waters

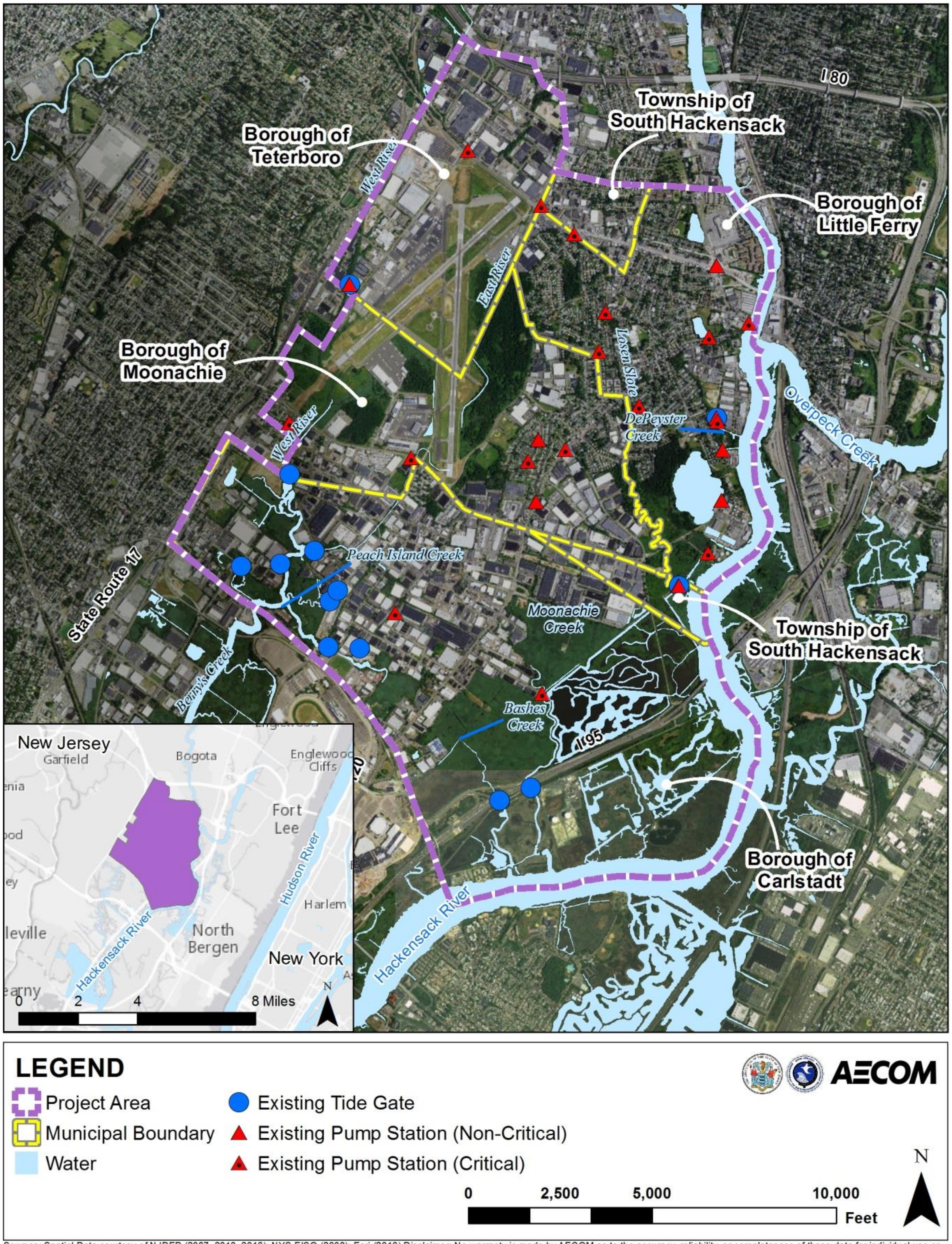

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Figure 3.16-3: Open Waters and Tidal Control Structures within the Project Area

NJDEP Water Quality Characterization

Within the surface waters of the Meadowlands District, there are several important hydrologic, sediment transport, and chemical characteristics that affect water quality that have been characterized by NJDEP. NJDEP Surface Water Quality Standards contain policies and surface water quality criteria (SWQC) to ensure that the designated uses of regulated waters are adequately protected. New Jersey's classification system categorizes surface waters based on the type of waterbody and the designated use of the waterbody. SWQC are numerical estimates of constituent concentrations that are protective of designated uses. Narrative criteria describe instream conditions to be attained, maintained, or avoided.

In New Jersey's surface water classification system, designations include: saline waters of an estuary and freshwater. Waterbodies are further classified based on designated uses.

- **SE1** waters are defined as saline estuarine waters with designated uses of shellfish harvesting in accordance with Shellfish Growing Water Classification, NJAC 7:12, maintenance, migration, and propagation of the natural and established biota; primary contact recreation; and any other reasonable uses (NJAC 7:9B-1.12(d)).
- **SE2** waters are saline estuarine waters with designated uses of maintenance, migration, and propagation of the natural and established biota; migration of diadromous fish (fish who live in both freshwater and salt water); maintenance of wildlife; secondary contact recreation; and any other reasonable uses (NJAC 7:9B-1.12(e)).
- **FW2** waters are subject to man-made discharges, and are further classified as either trout waters or non-trout (NT) waters.

The Hackensack River is classified as an SE2 waterbody from its mouth to its confluence with Overpeck Creek at the Borough of Little Ferry (see **Figure 3.16-3**). The Hackensack River is then classified as an SE1 waterbody from Overpeck Creek to the Oradell Dam. Tributaries within the Project Area, including Losen Slote, Moonachie Creek, Bashes Creek, Peach Island Creek, West Riser Ditch, East Riser Ditch, DePeyster Creek, and Berry's Creek are classified as FW2-NT or SE2 waters in tidally influenced areas. Designated uses are outlined in more detail in **Table 3.16-3**.

The NJDEP coordinates and conducts assessments of water quality for all waters of the State. NJDEP submits the New Jersey Integrated Water Quality Assessment Report (Integrated Report) biannually to the USEPA, which presents the water quality assessment results. These Integrated Reports contain listings of waters that do not attain their designated uses (i.e., impaired waterbodies), and describes progress toward attainment of the designated uses. Designated uses include aquatic life, recreation, drinking water, fish consumption, shellfish consumption, industrial use, and agricultural use. The 2016 Integrated Report is under development. The 2014 Integrated Report is the latest report available on the NJDEP website (State of New Jersey 2016a). Therefore, the following discussion relies on the most recently available 2014 Integrated Report.

Table 3.16-3: New Jersey Desginated Uses for SE1, SE2, and FW2 Waters

Classification	Waterbody	Designated Uses
SE1	Hackensack River – Overpeck Creek to Oradell Dam	1. Shellfish harvesting in accordance with NJAC 7:12. 2. Maintenance, migration, and propagation of the natural and established biota. 3. Primary contact recreation. 4. Any other reasonable uses.
SE2	Hackensack River – Mouth to Overpeck Creek; saline portions of Losen Slote , Bashes Creek, Moonachie Creek, DePeyster Creek, Peach Island Creek, Berry's Creek, and East and West Riser Ditches	1. Maintenance, migration, and propagation of the natural and established biota. 2. Migration of diadromous fish. 3. Maintenance of wildlife. 4. Secondary contact recreation. 5. Any other reasonable uses.
FW2	Freshwater portions of Losen Slote, Bashes Creek, Moonachie Creek, DePeyster Creek, Peach Island Creek, Berry's Creek, and East and West Riser Ditches	1. Maintenance, migration, and propagation of the natural and established biota. 2. Primary contact recreation. 3. Industrial and agricultural water supply. 4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation, and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection. 5. Any other reasonable uses.

The 2014 Integrated Report includes a water quality inventory, known as the 305(b) Report. This report assesses overall water quality and the ability to support designated uses of all principal waters, as well as strategies to maintain and improve water quality. The Integrated Report also includes a listing of water quality-limited waters. This list, known as the 303(d) List, identifies waters that do not support designated uses because they do not meet New Jersey Surface Water Quality Standards.

The Project Area's southwestern border runs along Paterson Plank Road (State Route 120), which separates Berry's Creek into two assessment areas: one north and one south of Paterson Plank Road. Berry's Creek north of Paterson Plank Road is located within the Project Area and includes Peach Island Creek and East and West Riser Ditches. Berry's Creek south of Paterson Plank Road (which extends to its confluence with the Hackensack River) is outside of the Project Area, but is included in this discussion because Berry's Creek assessment areas north and south of Paterson Plank Road are listed in the 305(b) Report for nonattainment of designated uses. The remaining open waterbodies (Losen Slote, Bashes Creek, Moonachie Creek, and DePeyster Creek) are not included in the 305(b) or 303(d) lists because they either fully support designated beneficial uses or have not been studied. The Project Area is located within NJDEP Watershed Management Area (WMA) 05, as referenced **Table 3.16-4** and **Table 3.16-5**, and shown in **Figure 3.16-4**.

Table 3.16-4 summarizes the attainment status for various beneficial uses of Berry's Creek. Assessment units, or sub-watersheds, that meet the applicable water quality standards are determined to be fully supporting their designated use, whereas assessment units that do not meet these standards may be designated as "not supporting." Additionally, the designation of "insufficient data" is made when there is inadequate information available to determine if the designated use is met. Attainment designations are based on the following assessments:

- **Aquatic Life:** NJDEP utilizes a suite of key parameters to assess aquatic life use. The key parameters include total phosphorus, dissolved oxygen, pH, and temperature. Common sources of variations in these parameters are point and non-point sources (such as sewage treatment plant discharges), loss of vegetative buffers to filter runoff, and land use practices such as the application of fertilizers.
- **Recreation**: Recreation use assessment is based on the presence of pathogenic bacteria indicators (*E. coli* and *Enterococcus*), which pose a human health risk.
- **Fish Consumption**: Fish consumption advisories are based on certain bioaccumulative toxic pollutants. Mercury, dioxin, chlordane, PCBs, and dichloro-diphenyl-trichloroethane (DDT) and its metabolites are the critical parameters for this assessment.

Figure 3.16-5 lists the sources of impairment from the 2014 Integrated Report for the Berry's Creek assessment areas.

Table 3.16-4: Designated Use Attainment – 2014 Draft Integrated List of Waters

WMA	Assessment Unit Number	Assessment Unit Name [1]	Aquatic Life	Recreation	Fish Consumption
05	02030103180060-01	Berry's Creek (north of Paterson Plank Road)	Not Supporting	Insufficient Data	Not Supporting
05	02030103180070-01	Berry's Creek (south of Paterson Plank Road)	Not Supporting	Fully Supporting	Not Supporting

[1] Losen Slote, Bashes Creek, Moonachie Creek, and DePeyster Creek not included in 2014 305(b) Report.
WMA = Watershed Management Area

Table 3.16-5: 303(d) List of Waters Sources of Impairment from 2014 Draft Integrated Report

WMA	Assessment Unit Number	Assessment Unit Name	Parameter
05	02030103180060-01	Berry's Creek (north of Paterson Plank Road)	Arsenic, Benzo(a)pyrene (PAHs), Cadmium, Chlordane in fish tissue, Copper, DDT and its metabolistes in fish tissue, Dieldrin, Dioxin (including 2,3,7,8-TCDD), Heptachlor epoxide, Lead, Mercury in fish tissue, PCBs in fish tissue
05	02030103180070-01	Berry's Creek (south of Paterson Plank Road)	Arsenic, Benzo(a)pyrene (PAHs), Cadmium, Chlordane in fish tissue, Chromium, Copper, DDT and its metabolites in fish tissue, Dieldrin, Dioxin (including 2,3,7,8-TCDD), Heptachlor epoxide, Lead, Mercury in fish tissue, PCB in fish tissue

DDT = dichloro-diphenyl-trichloroethane
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
TCDD = Tetrachlorodibenzo-p-dioxin
WMA = Watershed Management Area

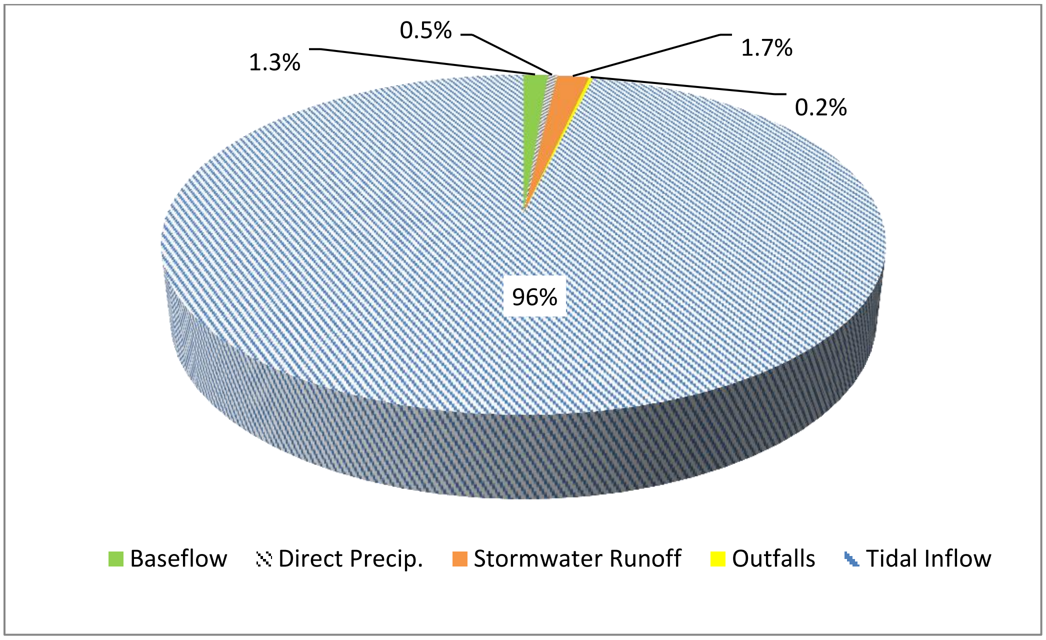
Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.16-4: NJDEP Watershed Management Area 05

Ecosystem Water Balance and Tidal Influences

The water balance of a hydrologic system is based on the principle that the sum of water inflows must equal the sum of outflows minus any change in storage that occurs. It is important to understand the water balance for the Project Area, and the Meadowlands District as a whole, because the Project could alter the water balance for the system. Any such change may, in turn, affect water and sediment quality within the Project Area.

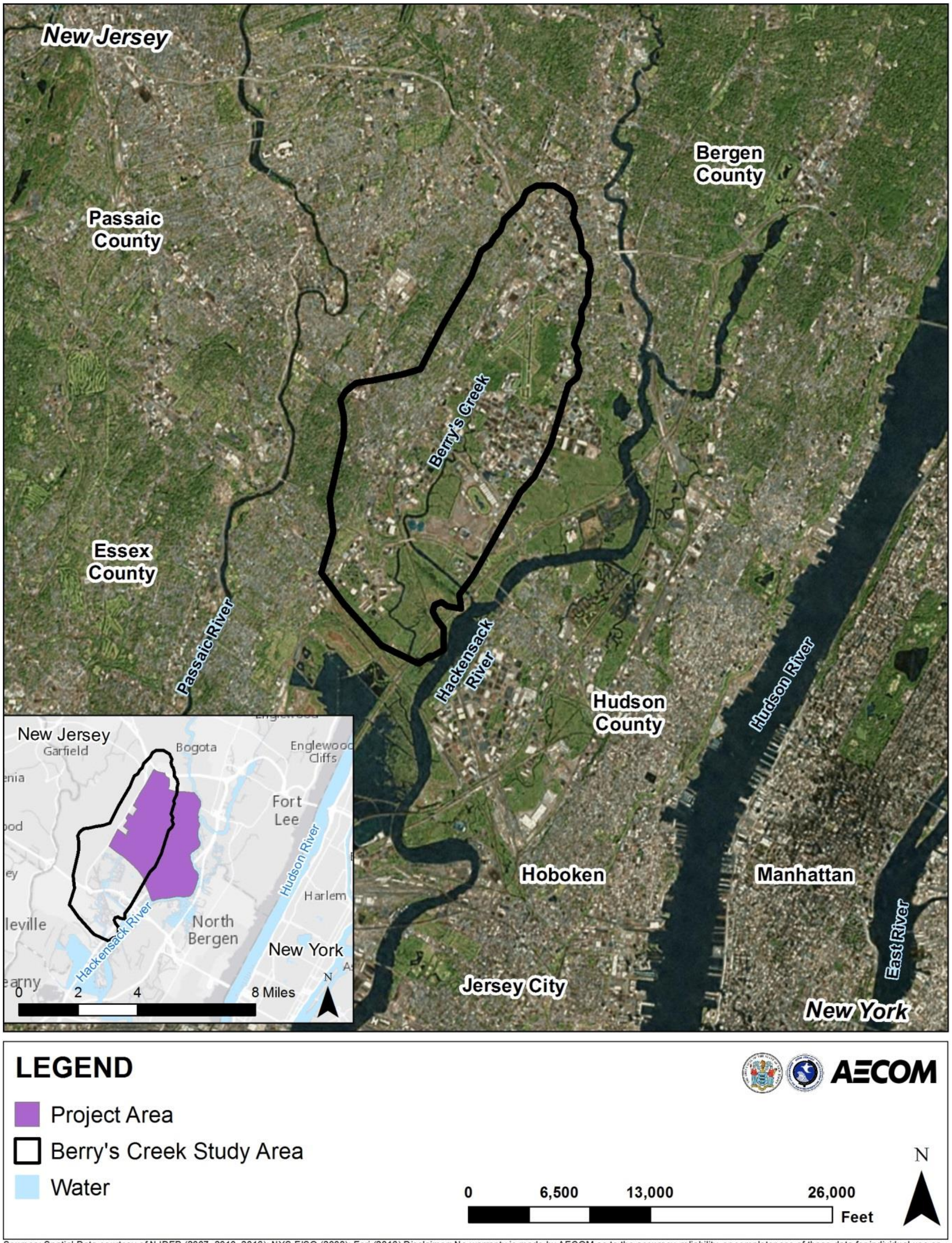
Portions of the Meadowlands District drainage ditches and streams located downstream of the tide gates and pump stations are dominated by tidal influences. Locations of tide gates and pump stations in each of the major tributaries of the Project Area are shown in **Figure 3.16-3**. A semi-diurnal high tide inundates much of the wetlands in the Project Area twice per day, with the volume of tidal water moving in and out of the wetlands exceeding inflows from freshwater sources, including the Hackensack River, by about an order of magnitude or more. According to the Draft Remedial Investigation Report prepared for the Berry’s Creek Study Area (BCSA), the water balance for the BCSA between May 2009 and October 2011, shown in **Figure 3.16-5**, estimates that the tidal water flux, or movement of water into or out of the system, accounts for 96 percent of the total water flux for the system. The remainder of flow in the system consists of base-flow runoff, direct precipitation, stormwater runoff, and outfall releases (Berry's Creek Study Area Cooperating PRP Group 2016).[30] The BCSA, as defined by the sub-watershed (Hydrologic Unit Code 14: 02030103180060), is shown on **Figure 3.16-6**. However, it should be noted that the Remedial Investigation is restricted to just the waterways and marsh areas above Paterson Plank Road. These are more clearly shown within the boundaries of the BCSA in **Figure 3.20-1**.



Source: Draft Remedial Investigation Report (Berry's Creek Study Area Cooperating PRP Group 2016)

Figure 3.16-5: Berry’s Creek Water Balance

[30] The Berry’s Creek Study Area Cooperating Potentially Responsible Party Group entered into an Administrative Order on Consent in 2008 within the USEPA Region 2 to perform a remedial investigation and feasibility study pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.16-6: Berry's Creek Study Area

The NJSEA provides real-time tide monitoring at locations along four waterways within the Project Area: East Riser Ditch; Moonachie Creek; West Riser Ditch; and Losen Slote. Tidal characteristics of the Hackensack River within the Project Area are also available from NOAA. Measured elevations at the Battery and at Bergen Point in Newark Bay form the basis of the tidal characteristics.

Ecosystem Solids Balance

Common reed dominates the wetlands in the Project Area. Common reed is a tall and rapidly growing plant that provides a dense cover and adds to the physical stability of the ecosystem. This dense vegetative growth traps much of the particulate material that enters the marshes during rising tide and its root system holds the deposited sediment in place as water moves in and out of the marshes over the tidal cycle, and during periods of extreme high-water events. Common reed also serves as a major source of particulate organic material to the system over its annual lifecycle. Plant growth during the warmer months returns to the sediment as biomass when the plant dies or goes dormant at the end of the growing season. The result is a net annual contribution to the “solids balance” of the wetlands. This source of sediment accumulation, in combination with the trapping of particulates from other sources that enter the ecosystem (e.g., via the Hackensack River), leads to a long-term accumulation of solids in the wetlands. The marshes of the Project Area appear to be stable depositional areas (Berry's Creek Study Area Cooperating PRP Group 2016).

Water and Sediment Quality of the Project Area

The Project Area includes several tributaries that flow either directly or indirectly to the Hackensack River and then to Newark Bay. Several of these tributaries have one or more tide gates installed for flood control (**Figure 3.16-3**). Many of the creeks in the Project Area contain contaminated sediments. For example, sediments in Peach Island Creek and Berry’s Creek, both within a USEPA-designated Superfund Site, contain elevated levels of mercury, PCBs, metals, and other constituents that exceed New Jersey Ecological Screening Criteria in both freshwater and saltwater reaches. Mercury and PCBs have been identified as primary chemicals of potential concern (COPC) in the context of the Berry’s Creek Remedial Investigation and are, therefore, of particular interest. A review of data for West and East Riser Ditches, downstream of their respective tide gates, indicates that these remedial investigation results are in general agreement with nearby data from the BCSA.

Within the Project Area, recent sediment data are available for the Berry’s Creek COPCs for two other tributaries (DePeyster Creek and Losen Slote) that flow directly to the Hackensack River. In the case of DePeyster Creek, sediment concentrations of total mercury and total PCBs are similar to the average concentrations found within Peach Island Creek and Berry’s Creek. Average sediment concentrations in Losen Slote are somewhat higher than in DePeyster Creek, but still at the low end of the range for the Berry’s Creek sub-reaches (Berry's Creek Study Area Cooperating PRP Group 2016). No water or sediment quality data are known to exist for the other two tributaries in the Project Area, Moonachie and Bashes Creeks. Maintenance dredging of Losen Slote was conducted in the summer of 2016 by the Borough of Little Ferry and the Bergen County Mosquito Control Commission, and water and sediment quality data will be available soon.

Other COPCs in the above-referenced study, but considered to be of secondary importance because of their limited contribution to human and ecological health risk, include chromium, copper, lead, and nickel. While these metals frequently exceed New Jersey SWQC, a refined bioavailability-based methodology (i.e., a methodology that considers whether these metals can be absorbed by an organism) has been used to analyze their toxicity (USEPA 2005). The analysis indicated that these metals are not expected to cause toxicity.

Many other organic chemicals have been measured in sediments in the Project Area, including polycyclic aromatic hydrocarbons (PAHs), PCBs, dioxins/furans, semi volatile organic compounds (SVOCs) and VOCs. Several of these chemicals exceed New Jersey sediment severe effects levels for freshwater or New Jersey sediment effects range medium levels for marine sediments and, as a result, they are a potential cause for concern. More information on contamination in the Project Area is provided in **Section 3.20**.

3.16.3.2 Groundwater

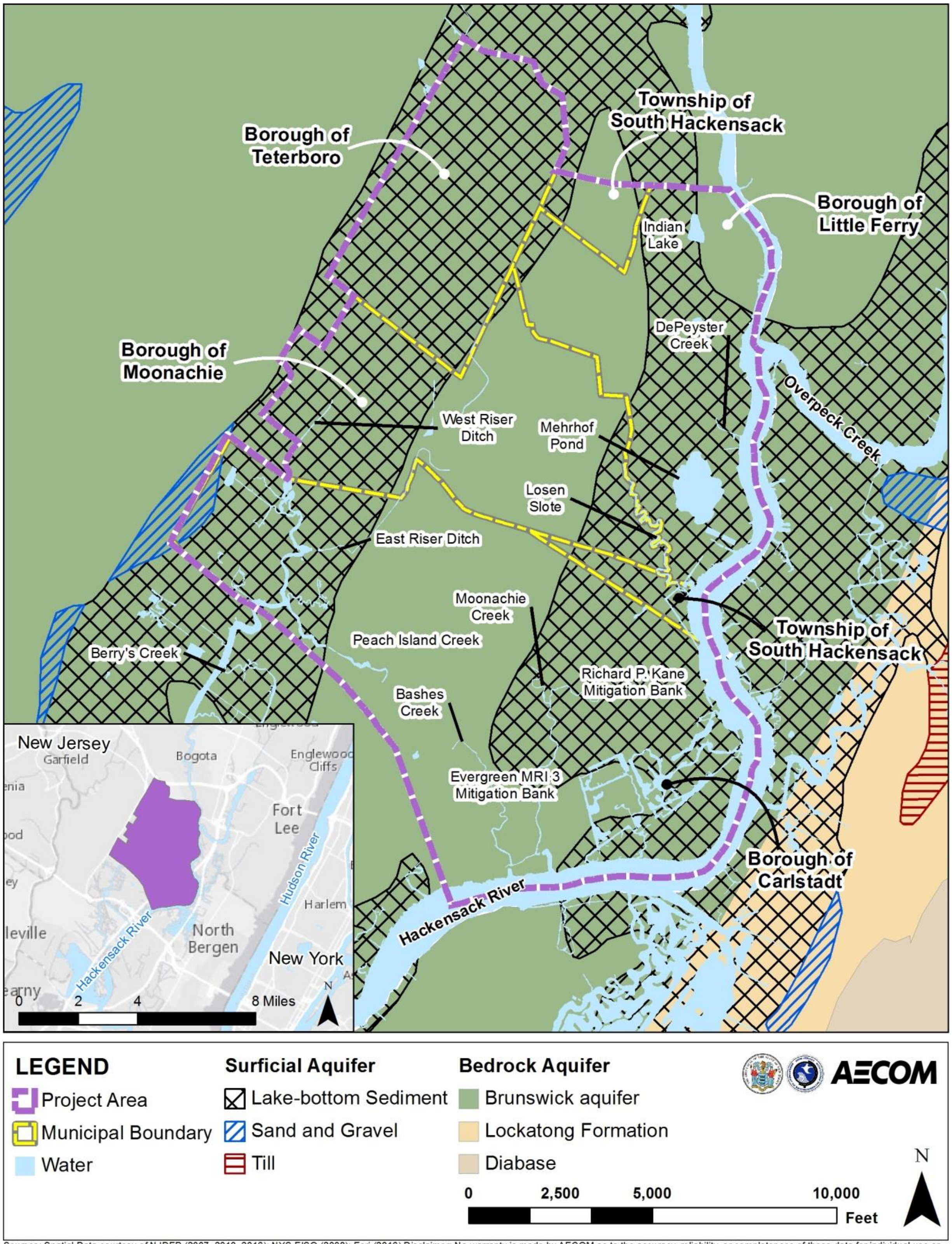
Groundwater occurs in the unconsolidated surficial glacial soils and bedrock. Groundwater starts as precipitation that falls on the ground surface and infiltrates into the small voids between grains of sand, silt, and clay in the glacial deposits. Ultimately the precipitation fills up the void spaces to create groundwater. Groundwater is present in bedrock aquifers and surficial aquifers. Surficial groundwater moves downhill, from higher water elevations to lower water elevations as groundwater infiltrates at higher elevations, migrates through the aquifer, and ultimately discharges to surface water. Groundwater in bedrock aquifers migrates through a series of fractures, weathered segments, fault lines, and geologic beds.

As discussed in **Section 3.15**, the Meadowlands District is located within the Piedmont Province, which is a subdivision of the greater Newark Basin. A bedrock aquifer within the Brunswick (Passaic) Formation of the Newark Group underlies the Project Area (NJDEP 1998). Groundwater in the Brunswick Aquifer occurs in a series of joints and fractures in the sandstone, siltstone and shale bedrock (Carswell 1976, NJDEP 1998). Surficial aquifers consisting of glacial lake bottom sediments are present in the western and eastern portions of the Project Area. A portion of a surficial aquifer consisting of sand and gravel underlies the westernmost portion of the Project Area (see **Figure 3.16-7**).

Groundwater Quality Standards

The NJDEP Ground Water Quality Standards (NJAC 7:9C) contain technical and general policies, including classification and anti-degradation policies, as well as groundwater quality criteria to ensure that the designated uses and classes of groundwater are maintained, restored, and enhanced. There are three established major classes of groundwater in New Jersey:

- **Class I Ground Water of Special Ecological Significance:** Maintenance of special ecological resources is the primary designated use for Class I groundwater. It includes groundwater within a watershed of freshwater 1 (FW1) surface waters, State-owned natural areas, and major aquifers of the Pinelands Area.
- **Class II Ground Water for Potable Water Supply:** Class II includes all areas not designated as Class I or Class III. It is the primary designation used for potable groundwater treated conventionally at current water quality (Class II-A) or after enhancement or restoration of regional water quality (Class II-B).
- **Class III Ground Water with Uses Other Than Water Supply:** Class III includes groundwater not suitable for potable supplies due to natural hydrogeologic characteristics or natural water quality.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.16-7: Aquifer's in Project Area

The Project Area contains Class II groundwater. Several institutional controls, or administrative and legal controls, are in place as directed by NJDEP in geographically defined areas to prevent the use of contaminated groundwater areas as potable water sources where the Class II Ground Water Quality Standards are not met.

Institutional controls include Currently Known Extents (CKEs) of groundwater contamination, which are areas known to be compromised due to local water quality exceedances of established standards for specific contaminants as per NJAC 7:1J (Processing of Damage Claims Pursuant to the Spill Compensation and Control Act). Based on a search using NJDEP's GeoWeb application, no CKE sites are located within the Project Area.

In addition to CKEs, Classification Exception Areas (CEAs) are institutional controls established in accordance with NJAC 7:9C-1.6 and 1.9(b); details of CEAs in the Project Area are provided in **Section 3.20**. CEAs are areas where designated aquifer uses have been suspended for a specified period of time due to the waterbody's inability to meet pollutant standards in a localized area, or the presence of historic fill material that has been contaminated prior to placement. Drinking water within the Project Area is not affected by the presence of CEAs; however, the presence of CEAs within the Project Area is an indicator that localized waterbodies may have been impaired by groundwater discharge to surface water.

Additional information on contaminants of concern for the Project Area can be found in **Section 3.20**, Hazards and Hazardous Materials.

Drinking Water Sources

Municipalities within the Project Area do not use the Newark Group aquifers (i.e., groundwater) as a potable water source. Potable water in the Project Area is primarily provided from storage in the Oradell and Woodcliff Lake reservoirs in Bergen County, New Jersey; Lake Tappan Reservoir in Bergen County, New Jersey and Rockland County, New York; and Lake DeForest Reservoir in Rockland County, New York. When needed, municipalities supplement these sources with occasional draw from the Wanaque and Monksville reservoirs in Passaic County, New Jersey and the Boonton Reservoir in Morris County, New Jersey (SUEZ 2016d). The Haworth Water Treatment Plant, operated by SUEZ North America (SUEZ), provides water supply treatment for these sources. SUEZ also supplements its supply for this plant with water from 60 potable wells throughout Rockland County, New York (SUEZ 2016a).

The Passaic River, in Totowa, New Jersey within Passaic County, also supplements the local water supply. The Alan C. Levine Little Falls Water Treatment Plant, operated by the Passaic Valley Water Commission, provides water treatment for this supply source. SUEZ supplements its supply in the area with groundwater from potable wells in addition to the 60 potable wells discussed above, including 58 wells throughout Bergen County. These 58 wells are all located outside of the Project Area and include wells owned by the Ridgewood Water Department and 18 additional wells located in Park Ridge and Woodcliff Lake in Bergen County (SUEZ 2015).

3.16.3.3 Wetlands

Meadowlands Wetlands Evolution

When European settlers first arrived on the Hackensack River and in the Meadowlands District area, they encountered a predominantly freshwater tidal river system with forested swamps and bogs, including extensive stands (approximately 6,000 to 10,000 acres) of Atlantic white cedar forest, and freshwater and brackish marshes in its lower reaches (USFWS 2007).

By the early 1700s, landholders were draining and filling wetlands in the Meadowlands District area to create farmland and to control mosquito populations. Large portions of the Meadowlands District have been filled for industrial, commercial, residential uses, and the creation of landfills (Kiviat and MacDonald 2004). Railroad construction across portions of the Meadowlands District starting in the 1830s introduced extensive ditching, diking, and filling of wetlands, resulting in the fragmentation of tidal drainage basins. Major roadways were constructed across the Meadowlands District at an increasing rate throughout the 1900s. Following implementation of the New Jersey General Health Act in 1904, extensive marsh-ditching and draining activities began. By 1924, the Bergen County Mosquito Commission is reported to have created approximately 1,000,000 feet of drainage ditches through salt marshes and over 500,000 LF of upland ditches. By 1945, the vast majority of salt marshes along the Hackensack River had been ditched and diked (USFWS 2007).

Direct wetland loss from draining, filling, diking, shoreline hardening, and development has historically been the greatest threat to wetland resources of the Meadowlands District. Tiner et al. (2005) estimated the overall rate of wetland loss between 1890 and 1950 at approximately 100 acres per year. Most of the losses during that 60-year period were due to filling activities; however, nearly 1,400 acres of wetlands were converted to open water habitats when a series of dikes near Sawmill Creek were damaged and/or breached during a severe storm event in 1950. Wetland loss rates in the Meadowlands District doubled from the mid-1950s to the mid-1960s, and continued to increase during the 1960s. However, wetland loss rates declined during the years following implementation of the Federal CWA, which regulates development projects in wetlands and other waters. From the mid-1980s through the mid-1990s, the rate of wetland losses declined substantially. Wetland losses in the Meadowlands District since the mid-1990s have been primarily due to direct loss or encroachment of small parcels (USFWS 2007). Today, wetlands throughout the Meadowlands District and specifically within the Project Area experience degradation/loss as a result of habitat fragmentation associated with transportation infrastructure (road, rail, and aviation), eutrophication (excess nutrient loading), and the effects of invasive species. Several sewage treatment plants located along the Hackensack River cumulatively discharge approximately 100 million gallons of treated wastewater each day and, historically, nitrogen loadings have been estimated to occur at a rate of approximately 13 tons per day (NJSEA 1975, USFWS 2006).

Invasive plants are an important concern in the Meadowlands District, where common reed (an invasive plant species) dominates thousands of acres (Kiviat and MacDonald 2004). Invasive plants are often effective colonizers in disturbed habitats, out-competing native vegetation under stressed conditions. Within the Project Area, residential and industrial development and transportation infrastructure increase habitat fragmentation, loss, and stress, thereby worsening this threat. While common reed is native to New Jersey, it became much more abundant in the Meadowlands District during the 1900s due to the proliferation of a more aggressive European genotype in North America (Saltonstall 2002). Human activity has accelerated the spread of this new common reed genotype by increasing the abundance of disturbed wetland soils and lowering salinity (Bart and Hartman 2002, 2003).

Another factor affecting wetlands in the Project Area is global climate change and sea level change, through the direct loss of land and habitat from inundation and migration of coastal landforms inland (retreat). However, in urbanized areas, landform migration is severely restricted because of intense shoreline development and re-alignment (Titus, et al. 2009). See **Section 3.10**, Global Climate Change and Sea Level Change, for further details on how rising sea levels and other climate factors are affecting wetlands.

Wetland Characterization and Distribution

A variety of open water and wetland types occur within the Project Area and throughout the Meadowlands District (NJSEA 1975, 1980, 1984, 1987). The NJSEA completed several efforts to map wetlands and define plant community zones throughout the Meadowlands District. In a series of assessments repeated at 5-year intervals from 1975 to 1984, the NJSEA evaluated and classified wetland resources into “bio-zones” and monitored changes in wetland plant communities over time (HDMC 1975, 1980, 1984). In the early 2000s, researchers utilized remote sensing, the analysis of color-infrared aerial photography, to classify and map the extent of various wetland types as part of the NWI program (Tiner et al. 2005).

Wetlands types in the Project Area are illustrated in the USFWS NWI Map (**Figure 3.16-1**) and the NJDEP Wetlands and Open Waters map (**Figure 3.16-2**). Estuarine emergent wetlands comprise the majority of the estuarine wetlands of the Project Area, occupying approximately 840.4 acres. These wetlands are now the most common and widely distributed wetland type within the Meadowlands District (Tiner et al. 2005) due to the gradual reduction in freshwater flow of the Hackensack River since the construction of the Oradell and other dams. Conversely, palustrine (freshwater) wetlands, now restricted almost entirely to the upper Berry’s Creek sub-basin, occupy 367.4 acres within the Meadowlands District. **Table 3.16-6** provides a summary of the wetlands by type in the Project Area. Total wetland acreages within the overall Project Area were calculated from NJDEP wetlands mapping data (NJDEP 2015).

Table 3.16-6: NJDEP Wetlands Acreage in the Project Area

NWI Classification	NJDEP Classification	Total Acres in Project Area
Estuarine Intertidal Emergent	Saline Marsh (High Marsh)	46.7
	Saline Marsh (Low Marsh)	288.3
	Phragmites Dominate Coastal Wetlands	505.4
Freshwater Forested	Deciduous Wooded Wetlands	193.0
Freshwater Scrub/Shrub	Deciduous Scrub/Shrub Wetlands	65.6
Freshwater Emergent	Herbaceous Wetlands	35.6
	Phragmites Dominate Interior Wetlands	73.2
Modified	Managed Wetlands in Maintained Lawn Greenspace	20.4
	Disturbed Wetlands (Modified)	17.6
	Disturbed Tidal Wetlands	92.7
Estuarine Deepwater	Open Water	484.8
Riverine		
Lake		
Totals		**1823.3**

(NJDEP 2015)

As described in **Section 3.14.3.2** and **Appendix L**, the functions and values of wetlands and watercourses were evaluated using the EPW method (Bartoldus, et al. 1994) and the SVAP (NRCS 1988). Based on the EPW, wetlands in the Project Area are generally highly functional for shoreline bank erosion control, sediment stabilization, and improving water quality, and have low value for fish and wildlife habitat.

While this is also true for common reed marsh communities, they scored lower for each wetland function and value than other wetland habitat communities. Based on stream evaluations using SVAP, all but one of the watercourses (the lower reach of Losen Slote) received a poor rating. Further discussion of the EPW and SVAP techniques, preliminary results, and detailed scoring information are provided in **Appenidx L**.

Existing open water and wetland types within the Project Area are described below. These descriptions follow the overall NWI Mapping classification system.

Estuarine Intertidal Emergent Wetlands (Saline Marshes and Coastal Wetlands)

High salt marshes flood during monthly spring high tides and during storm and wind-driven tides. High salt marsh dominated by native vegetation is rare in the Meadowlands District. Historically, farmers converted much of this habitat type to agricultural land. In the past 100 years, invasive common reed has also colonized native high salt marsh habitat and displaced native species. However, approximately 10 acres of native high salt marsh are present in Berry's Creek Marsh and within the MRI Mitigation Bank located within the Project Area.

Brackish marshes with variable salinity (e.g., mesohaline and oligohaline) exist in the middle reach of the Hackensack River, which includes the reach of Hackensack River along the Project Area. These marshes range from freshwater in the spring saline or nearly saline in the late summer/early fall. Historically, dikes and levees isolated many of these areas from tidal flow and sediment supply, resulting in land subsidence. This facilitated aggressive colonization by common reed, which typically dominates the vegetative community of these areas. There are substantial parcels of brackish marsh surrounding lower Berry's Creek. In addition, three wetland mitigation banks within the Project Area, constructed in the Borough of Carlstadt, represent approximately 300 acres of restored brackish low salt marsh within the Project Area (see **Figure 3.16-2**). These three wetland mitigation banks are the Evergreen MRI3 Wetland Mitigation Bank, MRI Mitigation Bank and the Richard P. Kane Wetland Mitigation Bank.

Freshwater Forested Wetlands (Deciduous Wooded Wetlands)

Forested areas, including swamps, occur along the headwaters of rivers and streams in the Meadowlands District. Within the Project Area, approximately 40 acres of forested freshwater wetlands are present around Teterboro Airport. Tall woody vegetation greater than 20 feet in height characterizes these communities. A small fringe of freshwater forested wetlands is also present on the perimeter of the Mehrhof Pond in the Borough of Little Ferry. Historically, coniferous swamps dominated by Atlantic white cedar were prevalent in the Meadowlands District, but these forests were eliminated during settlement of the area.

Freshwater Scrub/Shrub Wetlands (Deciduous Shrub/Scrub Wetlands)

This wetland type is similar to the Freshwater Forested Wetlands described above. However, it is dominated by smaller woody vegetation less than 20 feet in height, and within the project area is generally located in the proximity of Teterboro Airport.

Freshwater Emergent Wetlands (Herbaceous Wetlands and Interior Wetlands)

Freshwater or palustrine (non-tidal) wetlands within the Project Area are isolated and are primarily located in the Borough of Carlstadt. One of these remaining wetlands remnants is less than 7 acres in size, dominated by non-persistent vegetation, and adjoins a coastal plain lowland forest at Losen Slote Creek Park. Another freshwater emergent wetland area is located within the upper Berry's Creek reach.

Modified Wetlands (Managed and Disturbed Wetlands)

Modified wetlands include both managed and disturbed wetlands; they include wetlands that have undergone alterations in size and/or modifications to their original vegetation, soil, and hydrology. Within the Project Area, managed wetlands are present within and adjacent to Teterboro airport, while disturbed wetlands remain present in places surrounded or encompassed by industrial and transportation land uses. Disturbed wetlands are generally located near the Hackensack River on the eastern side of the Project Area.

Estuarine Deep Water and Riverine Waters (Open Water)

Estuarine open water habitats in the Project Area (including the mainstem of the Hackensack River) are very prevalent, particularly at the lower reaches and confluences of the tributaries at the Hackensack River, and the Hackensack River itself (Tiner et al. 2005). Deep water estuarine habitats are open water habitats permanently submerged by at least 6.6 feet (2 meters) of water at low tide (Cowardin, et al. 1979). Estuarine deep water occurs throughout the Hackensack River and its major tidal tributaries. Shallow water estuarine habitats are open-water habitats characterized by substrate elevations between Mean Low Water and 6.6 feet (2 meters) below Mean Low Water (Cowardin, et al. 1979). Typically, these areas are situated between estuarine deep water habitats and mudflats.

Ponds/Lakes and Other Freshwater Wetlands (Open Water)

Mehrhof Pond is a 77-acre site located to the east of Losen Slote Creek Park, adjacent to the BCUA's Treatment Plant on the Hackensack River, in the Borough of Little Ferry. The site consists of a freshwater pond surrounded by native grasslands, wet meadow areas, and palustrine forested wetlands. The pond was formerly a clay pit. The clay was used for brick manufacturing until the 1940s (USFWS 2007).

Large Wetland Complexes

Large, contiguous wetlands are an important landscape feature within the Meadowlands District and in the Project Area, especially in the most heavily developed areas where they perform vital ecosystem functions and represent important open space resources. Large wetland complexes provide a “critical mass” of habitat for native wildlife throughout the year, as well as for migratory species on a seasonal basis. Large wetland complexes are also more effective at intercepting and storing floodwaters and mediating wave energy along shorelines. Wetlands are valued for their aesthetic properties and provide active and passive recreational opportunities in urban settings.

Substantial wetland complexes within the Project Area include the Richard P. Kane Natural Area, which is owned by the Meadowlands Conservation Trust, as well as a network of extensive tidal marshes along Berry's Creek (Berry's Creek Marsh) and fringe wetlands associated with Mehrhof Pond (see **Figure 3.16-2**). The 587-acre Richard P. Kane Natural Area represents the second largest public landholding in the Meadowlands District (Kiviat and MacDonald 2002). The Richard P. Kane Tidal Wetland Mitigation Bank is located within the Richard P. Kane Natural Area in the Borough of Carlstadt on the north side of the New Jersey Turnpike, as shown on **Figure 3.16-2**. Construction of this 217-acre mitigation bank was initiated in 2010 to provide mitigation for major transportation projects within the Meadowlands District (MERI 2015). Construction was substantially completed in 2012 but the activities resulted in more open water and mudflat habitat than originally planned and large areas within the site were subsequently replanted with *Spartina* spp.

Along the upper portion of Berry's Creek, and also shown in **Figure 3.16-2**, is a brackish tidal marsh named Eight-Day Swamp. Common reed dominates these wetlands; however, both high and low *Spartina* spp. marsh occurs in scattered areas (Kiviat and MacDonald 2002).

Large tracts of wetland in the Borough of Carlstadt have been restored through hydrological enhancements and the establishment of native salt marsh species. Restoration activities on about 273 acres of land south of the New Jersey Turnpike and adjacent to the Transco facilities and the Hackensack River were completed in several stages. Between 1999 and 2001, MRI restored 206 acres of wetlands during the development of Phases 1 and 2 of the MRI Meadowlands Mitigation Bank. Between 2011 and 2012, Evergreen Environmental, LLC restored the remaining 67 acres to develop the Evergreen MRI3 Wetland Mitigation Bank (51 acres) and a 16-acre mitigation project for the expansion of the Global Marine Terminal in Jersey City. See **Figure 3.16-2** for an approximate location of these wetland mitigation banks. Currently, the low marsh areas are dominated by smooth cordgrass (*Spartina alterniflora*), dwarf spike rush (*Eleocharis parvula*), and marsh fleabane (*Pluchea purpurascens*). The high marsh areas are dominated by saltmarsh hay (*Spartina patens*), spikegrass (*Distichlis spicata*), and groundsel tree (*Baccharis halmifolia*) although common reed is encroaching on some of the high marsh areas in the MRI Phase 1 and 2 parcels (MERI 2015).

Also, along Losen Slote, a wetland complex consisting of forested, shrub/scrub and emergent wetlands is present north of the tide gate. This complex is bordered largely by vegetated wooded uplands and the BCUA pond. This complex and the large wooded tracts present on Teterboro Airport represent the largest freshwater wetland complexes within the Project Area.

3.17 Hydrology and Flooding

3.17.1 Introduction

This section describes the existing hydrologic and hydraulic conditions in and near the Project Area, including the Hackensack River, its tributaries (i.e., Losen Slote, East Riser Ditch, West Riser Ditch, DePeyster Creek, Peach Island Creek, Moonachie Creek, Bashes Creek, and Berry's Creek), other waterbodies draining within or near the Project Area, and existing stormwater systems. Information from prior hydrologic and hydraulic modeling efforts, analyses, field studies performed in the waterways, and information from previous reports, including appropriate FEMA Flood Insurance Studies and State/local flood surveys, were used to document the current conditions. The following subsections identify relevant existing regulations, Project Area conditions, waterbodies and tidal influences, inland and coastal flooding problems, and existing flood control infrastructure and measures within and near the Project Area.

3.17.2 Regulatory Context

Federal, State, and local regulations guide the extent and magnitude of potential flood risk management measures. Federal regulations can limit whether flood insurance benefits can be granted to local residents; State regulations govern whether a project may induce flooding and what flood mitigation requirements must be met; and local regulations can limit the size and scope of drainage improvements. More detailed information on Federal, State, and local regulatory requirements for the Proposed Project are presented in **Appendix B**.

Federal

EO 11988 (*Floodplain Management*) requires Federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. EO 13690 (*Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input*) detailed revisions to EO 11988 and redefined the level of protection required for critical infrastructure.

HUD's regulations, set forth under 24 CFR Part 55, implement the requirements of EO 11988, EO 11990, and the principles of the Unified National Program for Floodplain Management. These regulations apply to all HUD actions that are subject to potential harm by location in floodplains or wetlands. Covered actions include the proposed acquisition, construction, demolition, improvement, disposition, financing, and use of properties located in floodplains or wetlands. When developing project alternatives for consideration, HUD, or the Responsible Entity, must avoid impacts where possible, and seek to use natural systems, ecosystem processes, and nature-based approaches.

State

In an effort to minimize flood damage, the NJDEP Division of Land Use Regulation, under authority of the Flood Hazard Area Control Act (FHACA; NJSA 58:16A:-50 *et seq.*) and others, has adopted rules, regulations, and minimum standards concerning development and use of land within the floodplain, including drainage improvements and flood protection measures, as described below.

The construction of any hard projects (e.g., levees, floodwalls, pump stations) requires compliance with the New Jersey Stormwater Management Rules (NJAC 7:8). The requirements in 7:8-5.4, Runoff Quantity Standards, specifically state that, 'no increase in runoff downstream' may occur. Stormwater quality rules may also apply.

Because much of the Project Area is located within the coastal floodplain, net fill rules in response to any potential fill would likely not apply; however, any actions that induce flooding impacts may invoke the FHACA Rules (NJAC 7:13). The Flood Hazard Control Act Rules aim to protect surface water quality, protect wildlife and natural habitats in waters and riparian areas, and minimize the flooding impacts to public health, safety, and property within flood hazard areas.

NJSEA

Any improvements to stormwater drainage facilities or open channels must also comply with applicable NJSEA regulations. Subchapter 9 of NJAC 19:4 establishes floodplain management regulations in the Meadowlands District. This subchapter provides procedures and engineering and planning standards that NJSEA must use to evaluate applications for the development or use of land within the Meadowlands District. It includes methods and provisions for: restricting or prohibiting uses that are dangerous to health, safety, and property due to water hazards, or which result in damaging increases in flood heights; requiring uses that are vulnerable to floods be protected against flood damage at the time of initial construction; controlling the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel flood waters; controlling filling, grading, dredging and other types of development that may increase flood damage; and preventing or regulating the construction of flood barriers that would unnaturally divert flood waters or increase flood hazards in other areas.

3.17.3 Existing Conditions

The following subsections discuss the various influences on the Project Area's hydrology, coastal water surface elevations, and, subsequently, stormwater runoff and storm surge elevations.

3.17.3.1 Climate

Annual rainfall in the Project Area averages approximately 47 inches and annual snowfall averages 40 to 50 inches. During the warm season, thunderstorms are responsible for most of the rainfall. Cyclones and frontal passages are less frequent. Thunderstorms spawned in Pennsylvania and New York often move into the Project Area, where they usually reach maximum development in the evening (ONJSC 2014). More information on regional climate conditions can be found in **Section 3.9.3**.

The Project Area is also subject to impacts from coastal storms, often characterized as "nor'easters," which are most frequent between October and April. These storms track over the coastal plain or up to several hundred miles offshore, bringing strong winds and heavy rains. Typically, at least one significant coastal storm occurs each winter; some years' experience as many as five to ten such storms. Tropical storms and hurricanes are also a special concern along the coast. In some years, they contribute a significant amount to the precipitation totals of the region. Damage during times of high tide can be severe when tropical storms or nor'easters affect the region (ONJSC 2014).

3.17.3.2 Storm History

Flooding in the Project Area can occur during any season of the year since New Jersey lies within the major storm tracks of North America. The worst storms have occurred in late summer or early fall when tropical disturbances (hurricanes) are most prevalent. Recent tropical events include Tropical Storm Floyd, Hurricane Irene, and Hurricane Sandy.

Hurricane Floyd originally made landfall in Cape Fear, North Carolina as a Category 2 hurricane on September 16, 1999. The storm crossed over North Carolina and southeastern Virginia before briefly entering the western Atlantic Ocean. The storm reached New Jersey on September 17, 1999 as a tropical storm. Record-breaking flooding from rainfall exceeding 14 inches was recorded throughout the State of New Jersey. A Federal Emergency Declaration was issued on September 17, 1999 (FEMA 2014a).

Having earlier been downgraded to a tropical storm, Hurricane Irene came ashore in Little Egg Inlet in southern New Jersey on August 28, 2011. In anticipation of the storm, Governor Chris Christie declared a State of emergency on August 25th, with President Obama reaffirming the declaration on August 27th. Mandatory evacuations were ordered throughout the State of New Jersey. Wind speeds were recorded up to 75 miles per hour and rainfall totals reached over 10 inches in many parts of the State. Extensive flooding throughout the Project Area caused damage to homes, businesses, and public infrastructure. The flooding was exacerbated by high water levels in reservoirs and wetlands as a result of previous heavy rains. Over 1 million customers lost power during the storm (Bergen Beat 2012, cited in DHS 2018, DHS 2018).

Hurricane Sandy came ashore as an immense tropical storm in Brigantine, New Jersey, on October 29, 2012. Although rainfall was limited to less than 2 inches within the Project Area, wind gusts were recorded up to 76 miles per hour. A full moon made the high tides 20 percent higher than normal and amplified the storm surge. The New Jersey shore suffered the most damage. Seaside communities were damaged and destroyed up and down the coastline. Although protected from severe waves, the

Project Area experienced record storm surge elevations. Some 2.7 million households within New Jersey lost power. Initial reports suggest that 72,000 homes and businesses statewide were damaged or destroyed by the storm. Governor Chris Christie declared a State of emergency on October 31, 2012 (FEMA 2014a).

The largest historical tide in the Project Area was produced by the (unnamed) hurricane of September 3, 1821. On the basis of old street maps and newspaper accounts, it has been concluded that the surge produced by that hurricane was approximately 10 to 11 feet. However, the surge peak occurred at the time of a low astronomical tide, and mean sea level for September 1821 was approximately 1.5 feet below present mean sea level for August. Consequently, such a hurricane surge on a high astronomic tide would now produce a tide of approximately 14 feet in elevation (NAVD 88). Although the 1821 hurricane was weaker than other historic storms, its track, just inland from the Atlantic coast, and its forward speed was conducive to critical storm surge conditions (FEMA 2014a).

Previous studies of the records have shown that the most important hurricane surges of interest in the Project Area are those of 1821, 1938, 1944, 1954, 1955 (Connie), 1960 (Donna), 1971 (Doria), and 2012 (Sandy). Hurricane Diane in 1955, Tropical Storm Agnes in 1972, Tropical Storm Floyd in 1999, and Hurricane Irene in 2011 failed to produce major surges, although they resulted in heavy rainfall. Important hurricane surges nearby in Battery, New York from 1926 to 2012 are presented in **Table 3.17-1**.

Table 3.17-1: Important Hurricane Surges: Battery, New York

Date	Surge Height (feet)*
October 2012 (Sandy)	9.4
September 1960 (Donna)	5.3
September 1944**	5.0
August 1971 (Doria)	4.2
September 1938***	4.1
August 1954 (Carol)	3.1
August 1955 (Connie)	3.1

*Net surge, exclusive of predicted tide
**1944 Great Atlantic Hurricane
***New England Hurricane of 1938
Source: (NOAA 2017)

Extratropical cyclones, or nor'easters, are far more frequent in the area than hurricanes and may produce severe surges. Winds in the nor'easters blow in a direction that is conducive to surge generation along the 80 or 90 miles of continental shelf off of New York Bight (FEMA 2014a). Important nor'easter surges nearby in Battery, New York from 1926 to 1976 are presented in **Table 3.17-2**.

Table 3.17-2: Important Nor'easter Surges: Battery, New York

Date	Surge Height (feet)*
November 1950	8.5
November 1953	5.4

Date	Surge Height (feet)*
November 1932	5.3
December 1974	5.2
November 1968	5.0
February 1927	4.6
March 2010	4.4
December 1992	4.3

*Net surge, exclusive of predicted tide.
Source: (NOAA 2017)

3.17.3.3 Coastal Storm Surge Modeling

The FEMA Region II office initiated a study in 2009 to update the coastal storm surge elevations within the states of New York and New Jersey, including the Atlantic Ocean, Barnegat Bay, Raritan Bay, Jamaica Bay, portions of Long Island Sound, estuarine reaches of the Hudson River, and their tributaries. The study replaced outdated coastal analyses as well as previously published storm surge stillwater elevations for all of FEMA's Flood Insurance Study Reports in the area, including the Project Area (FEMA 2014a). The latest FEMA model data for the 1 percent annual chance event (100-year) were approximately one-half foot higher than the effective model data completed in 1995 (FEMA 2014a).

A comparison of FEMA's effective and current modeled stage versus frequency data are shown in **Table 3.17-3**.

Table 3.17-3: Project Area Stage vs. Frequency

Annual Chance Event	FEMA Effective Water Surface Elevation (Feet NAVD 88; 2005)	FEMA Preliminary Water Surface Elevation (Feet NAVD 88; 2014)
10% (10-year)	5.6	5.0
2% (50-year)	7.0	7.0
1% (100-year)	7.7	8.1
0.2% (500-year)	8.1	11.0

In 2016, following an appeal of the Preliminary Flood Insurance Study by New York City, FEMA agreed to re-evaluate the coastal model parameters used in the 2009 analysis and remodel the coastal surge. This may result in lower FEMA stage versus frequency curves for the Project Area; however, this process is expected to take several years. Therefore, the project team is developing a separate coastal model utilizing some of the FEMA parameters, an expanded and refined surface grid, and additional information that will be used for the evaluation of coastal protection features.

Following Hurricane Sandy, NOAA published a Technical Report, "Extreme Water Levels of the United States 1893-2010," including an updated Appendix VIII, "Effect of Hurricanes Irene and Sandy on High Water Exceedance Probability Levels for Bridgeport, the Battery, and Sandy Hook" (NOAA 2013c). The

North Atlantic Coast Comprehensive Study (NACCS) required a post-Sandy extreme water level analysis that included all of the long-term NOAA water level gages that are within the NACCS. As a result, the USACE Engineering Research and Development Center conducted a study similar in nature to the 2013 NOAA Technical Report. The results of this study are shown to agree well with those published in the 2013 NOAA Technical Report (USACE 2015). Stevens Institute of Technology in Hoboken, New Jersey, as well as the Meadowlands Environmental Research Institute (MERI), also maintain smaller scale coastal surge models for analysis and flood predictions.

For the current Proposed Project, three coastal hydrodynamic models were used for the surge analysis as well as two wave models that serve different purposes. A high resolution MIKE21 model (0.7 million elements) was developed and, in conjunction with a regional Advanced Circulation (ADCIRC) model, was used primarily for the evaluation of effects from coastal alternatives on water levels. The MIKE21 model domain includes both the Hackensack River (to Oradell Dam) and Passaic River (to Dundee Dam) and extends south to Bergen Point, New Jersey. Sensitivity testing confirmed that this domain was large enough to capture any effects from the proposed coastal alternatives.

3.17.3.4 Tides and Channels

The tidal range between mean low water and mean high water for the Hackensack River is 5.2 feet in Kearny, New Jersey, and 4.7 feet in New Milford, New Jersey (NJDEP 2001). The width of the Hackensack River ranges from 900 to 1,500 feet from the mouth of the river north. There are 3.5 miles of a dredged, maintained, shipping channel that is 300 to 500 feet wide and 30 feet deep. From the Borough of Little Ferry to the City of Hackensack, there is an 11-foot deep navigation channel. The area between the dredged areas has a natural 21-foot average depth (USDC 2016).

3.17.3.5 Sea Level Change

Sea level in the northeast US has risen approximately 12 inches since 1900, which is 50 percent more than the global average (Horton, et al. 2014). In the New York metropolitan region, sea level has risen at approximately double the rate of the global average (Horton, et al. 2015a). Various agencies, including USACE, NOAA, the NPCC, and Rutgers University, have published projections to analyze potential sea level change over the coming decades, all of which anticipate sea level to rise, and many of which have produced similar results. Overall, there is some variance between the low and high projections, which depend on the level of continued GHG emissions. However, the middle range of these projections indicates that sea level may rise another 1.2 to 2.4 feet by the year 2075, and 1.8 to 4.0 feet by the end of the century (NOAA 2013a). As discussed in **Section 3.10.3.1**, the NJDEP will focus on the 2075 NOAA Intermediate-Low (i.e., 1.2 feet of SLR) and Intermediate-High (i.e., 2.4 feet of SLR) projections for analysis in this document. For a complete discussion of sea level change and the available projection data, please see **Section 3.10.3.1**.

SLR is expected to exacerbate existing flooding issues and increase the portions of the Project Area where inundation cannot be controlled by the existing infrastructure. In the case of extreme flood events, the recurrence interval between extreme river discharge storm events will become smaller, meaning that the Project Area will be subject to more extreme events more frequently. More frequent flooding will lead to further stress on engineering controls, as well as produce further hindrances associated with flooding that are endured by business-owners and residents in the Project Area and the Meadowlands District as a whole (Rutgers University 2007b).

3.17.3.6 Precipitation Data

Precipitation data used in the drainage analysis were obtained from NOAA Atlas 14, Volume 2, Version 3, for Moonachie, New Jersey for up to the 24 hour, 500-year event (NOAA 2016); 250-year values were interpolated. Point precipitation frequency estimates for the Project Area are shown in **Table 3.17-4**.

Table 3.17-4: Project Area Precipitation Estimates

Point Precipitation Frequency Estimates - Intensity (inches)									
	Average Recurrence Interval (years)								
Duration	**1**	**2**	**5**	**10**	**25**	**50**	**100**	**250**	**500**
5-min	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8
15-min	0.7	0.8	0.9	1.1	1.2	1.3	1.4	1.5	1.6
60-min	1.1	1.4	1.7	2.0	2.3	2.6	2.9	3.2	3.5
2-hr	1.4	1.7	2.1	2.4	2.9	3.3	3.7	4.2	4.7
3-hr	1.5	1.9	2.3	2.7	3.3	3.7	4.2	4.7	5.3
6-hr	2.0	2.4	3.0	3.5	4.2	4.8	5.4	6.2	6.9
12-hr	2.4	2.9	3.7	4.4	5.3	6.1	6.9	8.0	9.1
24-hr	2.7	3.3	4.2	5.0	6.2	7.2	8.3	9.8	11.3
2-day	3.2	3.9	5.0	5.9	7.2	8.3	9.6	11.3	13.0

3.17.3.7 Rainfall and Storm Surge Correlation

As this section demonstrates, there is little correlation between rainfall and storm surge in the Project Area. The USACE performed a detailed correlation analysis for the nearby South River, Raritan River Basin Hurricane and Storm Damage Reduction Study in 2002 to determine what, if any, correlation exists between rainfall and surge events in the region. As shown in **Figure 3.17-1**, most of the higher tide events occurred with little rainfall, and most high rainfall events occurred with normal tides (the normal tide range is shown on the x-axis). This, along with the general wide scatter of precipitation amounts with a constant storm surge and vice versa, indicates that there is no correlation between the surge events and rainfall. Therefore, it is unreasonable to predict one condition from the other based on these historic records (USACE 2002b, USACE 2016). Please note that the data in **Figure 3.17-1** are based on the National Geodetic Vertical Datum of 1929 (NGVD 29). This document uses the NAVD 88 for all other elevations. In the study area, the conversion factor used to convert NGVD 29 data to NAVD 88 data is approximately -1.0 foot (e.g., an NGVD 29 value of 3.0 feet would have an NAVD 88 value of approximately 2.0 feet) (FEMA 2014a).

Dependence

Storms that typically produce tidal surges (i.e., hurricanes and nor'easters) can also produce somewhat significant rainfall. Likewise, many of the high rainfall events are accompanied by some degree of storm surge. If this were not true, the high surge events would not likely have any rainfall, and the paired data in **Figure 3.17-1** would fall much closer to each axis. As expected, the figure reveals a minor dependence between the interior (i.e., rainfall) and exterior (i.e., tidal surge) conditions. The fact that the main cluster of points that includes some rainfall (one to two inches) also includes a tide height greater than the mean tide level (0.9 feet in elevation) is evidence of this.

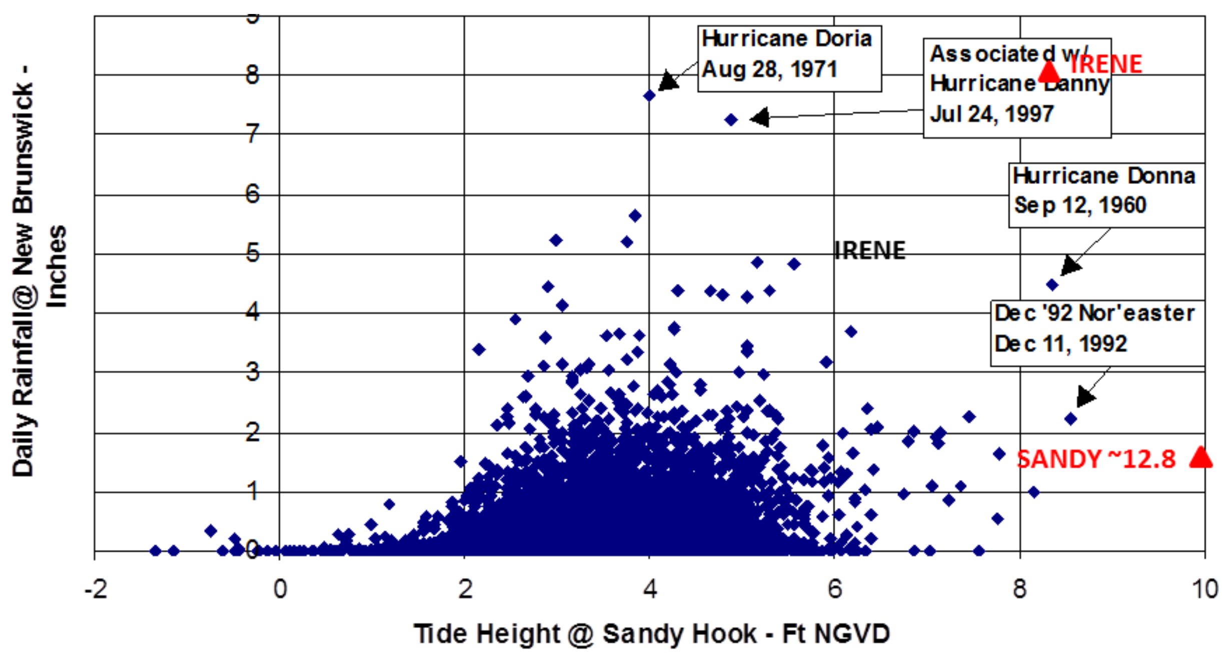


Figure 3.17-1: Tide-Rainfall Correlation Plot

Coincidence

The coincidence between the interior and exterior conditions involves the timing of the peak discharge and the timing of the peak exterior surge. In the exterior condition, the timing of the peak exterior stage is unpredictable because of the impacts of tidal fluctuation to the overall storm surge elevation. Therefore, predicting the coincidence of the peak exterior event and the peak interior flows is uncertain. Assuming that the interior and exterior events occur at the same time would be considered the worst case scenario and a conservative approach for analyzing potential impacts.

3.17.3.8 Principal Flood Problems

Flooding in the Project Area is typically a result of: (1) systemic inland flooding from high-intensity rainfall/runoff events and (2) coastal flooding from storm surges. The interrelationship between coastal flooding and rainfall events contributes to the recurring flooding conditions throughout the Project Area. Flooding can occur during any season of the year since New Jersey is located within the major storm tracks of North America. Flooding is generally the result of heavy rainfall produced by hurricanes moving up the coast, large frontal storms from the west and south, and local thunderstorms. The worst storms have occurred in late summer or early fall when tropical disturbances (e.g., hurricanes) are the most prevalent. Recent tropical events include Tropical Storm Floyd in 1999, Hurricane Irene in 2011, and Hurricane Sandy in 2012 (FEMA 2014a).

Inland / Stormwater Flooding

Inland flooding occurs during periods of excessive rainfall and is often made worse by high or surge tides which block stormwater outflows. Stormwater flooding occurs from two sources: (1) flood flows exceeding the capacity of local rivers, tributaries, and drainage ditches; and (2) flows exceeding design capacities of infrastructure networks.

Within the Project Area, the eight major tributaries to the Hackensack River which are subject to flooding include the following: Losen Slote, East Riser Ditch, West Riser Ditch, DePeyster Creek, Peach Island

Creek, Moonachie Creek, Bashes Creek, and Berry's Creek. The East and West Riser Ditches converge at Berry's Creek. For many of the stream reaches, tide gates and pump stations act as downstream boundaries, limiting surge impacts but also restricting outflow to the pump and gate capacities (FEMA 2014a).

Much of the stormwater infrastructure in the Project Area (see **Figure 3.17-3**) is in poor condition and is not being maintained or serviced on a regular basis. Based on measurements and modeling conducted by the USACE as part of their Hackensack Meadowlands Project, the major sources that contribute to regional flooding are tidal flows entering the Hackensack River from Newark Bay and, to a lesser degree, freshwater flows from the Hackensack River watershed. Because of the very high proportion of impervious cover in the majority of the Project Area and the shallow groundwater table, relatively little rainfall infiltrates, so virtually all precipitation becomes surface runoff. The high groundwater table also affects the capacity and functionality of both water quantity and water control systems in the Project Area (Rutgers University 2007a).

Even smaller storms that do not generate a storm surge can cause flooding that is tidally dependent. Because so much of the Project Area and the entire Meadowlands District is only a few feet above sea level, many of the storm sewers that drain these low areas are barely above normal water surface elevations and are equipped with tide gates that control the discharge from the pipes. If a significant runoff event, such as an intense summer thunderstorm, coincides with a high tide, the storm sewers may simply be unable to drain until the tide recedes and there is positive head between the flood levels and the invert of the storm sewers. This tidal backwater effect can be present even with completely functional tide gates. If the tide gates are malfunctioning or blocked, the flooding problems are exacerbated and may persist over multiple tide cycles.

The NJSEA undertook a significant effort in 2004 to identify the areas subject to stormwater flooding. This effort is documented in the Hackensack Meadowlands Floodplain Management Plan (NJSEA 2005), and, in conjunction with additional, more current data, contributed to the preliminary design of the Proposed Project's Build Alternatives. **Table 3.17-5** lists 29 sample locations with existing inland flooding problems, including specific characteristics of the storms that lead to flooding (e.g., total rainfall, storm length, maximum intensity, peak tide level, etc.). Based on this data, relatively small rainfall events (i.e., less than 1 inch of precipitation) can exceed the drainage capacity of the local stormwater networks and result in localized flooding, particularly if coupled with high tide. The inland flooding locations listed in **Table 3.17-5** are displayed on **Figure 3.17-2**. Please refer to Subappendix B5 in the Feasibility Study Report for detailed maps, images, and topographic data for each location (NJDEP 2018).

Table 3.17-5: Inland Flooding Observations in Project Area

Observation Number	Location	Event Date	Total Rainfall (in.) [1]	Storm Length (hours)	Return Frequency Total Rainfall (years) [2]	Maximum Intensity (in./hr.) [1]	Return Frequency Max. Intensity (years) [2]	Peak Tide Level (ft. NAVD 88) [3]	Model Area	Estimated Flooding Elevation (feet NAVD 88)	Source
1	140 Kero Road	7/8/2005	1.42	24	<1	0.40	<1	2.97	Peach Island Creek	4.5	
2	110 Asia Place	6/10/2005	1.08	3	<1	0.71	<1	2.52	Peach Island Creek	3.75	
3	1 Carol Place	10/12/2005	3.87 [4]	24	2-5	0.55	<1	4.84	Carol Place	4.8	
4	Grand Street and Moonachie Avenue	10/14/2005	7.14	77	10-25	0.55	<1	4.84	West Riser Ditch	3.4	A
5	Grand Street and Anderson Avenue	10/14/2005	7.14	77	10-25	0.55	<1	4.84	West Riser Ditch	3.4	
6	Grand Street and Christina Avenue	10/14/2005	7.14	77	10-25	0.55	<1	4.84	M2	3.4	
7	Avenue A and Moonachie Avenue	10/14/2005	7.14	77	10-25	0.55	<1	4.84	East Riser Ditch	4.5	
8	Brandt Street	8/31/2014	0.77	6	<1	0.74	<1	2.55	Main Street	4.5	
9	Garden Street	8/31/2014	0.77	6	<1	0.74	<1	2.55	Main Street	4.5	B
10	Grand Street	8/31/2014	0.77	6	<1	0.74	<1	2.55	Main Street	4.5	
11	John Street	8/31/2014	0.77	6	<1	0.74	<1	2.55	Main Street	4.5	
12	Riser Road	4/6/2017	0.83	13	<1	0.44	<1	4.28	East Riser Ditch	4.7	
13	Main Street and Brandt Street	4/6/2017	0.83	13	<1	0.44	<1	4.28	Main Street	4.7	
14	Kaufman Avenue and Frederick Street	4/6/2017	0.83	13	<1	0.44	<1	4.28	Main Street	4.7	
15	Katherine Street	4/6/2017	0.83	13	<1	0.44	<1	4.28	DePeyster Creek	4.7	
16	Riverside Avenue	4/6/2017	0.83	13	<1	0.44	<1	4.28	DePeyster Creek	4.7	
17	Hartwick Street	4/6/2017	0.83	13	<1	0.44	<1	4.28	DePeyster Creek	4.7	C
18	Industrial Avenue	4/6/2017	0.83	13	<1	0.44	<1	4.28	DePeyster Creek	4.7	
19	Parking lot, off Washington Place	4/6/2017	0.83	13	<1	0.44	<1	4.28	Carol Place	3.75	
20	Parking lot, off Moonachie Road	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Carol Place	4.5	
21	State Street	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Losen Slote Creek	4.5	
22	Moonachie Road between West Park Street and Broad Street	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Losen Slote Creek	4.5	
23	Adams Street	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Losen Slote Creek	2.5	
24	Eckel Road	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Losen Slote Creek	4	
25	Sabina Street	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Losen Slote Creek	4	
26	Redneck Avenue and Paroubek Street	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Losen Slote Creek	4.75	C
27	William Street	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Losen Slote Creek	4.25	
28	East Grove Street (1)	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Losen Slote Creek	4.75	
29	East Grove Street (2)	5/5/2017	3.36	24	2-5	1.22	1-2	0.88	Losen Slote Creek	4.75	

Notes:
1. Total rain at Teterboro Airport Point Gauge
2.Return frequency for storm length and peak intensity (1 hour) is based on point return frequency estimate for Moonachie, NJ.
3. Peak tide level at The Battery, NY
4. Observation occurred in the middle of storm event. Total shown is at the end of 10/12/2005
Source:
A. (NJSEA 2005); B. (Morris 2014); C. Field Observations

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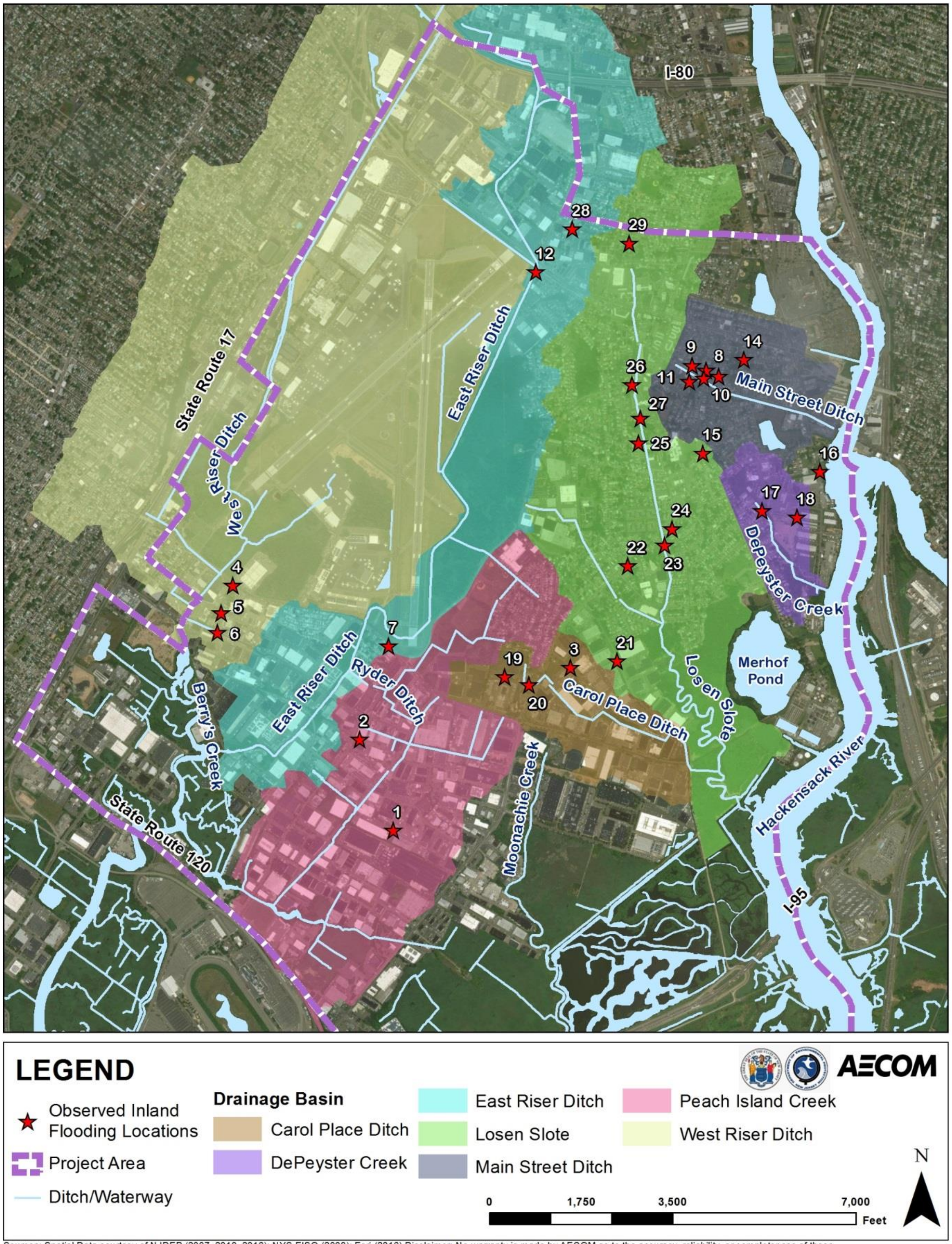


Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate usewith other data.This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.17-2: Observed Inland Flooding Locations in Project Area

Coastal Flooding

Coastal flooding in the Project Area has been the subject of extensive study going back to the original USACE study in 1969. This was followed by a reconnaissance report in 1981 (USACE 1981), another reconnaissance report in 1988 (USACE 1988), and a third reconnaissance report in 1993 (USACE 1993). A follow-on, more detailed analysis was completed by the USACE in 2004. In summary, coastal flood protection has been studied extensively in the last 50 years.

Figure 3.17-4 presents the 100-year floodplain (i.e., the area with a 1 percent chance of being inundated within any given year) and the 500-year floodplain (i.e., the area with a 0.2 percent of being inundated within any given year) boundaries for the Project Area. As shown on the figure, over 90 percent of the Project Area is within the 100-year floodplain created by coastal surge. Based on an examination of the Preliminary Flood Insurance Rate Maps (FIRM) for the Project Area, the 100-year flood elevation is 8 feet (NAVD 88) (FEMA 2014a).

3.17.3.9 Existing Flood Protection

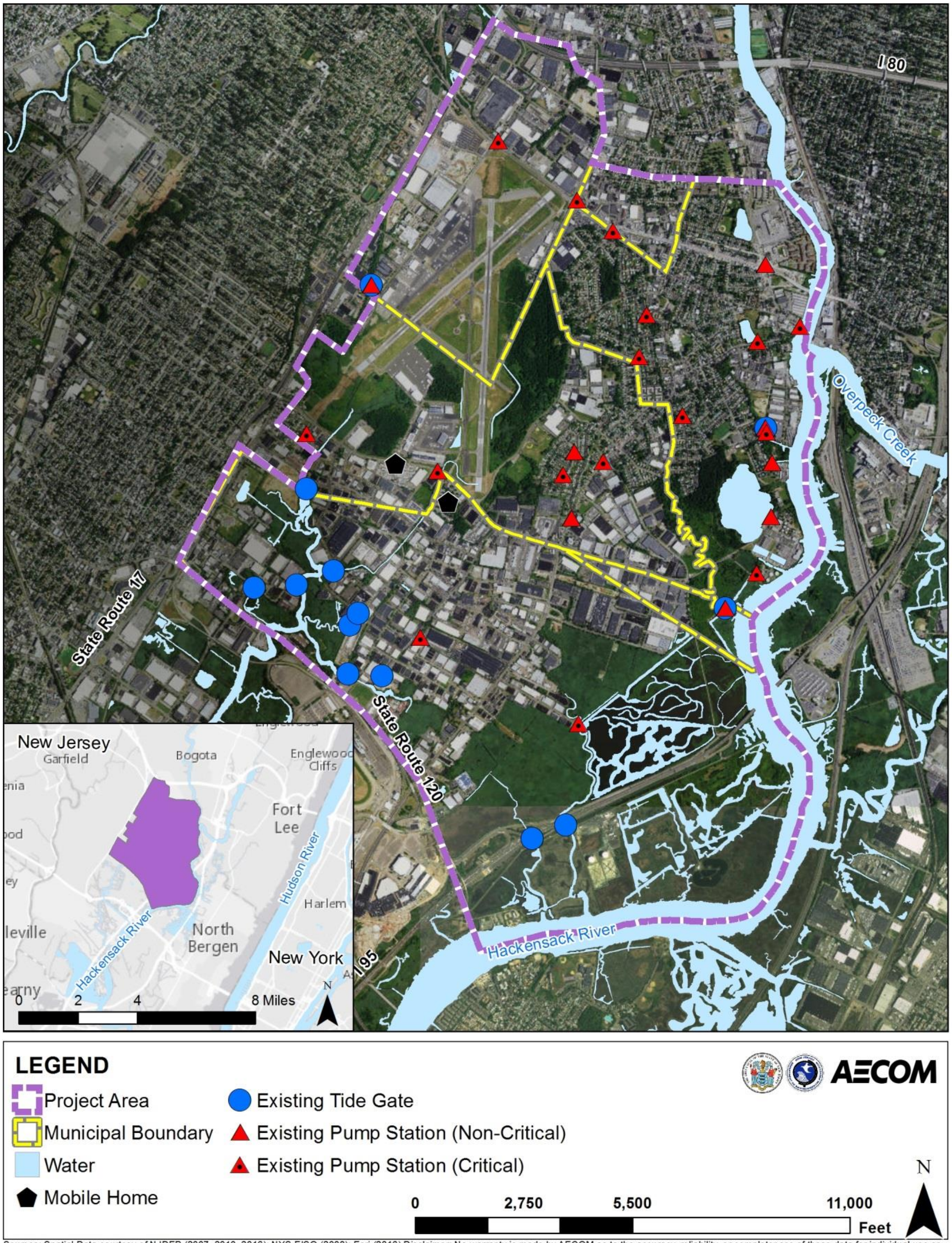
Berms and Levees

Within the Project Area, existing berms typically consist of raised ridges of earth that resulted from the historic excavation of drainage ditches as a mosquito control strategy to prevent standing water in low-lying areas. Earthen berms also prevent waters from high tides from reaching and ponding in the low-lying meadows. Between 1913 and the late 1970s, hundreds of miles of ditches were dug in the vicinity of the towns of Carlstadt, Little Ferry, and Moonachie.

The berms were typically not engineered, with the exception of portions adjacent to flood gates and pump stations; many of the berms have settled, slumped, or were just constructed haphazardly. Until Hurricane Sandy, this berm system provided limited flood protection to the residential and industrial areas of these towns from the highest of the high tides, but offered only minor flood protection for larger events, typically less than a 10-year event. Hurricane Sandy's sea surge measured 8.5 to 9.5 feet (NAVD 88) and overtopped all existing earthen berms in the Project Area (NJSEA 2013). The existing berms and levees in the Project Area are shown in **Figure 3.17-5**.

Pump Stations and Tide Gates

Existing flood protection features in the Boroughs of Teterboro, Little Ferry, Moonachie, and Carlstadt and the Township of South Hackensack include systems of tide gates, pump stations, and berms (see **Table 3.17-6**) (NJSEA 2006b). In the Borough of Little Ferry, a tide gate and pumping station are located on the Losen Slote near Birch Street. The pump station is typical of the region, with a maximum capacity of 27 cubic feet per second. The adjacent berm along the Hackensack River at the southern boundary of the Borough of Little Ferry is not of uniform height, nor is it continuous. This allows the tidal stages of the river to flood the characteristically low topographic areas of the borough (FEMA 2014a). The locations of existing flood protection pump stations and tide gates in the Project Area are shown in **Figure 3.17-4** (Rutgers University 2007a). Please refer to Subappendix A4-2 in the Feasibility Study Report for existing condition data on the tide gates and pump stations (NJDEP 2018).



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.17-3: Stormwater Infrastructure in the Project Area

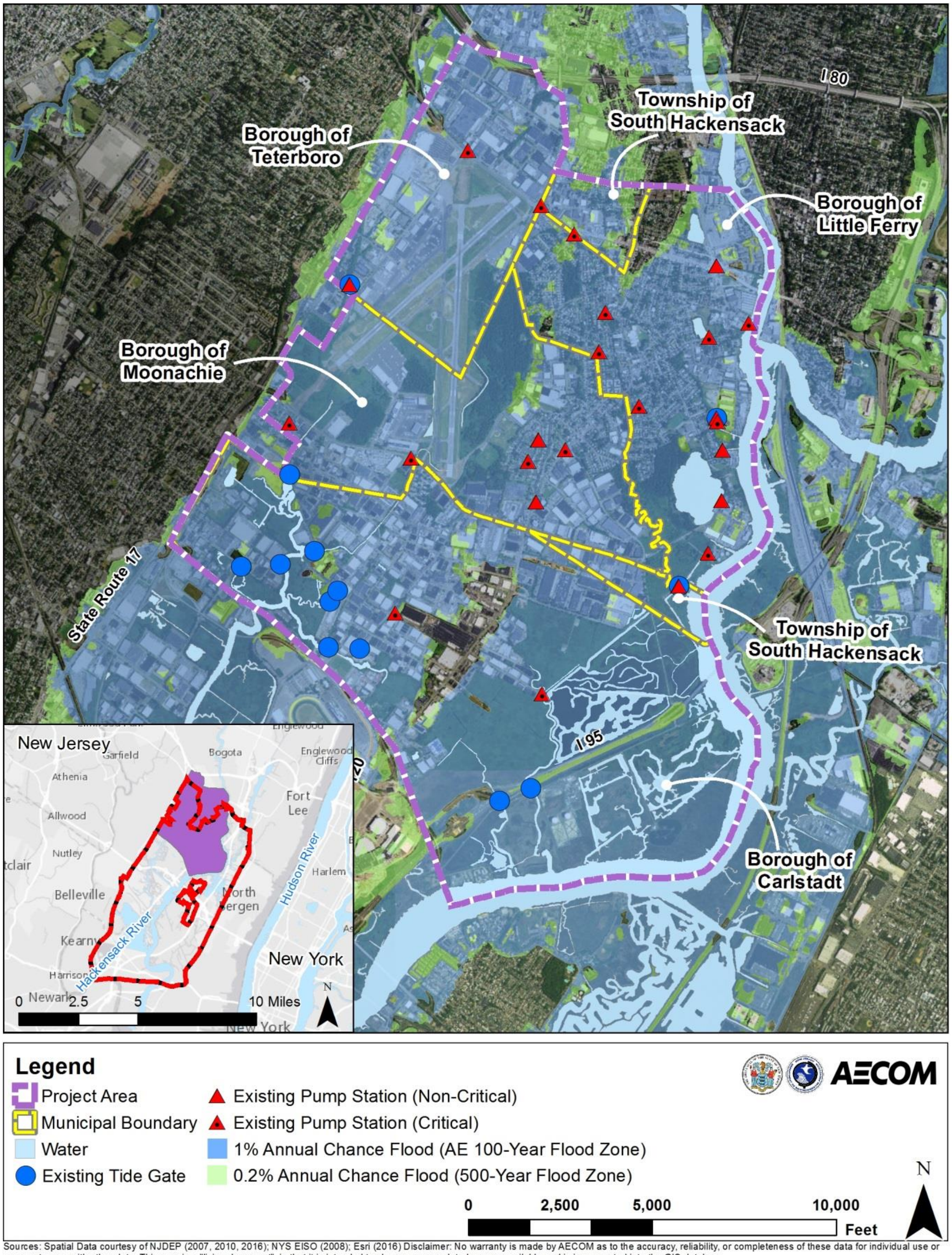
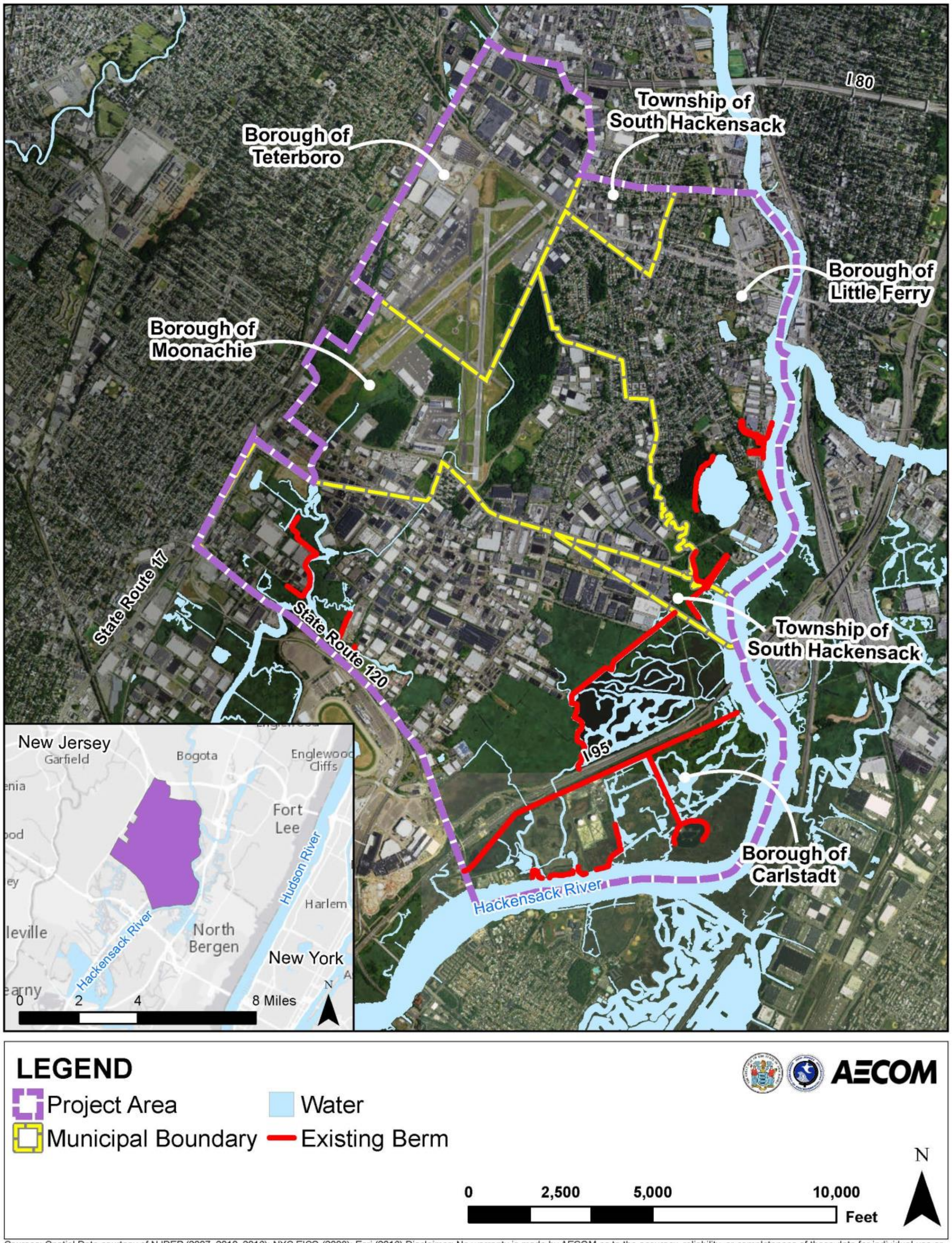


Figure 3.17-4: Floodplains in the Project Area



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.17-5: Existing Berms and Levees in the Project Area

Table 3.17-6: Existing Pump Stations and Tide Gates in the Project Area

Municipality	Tide Gates	Pump Stations
Carlstadt	7 Tide Gates: East Riser, Broad & 20th street, Dell Road, Waitex, Peach Island, Yellow Freight, Palmer Terrace, Moonachie Creek, Bashes Creek	None
Little Ferry	1 Tide Gate: DePeyster	3 Pump Stations: Willow Lake, DePeyster, Main Street
Moonachie	1 Tide Gate: West Riser	1 Pump Station: Lincoln Place
South Hackensack	1 Tide Gate: Losen Slote	1 Pump Station: Losen Slote
Teterboro	1 Tide Gate: Teterboro	1 Pump Station: Teterboro

3.17.3.10 Existing Stormwater Drainage

Including the Project Area, the Hackensack River Basin has a drainage area of approximately 202 square miles (USFWS 1997). Smaller tributaries, including East and West Riser Ditches, Losen Slote, and Berry's Creek, drain the Project Area to the river. Each of the Project Area's communities has their own stormwater drainage systems, consisting of pipes, swales, and outfalls, that empty into these tributaries. Upstream of the wetland areas of the Project Area, the drainage subbasins consist of mostly dense residential and urban development, interspersed with commercial and industrial properties. This land use results in a large percentage of impervious surfaces and high stormwater runoff.

Historically, stormwater management has been a significant challenge in the Project Area and the entirety of the Meadowlands District, as the District and the Project Area are less than 10 feet in elevation (NAVD 88) (Rutgers University 2007a). This lack of elevation puts a strain on the ability of the municipalities to drain stormwater. Drainage infrastructure is typically powered by gravity, and is slower if the slopes of the infrastructure are shallow (Guo, et al. 2014). Further, much of the Project Area has become impervious due to the high degree of development. This, in conjunction with the significant changes made to the natural hydrology of the Project Area, has severely limited the ability of the land to absorb and store stormwater and discharge it over time. Consequently, most rainfall becomes surface runoff and is thrust into the drainage infrastructure immediately. These issues are further compounded when the Hackensack River has a particularly high tide, such as a spring high tide, because the river is the ultimate destination for the stormwater. The river must be at a lower elevation than the drains in order for drainage to occur (Rutgers University 2007a).

In addition to the berms, tide gates, and pump stations discussed previously, the Project Area also contains two stormwater detention ponds and a series of drainage ditches, summarized in **Table 3.17-7**. A list of existing stormwater infrastructure in the Project Area is provided in **Table 3.12-5** within **Section 3.12.3.6**.

Table 3.17-7: Stormwater Infrastructure Located Within Project Area

Municipality	Infrastructure
Detention Ponds	
Little Ferry	Indian Lake
	Willow Lake
Ditches	
Multiple Municipalities	Commercial Ditch System
	East Riser Ditch System
	Industrial Avenue Ditch
	West Riser Ditch System
Moonachie	Grand Street Ditch
	Caesar Place Ditch
	Jackson Place Ditch
	Lincoln Place Pump Station Ditch
	Ryder Ditch
	Sova Place Ditch
Carlstadt	Eastern Avenue Ditch
	Gotham Parkway Ditch
	Bashes Creek Ditch System
	Moonachie Creek Ditch System
	Unnamed by Paterson Plank Road
	Veterans Ditch

Sources: (Borough of Little Ferry 2005, NJDEP 2016d)

3.18 Coastal Zone Management

3.18.1 Introduction

This section describes the different coastal zone regulated areas in the Project Area and identifies the coastal regulations applicable to the Proposed Project. CZM involves the protection of coastal areas in conjunction with environmental, economic, human health, and human activities. The Proposed Project is located within the tidally-influenced and surge-prone areas along the Hackensack River. The majority of the Project Area is located within the Meadowlands District, which is a regional planning area within the New Jersey's coastal zone.

3.18.2 Regulatory Context

States with federally approved coastal programs have delineated a coastal zone and established regulatory programs consistent with the Coastal Zone Management Act (CZMA) of 1972 (16 USC §§ 1451 *et seq.*). Because Federal funding would be provided for the Proposed Project, it is considered a Federal action under the CZMA (15 CFR Part 930, Subpart F), triggering the need for a Federal consistency determination, which is a finding that the Proposed Project would be consistent to the extent practicable with the State's coastal policies. These policies are detailed in the New Jersey CZM

Rules (NJAC 7:7), part of New Jersey's Coastal Management Program (NJCMP) approved under the Federal CZMA. The NJDEP would coordinate with the Office of Coastal Management within NOAA's National Ocean Service to formalize the Federal consistency determination.

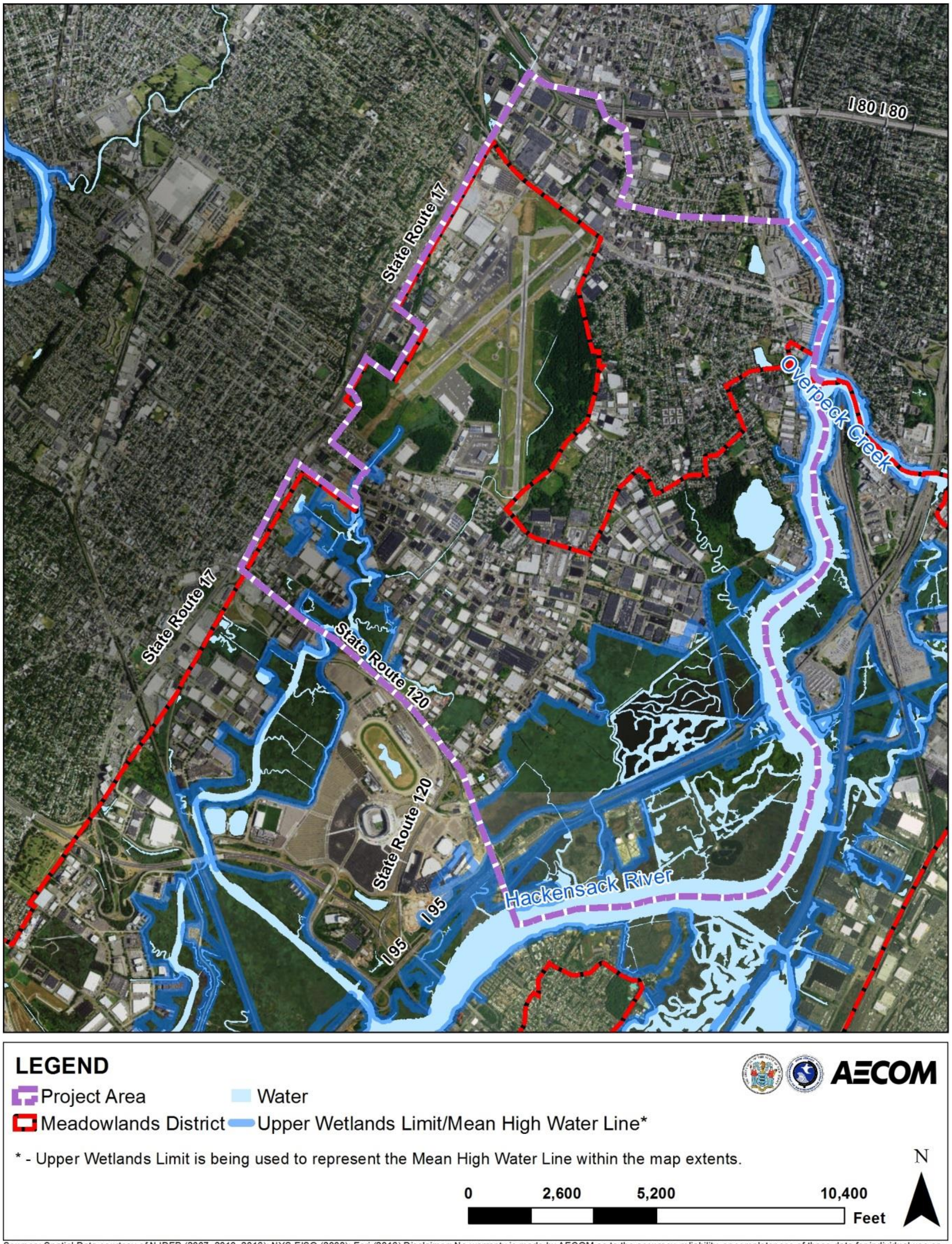
The NJDEP also has regulatory authority over portions of the coastal zone in the Project Area, pursuant to the Waterfront Development Act (NJSA 12:5-1 *et seq.*). Outside of the Meadowlands District, the coastal zone extends a minimum of 100 feet and a maximum of 500 feet landward from the mean high water line and also includes tidal waters and lands thereunder. The specific landward limit is set by the location of property lines and linear infrastructure. Within the Meadowlands District, the coastal zone regulated by NJDEP consists of tidal waterways and lands lying thereunder, up to and including the mean high water line. Through the Coastal Zone Management Rules (NJAC 7:7), NJDEP is also responsible for implementation of Section 401 of the Federal CWA, and issuing Water Quality Certificates in the Meadowlands District.

Pursuant to the Hackensack Meadowlands Reclamation and Development Act (NJSA 13:17-1 *et seq.*), the NJSEA (formerly the HMDC and later the NJMC), has the lead responsibility for planning and permitting, regulating development, and conservation within the Meadowlands District. Implementation is through compliance with the NJSEA Master Plan (NJSEA 2004). This regional planning agency was initially established in 1969 to oversee the regulation of landfills in the Meadowlands District. Prior to 1970, there were 51 unregulated landfills in the Meadowlands District and municipal refuse from throughout New Jersey was deposited in the Meadowlands District, primarily in wetlands. In addition to the landfills, industrial, commercial, and residential development in the Meadowlands District began as early as the 18th century. This development has substantially altered the land from its natural state through filling and draining of wetlands and channelization of tributaries, resulting in present conditions.

As established through a March 2005 MOA between NJMC and the NJDEP (NJDEP 2005), the NJMC is the lead agency overseeing land use planning and permitting within the Meadowlands District. As stated previously, the NJMC was incorporated into the NJSEA pursuant to the Hackensack Meadowlands Agency Consolidation Act (PL 2015 Chapter 19). Within the Meadowlands District, the NJDEP has jurisdiction over activities occurring in tidal waters and underlying lands at, and waterward of, the mean high water line. More detailed information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

3.18.3 Existing Conditions

The Project Area is primarily located within the limits of the Meadowlands District boundary, as illustrated on **Figure 3.18-1**. The Meadowlands District is located in Hudson and Bergen Counties in northeastern New Jersey, containing more than 16,000 acres (25 square miles). The NJSEA (formerly the NJMC) Zoning Map (NJSEA n.d.) presents the zoning areas of the Meadowlands District. The major Meadowlands District zoning classifications in the Project Area are light industrial, environmental conservation, and aviation facilities, along with smaller areas of public utility, low density residential, parks and recreation, and intermodal. The Meadowlands District regulations detail requirements for all building construction and include provisions to minimize impacts of flooding. In addition, the Meadowlands District regulations set provisions for the identification of redevelopment areas, which are areas deemed in need of revitalization and suitable for development. Additional information on zoning and land use in the Study Area can be found in **Section 3.2**, Land Use and Land Use Planning.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.18-1: Coastal Zone Management Areas

Despite centuries of development pressure, the Meadowlands District contains one of the largest urban wetland complexes in the State (the largest estuarine wetland in the Newark metropolitan area) and has been identified as a significant habitat complex in the New York/New Jersey Harbor Area (Tiner, et al. 2002). The Meadowlands District has been designated further within New Jersey's coastal zone (by CZM rules) as a "Special Area," an area "so naturally valuable, important for human use, hazardous, sensitive to impact, or particular in their planning requirements, as to merit focused attention and special management rules" (NJAC 7:7E- 3.1(a)). The Meadowlands District is designated by NJCMP as a "Geographic Area of Particular Concern" (pursuant to 16 USC § 1455), requiring "special management." According to the Federal Coastal Zone Management Program regulations at 15 CFR § 923.20, "special management" may include regulatory or permit requirements applicable only to the area of particular concern.

3.19 Sustainability/Green Infrastructure

3.19.1 Introduction

The fundamental basis of the Proposed Project is to enhance the sustainability of the Project Area by mitigating the effects of climate change, most notably coastal storm surge, inland flooding, and SLR. In concert with this basis, the Proposed Project would improve the overall resiliency of five communities with respect to potential physical and economic damages that could occur as a result of future storm events. A secondary objective for the Proposed Project is to implement green infrastructure features for additional sustainability benefits.

Green infrastructure is considered a key element of sustainable stormwater management, and is an integrated approach that considers the full lifecycle of stormwater projects including planning, design, construction, and maintenance. For the purposes of the Proposed Project, green infrastructure is defined as drainage solutions that minimize runoff from development, restore the natural hydrologic cycle, recharge groundwater, preserve open spaces, and provide long-term benefits for the affected communities (USEPA 2012a). Common approaches for implementing permanent sustainable stormwater management features include green infrastructure or low impact development (LID) strategies that emphasize nature-based methods and distributed source controls, such as permeable pavement, bioswales, rain gardens, green roofs, rain barrels, and cisterns.

This section identifies how green infrastructure features incorporated into the Proposed Project would:

- Comply with Federal sustainability directives to maximize Project benefits over costs and restore pre-development hydrology, and State regulatory guidance for the planning and design of LID techniques;
- Manage stormwater to complement drainage improvements for more frequent rainfall events and improve the quantity and quality of runoff throughout the drainage areas of the Hackensack River; and
- Provide community-level benefits.

Other Federal regulatory assessments related to energy and sustainability for air quality, GHG emissions, and global climate change can be found in **Sections 3.9**, **3.10**, **4.9**, and **4.10**. Due to the nature and scope of the Proposed Project, the application of a third-party sustainability rating system, such as the Institute of Sustainable Infrastructure's Envision or US Green Building Council's Leadership in Energy and Environmental Design (LEED), is not relevant.

3.19.2 Regulatory Context

The Project Area spans five municipalities in Bergen County, New Jersey, and is located within the Meadowlands District. The region is the subject of many laws, policies, and planning documents that require stormwater control or promote green infrastructure. This section summarizes the requirements for sustainable stormwater management, including:

- Federal policies and regulations, such as HUDs CDBG-DR Grantees, EO 13693 (*Planning for Federal Sustainability in the Next Decade*), and the Energy Independence and Security Act (EISA) of 2007 (PL 110-140);
- State and local regulations applicable to "major development;" and
- Open space policies and specific regional plans, which promote similar goals for green infrastructure, such as impervious to pervious surface conversions and maintaining or restoring the hydrologic cycle.

3.19.2.1 Federal Policies and Regulations

In 2007, EISA was signed and executed to increase US energy security, develop renewable energy production, and improve vehicle fuel economy. As part of this Act, stormwater management is also addressed. Section 438 requires new development or redevelopment projects with a Federal nexus which exceed 5,000 SF to maintain the pre-development hydrology and ensure that changes in runoff temperature, volumes, durations, and rates do not negatively impact receiving waters. To determine how to comply with these requirements and plan for future projects at Federal facilities or when Federal monies are used for design and construction of projects, Section 438 provides two options for comparing pre- and post-development runoff flows:

- **Option One:** Retaining the 95th percentile rainfall event: This option calls upon site designers to design, construct, and maintain stormwater management practices that manage rainfall onsite, and prevent the offsite discharge of stormwater from all rainfall events less than or equal to the 95th percentile rainfall event. A 95th percentile rainfall event is defined as the precipitation depth over a 24-hour period, with a minimum of 20 to 30 years of rainfall data; or
- **Option Two:** Site-specific hydrologic analysis: This option provides site designers with a process to design, construct, and maintain stormwater management practices using a site-specific hydrologic analysis to determine pre-development runoff conditions. Under Option Two, pre-development hydrology would be determined based on site-specific conditions and local meteorology by using continuous simulation modeling techniques, published data, studies, or other established tools. Pre-development hydrology is the volumes that are generated prior to development of a green site. For re-development projects, the intent is to maintain or improve the hydrologic condition of the site. Pre-development hydrology must be restored to the maximum extent feasible. The USEPA's Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal projects describes the process for identifying and sizing control measures to comply with Section 438 (USEPA 2009).

In 2015, EO 13693 (*Planning for Federal Sustainability in the Next Decade*) introduced new requirements beyond those established by EISA for GHG emissions reduction and reporting, energy conservation, renewable energy, and building performance. Installation of green infrastructure features is also explicitly encouraged to achieve the stormwater management goals of these Federal sustainability directives.

Recognizing that some sustainability benefits are difficult to quantify and compare to project costs, HUD published BCA analysis guidance "regarding the content and format of materials for approval of CDBG-

DR Action Plan Amendments releasing funds for construction of RBD projects" (HUD 2016b). This guidance allows RBD grantees to consider qualitative and quantitative measures of resiliency, environmental values, and social values as part of a project's overall BCA. For the Proposed Project, the co-benefits provided by green infrastructure, described with additional detail under **Section 3.19.3**, would be factored into the BCA developed consistent with this guidance from HUD.

3.19.2.2 State Policies and Regulations

Statewide stormwater management planning rules are discussed under NJAC 7:8, last amended on June 20, 2016. The stormwater management rules define a major development as a project that disturbs one acre of land or more or increases impervious surface by 0.25 acre or more. If a project triggers this threshold, design and construction must incorporate a number of standards. The following standards are some of the stormwater management strategies that would be considered for the Proposed Project:

- Nonstructural stormwater management strategies "to the maximum extent practicable;"
- Stormwater management measures that reduce the average annual total suspended solids (TSS) load in the development site's post-construction runoff by 80 percent and remove nutrients to the maximum extent feasible; and
- Stormwater management measures that maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site or demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the 2-year storm is infiltrated.

New Jersey's Stormwater Management rules (NJAC 7:8) are enforced by the NJDEP through the review of permits issued by its Division of Land Use Regulation, specifically through the Flood Hazard, Freshwater Wetlands, Highlands, and Coastal permit programs. The Stormwater Management rules can be implemented by municipalities through their planning and zoning processes. In the case of the Meadowlands District, jurisdiction over stormwater management planning is held by the NJSEA, which enforces stormwater and drainage regulations in accordance with the Meadowlands District Zoning Regulations, NJAC 19:4, specifically NJAC 19.4-8.6. Consistent with NJAC 7:8-2.3, municipalities, counties, soil conservation districts, regional planning agencies (such as the NJSEA), and other entities may be stormwater management planning agencies provided they are authorized under their enabling legislation to prepare stormwater management plans.

Additionally, municipalities must comply with the Municipal Stormwater Regulation Program, as per Subchapter 25 of the NJPDES regulations, NJAC 7:14A-25, which regulates discharges to surface water and groundwater of stormwater from large, medium, and small municipal separate storm sewer systems. Within the Study Area, the BCUA and member communities have formed a BCUA Combined Sewer Overflow Group, and, in accordance with an Individual NJPDES permit issued by NJDEP, are formulating and implementing a Regional Combined Sewer Overflow Long-Term Control Plan to work towards improved stormwater and surface water quality in the region.

NJDEP created the New Jersey Stormwater Best Management Practices Manual in April 2004. This manual, which has been updated periodically (most recently in September 2017), provides, in part, design specifications, removal rates, calculation methods, and soil testing procedures approved by the NJDEP as being capable of contributing to achievement of the standards specified in the stormwater management rules.

3.19.2.3 Regional and County Policies and Regulations

As described above, the NJSEA has authority to implement applicable components of NJAC 7:8 on behalf of member municipalities within the Meadowlands District. Bergen County has a separate Stormwater Management Program that applies to development sites of 2 acres or more. It is through this program that the Bergen County Planning Board may require plan review and stormwater management facilities based on the gross size of new development. The Meadowlands District Zoning Regulations (NJAC 19:4) provide requirements for stormwater management design. In addition, the NJSEA Master Plan identifies green infrastructure and best management practices (BMPs) for controlling stormwater from development as one of its strategies for enhancing and capitalizing on the Meadowlands District's waterways as a critical asset of the NJSEA District. Conformance with the BCUA Regional Combined Sewer Overflow Long-Term Control Plan would also be a consideration for proposed development within the BCUA service area that would impact the storm sewer system.

3.19.2.4 Municipal Policies and Regulations

Of the five communities located in the study area of the Proposed Project, both the Boroughs of Little Ferry and Carlstadt have developed Master Plan Re-examination Reports that emphasize the importance of sustainability initiatives as part of future master plan updates (Little Ferry Land Use Board 2013, Borough of Carlstadt Planning Board 2013). The Borough of Little Ferry's 2013 Master Plan Re-examination Report considers green infrastructure to reduce flooding, and suggests that the Borough also consider open space set-asides as a method of providing flood water storage during weather events. The Borough of Carlstadt's 2013 Master Plan Re-examination Report recommends the Borough pursue a Sustainable Jersey Certification. This certification provides access to grants and identifies funding opportunities for sustainable projects, including green infrastructure, as part of an initiative of the New Jersey League of Municipalities' Mayors' Committee for a Green Future, the municipal Land Use Center at the College of New Jersey, the New York Department of Environmental Protection, the New Jersey Board of Public Utilities, and a coalition of non-profits and other State agencies.

3.19.3 Existing Conditions

This section provides an overview of green infrastructure benefits, the existing conditions within the Project Area that can be evaluated to determine the impacts of green infrastructure at the watershed scale, and compare pre- and post-development conditions. Implementing green infrastructure features provides benefits to communities, including economic, social, and environmental benefits.

- **Economic benefits:** These benefits include financial savings in terms of pumping stormwater flows, local hiring and procurement for construction and maintenance of green infrastructure installations, and potential property value increases where green infrastructure or related amenities are located adjacent to existing parcels, particularly where adjacent parcels are vacant or blighted.
- **Built Human Environment and Social benefits:** These benefits include increased waterfront access, enhanced recreational, civic, and/or cultural features and uses (for example, where green infrastructure sites are designed as new public open spaces or connections to pedestrian, bicycle, or transit routes are created), and enhanced viewsheds and local visual quality. In addition, these benefits may include community engagement and partnerships to site, design, construct, or maintain green infrastructure systems.
- **Ecological and Environmental benefits:** In addition to the water quality benefits provided by reductions in stormwater runoff, ecological uplift and services are provided by green and natural

spaces, including habitat for pollinators, as part of green infrastructure design, and localized urban heat island reductions occur by creating shaded or pervious surface area.

Table 3.19-1 lists specific green infrastructure metrics that were used to guide the identification of green infrastructure features in the Project Area as part of the Proposed Project. The green infrastructure metrics for sustainable stormwater management were developed based on the purpose and need for the Proposed Project. Additionally, planning and design guidance was considered from the USEPA Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of EISA (USEPA 2009), New Jersey Stormwater Best Management Practices Manual (NJDEP 2004a), and Tier A Municipal Stormwater Guidance Document, NJPDES General Permit No NJ0141852.

Based on site visits, aerial images, and a review of municipal plans and funding sources within the Project Area, no green infrastructure features currently exist in the five communities.[31] Therefore, existing conditions are specific to current drainage networks, including sewers and surface waterways, impervious surface coverage and rainfall events that generate runoff rates within these networks, and volumes from impervious surfaces.

Table 3.19-1: Green Infrastructure Metrics for Sustainable Stormwater Management and Related Existing Conditions

Metric	Related Existing Condition	Relevant EIS Sections
Enhanced capacity or level of service within existing or proposed drainage systems	Drainage networks within five communities; rainfall conditions	Utilities and Service Systems (**Section 3.12**); Hydrology and Flooding (**Section 3.17**)
Reduced peak runoff and control of stormwater runoff quantity impacts	Impervious surface coverage; runoff generated within topography-(LiDAR) delineated sub-watersheds; rainfall conditions	Hydrology and Flooding (**Section 3.17**); Water Resources, Water Quality, and Waters of the US (**Section 3.16**)
Infiltration of runoff and groundwater recharge	Impervious surface coverage; runoff generated within topography-(LiDAR) delineated sub-watersheds; drainage networks within five communities; rainfall conditions	Utilities and Service Systems (**Section 3.12**); Hydrology and Flooding (**Section 3.17**)
Improved compliance with stormwater runoff quality standards	Land use cover; runoff generated within topography- (LiDAR) delineated sub-watersheds; surface water resources; rainfall conditions	Land Use and Land Use Planning (**Section 3.2**); Hydrology and Flooding (**Section 3.17**); Water Resources, Water Quality, and Waters of the US (**Section 3.16**)

Impervious surface coverage is an existing condition that can be effectively managed by green infrastructure, and the amount of impervious surfaces also impacts the sizing of green infrastructure features. Impervious surface is material such as concrete and asphalt that comprise roadways, parking areas, sidewalks and buildings and limits infiltration of stormwater into the ground. Impervious surfaces generate rates of runoff faster than grassed or vegetated areas that slow flow or open spaces and pervious areas that infiltrate stormwater. High peak runoff rates can create capacity issues in downstream drainage systems or erosion problems in stream channels. In addition, runoff from

[31] For the purposes of this EIS, green infrastructure features and source controls are differentiated from drainage ditches and basins that may currently be found within the Project Area.

roadways and developed sites with parking lots can collect petroleum products, salts, and other contaminants and transport them to the receiving waterbody.

Through GIS analysis, pervious and impervious surfaces were calculated. The impervious surface layer was taken from the NJDEP Land Use 2012 data set. As the land use/land cover of each polygon was mapped from 2012 aerial photography, a visual estimate was also made of the amount of impervious surface in each. This estimate was recorded as a percentage of the total polygon area, in five percent increments. Based on this estimate, it was determined that the Project Area contains approximately 2,187 acres (40 percent) of impervious surface and 3,218 acres (60 percent) of pervious surface. The existing impervious surface coverage in the Project Area represents the current (pre-development) condition (**Figure 3.19-1**). This information, when combined with existing drainage networks, drainage area, and rainfall conditions, indicates where runoff rates and volumes, and associated problems, may be greatest within the Project Area (i.e., locations that are 61 to 80 or 81 to 100 percent impervious).

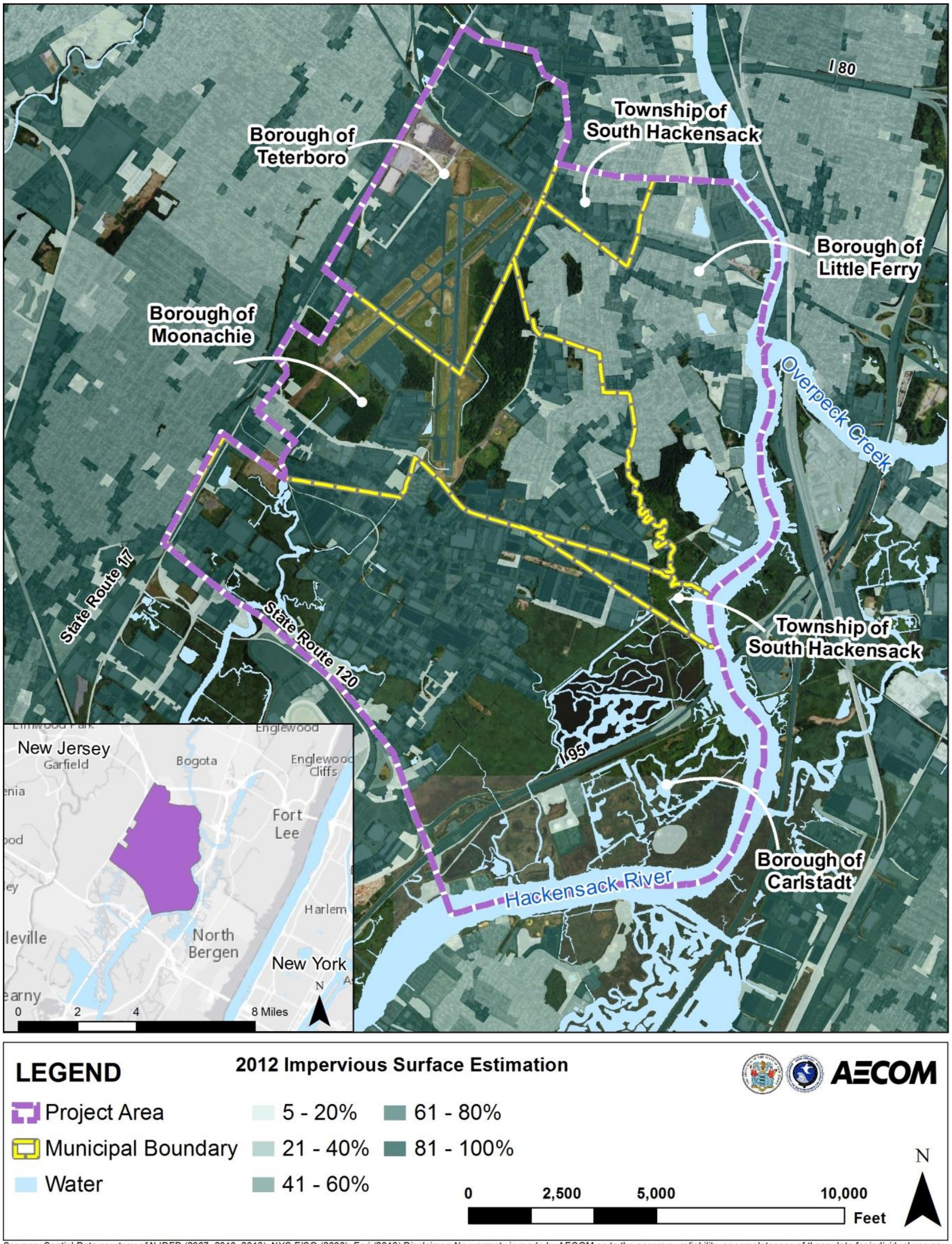


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Figure 3.19-1: Impervious Surfaces Based on NJDEP Land Use 2012 Data Set

3.20 Hazards and Hazardous Materials

3.20.1 Introduction

Hazardous materials are substances that pose a potential threat to human health or the environment, either by themselves or through interactions with other factors, and may be released to the soil, soil vapor, groundwater, surface water, or sediment. These materials are frequently encountered during construction activities in industrial areas that have been subject to past disturbance from construction, excavation, filling, and industrial uses. Hazardous waste is waste that poses substantial or potential threats to human health or the environment. The treatment, storage, and disposal of hazardous waste in the US are regulated under the Resource Conservation and Recovery Act (RCRA). This section assesses the potential for the presence of these materials in the Project Area.

Common contaminants of potential concern for the Project Area and adjacent uses are provided below.

- PCBs are most often associated with fluids in electrical and hydraulic equipment. They are also used as plasticizers in paints, and are found in pigments and dyes.
- Heavy metals, including arsenic, lead, cadmium, chromium, and mercury, can cause contamination from industrial discharges, application of agricultural pesticides (arsenic and lead), historic uses of leaded-gasoline and lead-based paint, and stormwater runoff after contact with automotive brakes and tires.
- VOCs are found in materials such as gasoline, dry cleaning fluid, degreasers, and paint thinners, which volatilize from liquid into vapors producing the familiar odors associated with these chemicals. VOCs are used in almost every type of industry and are frequently discovered in contaminated soil, groundwater, and soil vapor.
- SVOCs are found in many products, but major sources of an important subset of SVOCs (PAHs) are automobile exhaust and combustion of fuel (e.g., coal, wood, diesel) to generate power and heat. The waste products of combustion, such as coal ash, also contain PAHs.
- Pesticides and herbicides are associated with agriculture, ornamental crops, and pest control.

3.20.2 Regulatory Context

Regulated hazardous substances are identified through a number of Federal and State laws and regulations. A summary of the potentially applicable, relevant, and appropriate laws and regulations for the Proposed Project that govern the investigation, remediation, handling, disposal, and release of hazardous materials, hazardous substances, hazardous waste, and contaminated materials is included in **Table 3.20-1**. More detailed information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

Table 3.20-1: Summary of Federal and State Laws and Regulations

Law/Regulation	Project Context
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; 42 USC §§ 9601 *et seq.*)	Provides a Federal "Superfund" to fund or oversee cleanup of uncontrolled or abandoned hazardous waste sites. The most contaminated sites are generally CERCLA sites.
Superfund Amendments and Reauthorization Act (SARA; 42 USC §§ 9601 *et seq*.)	Reauthorized CERCLA to continue hazardous waste site cleanup activities. SARA Title III authorized the Emergency Planning and Community Right-to-Know Act (EPCRA).
Resource Conservation and Recovery Act (42 USC §§ 6901 *et seq*.)	Established "cradle-to-grave" requirements for hazardous waste from its generation through transportation, treatment, storage, and disposal.
Toxic Substances Control Act (TSCA; 15 USC §§ 2601 *et seq*.)	Addresses the production, importation, use, and disposal of specific chemicals, including PCBs, asbestos, radon, and lead-based paint.
Site Contamination (24 CFR § 50.3(i) and 24 CFR § 58.5(i)(2))	Establishes requirements for properties used in HUD programs regarding hazardous materials, contamination, toxic chemicals and gases, and radioactive substances, including if those properties are located within 3,000 feet of a toxic or solid waste landfill.
Identification of Explosive and Flammable Operations (24 CFR § 51C)	Establishes an Acceptable Separation Distance (ASD) that must be calculated for HUD-funded projects "from specific, stationery, hazardous operations that store, handle, or process hazardous substances" and have the potential to be an explosive or combustible hazard, such as ASTs.
Discharges of Petroleum and Other Hazardous Substances (NJAC 7:1E)	Covers the discharge of hazardous substances, including procedures to be followed in the event of a hazardous substance discharge.
Surface Water Quality Standards (NJAC 7:9B)	Specifies surface water quality criteria for toxic substances for human health and aquatic resources; used to evaluate impacts from contaminated groundwater discharging to surface water.
Groundwater Quality Standards (NJAC 7:9C)	Specifies groundwater classification, designated uses, and groundwater quality criteria and constituent standards.
Pollutant Discharge Elimination System Rules (NJAC 7:14A)	Regulates the discharge of pollutants to the surface water and groundwater of the State.
Underground Storage Tanks (NJAC 7:14B)	Establishes requirements for the registration, operation, design, construction and installation, permitting, release reporting and investigation, remediation, and closure of underground storage tanks and underground storage tank systems.
Solid Waste (NJAC 7:26)	Establishes standards and requirements for the management of solid waste (e.g., landfills).
Industrial Site Recovery Act (ISRA) Rules (NJAC 7:26B)	Requires the owner or operator of an industrial establishment to perform remedial activities as a pre-condition to closing operations, or transferring ownership or operations.

Law/Regulation	Project Context
Administrative Requirements for the Remediation of Contaminated Sites (NJAC 7:26C)	Contains criteria concerning whether and when remediation must be conducted under the supervision of a New Jersey Licensed Site Remediation Professional (LSRP). Establishes remedial timeframes.
Site Remediation Reform Act (NJSA 58:10C)	Establishes the LSRP program, the licensing board, and mandatory remedial timeframes.
Remediation Standards (NJAC 7:26D)	Establishes minimum standards for the remediation of contaminated groundwater and surface water and the minimum residential direct contact and non-residential direct contact soil remediation standards.
Technical Requirements for Site Remediation (NJAC 7:26E)	Sets forth the NJDEP's minimum technical requirements for investigating and remediating sites that are contaminated or at which contamination is suspected.
Spill Compensation and Control Act (NJSA 58:10-23.11)	Requires submission of discharge prevention, control and countermeasure plans, evidence of financial responsibility for cleanups, and reporting of unauthorized discharges.
Brownfield and Contaminated Site Remediation Act (NJSA 58:10B-1 *et seq.*)	Establishes requirements for the remediation of discharges of hazardous substances, remedial standards, and remediation funding source.

In addition to the Federal and State laws and regulations described above, American Society for Testing and Materials (ASTM) E1527-13, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, establishes the standard industry practice for assessing the environmental condition of a property. The specific reporting requirements for all appropriate inquiries, which include the evaluation of a property's environmental condition and the assessment of the likelihood of any contamination, are established under 40 CFR §§ 312.20-312.31, Standards and Practices for All Appropriate Inquiries and ASTM E1527-13.

3.20.3 Existing Conditions

The affected environment includes parcels of land and surface waterbodies within the communities of the Project Area having confirmed or suspected presence of hazardous materials, hazardous substances, or other contaminants. The Project Area is urban and densely developed with land uses ranging from heavy industry, transportation corridors, and residential use to open space, wetlands, and large areas set aside for recreation. For over 200 years, the Meadowlands District was subject to landfilling, dumping, and both intentional and unintentional releases of hazardous materials.

In order to gather existing information and data within the Project Area, the following sources were obtained and reviewed: a database search performed by Environmental Data Resources (EDR), Site Remediation Program GIS layers from NJ-GeoWeb, CEAs, Deed Notices, and HazSite analytical data, as well as reports specifically prepared for investigations of contaminated sites in the Project Area. Supplemental evidence from historic maps was also gathered to determine the presence of contaminants including:

- Historic aerial photographs provided by NETROnline (for the years 1931, 1953, 1954, 1966, 1970, 1979, 1987, 1995, 2002, 2006, 2008, 2010, 2012, and 2013);

- Historic topographic maps provided by the US Geological Survey (USGS) (Paterson 15-Minute Series: 1888, 1898, 1900, 1903; Passaic 30-Minute Series: 1900 and 1905); Weehawken 7½-Minute Series: 1935, 1940, 1943, 1947, 1967, 1981, and 1995); and
- Sanborn® Fire Insurance Maps for the Borough of Little Ferry (1909, 1918, 1925, 1931, 1940, and 1959).

The properties identified during the review process as representing an environmental concern were classified according to the ASTM International's "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process" Designation E 1527-13 terminology as follows:

- Recognized Environmental Condition (REC): "The presence or likely presence of any hazardous substance or petroleum products in, on, or at a property: (1) due to any release to the environment; (2) under conditions indicative of a release to the environment; or (3) under conditions that pose a material threat of a future release to the environment."
- Historical Recognized Environmental Condition (HREC): "A past release of any hazardous substance or petroleum products that has occurred in connection with the property and has been addressed to the satisfaction of the applicable regulatory authority or meeting unrestricted residential use criteria established by a regulatory authority, without subjecting the property to any required controls (e.g., property use restrictions, Activity and Use Limitations [AULs], institutional controls, or engineering controls)."
- Controlled Recognized Environmental Condition (CREC): "A REC resulting from a release of hazardous substances or petroleum products that has been addressed to the satisfaction of the applicable regulatory authority (e.g., as evidenced by the issuance of a No Further Action [NFA] letter or equivalent, or meeting risk-based criteria established by regulatory authority), with hazardous substances or petroleum products allowed to remain in place subject to the implementation of required controls (e.g., property use restrictions, AULs, institutional controls, or engineering controls)."

In cases where the existing information indicated that contaminated sites may affect the Proposed Project through the migration of contaminated groundwater, additional information, including a site visit and/or NJDEP and municipal file reviews of the contaminated sites, was obtained to determine the location, type and extent of contamination within the Project Area. Based on this data gathering process, a summary of RECs, HRECs, and CRECs that could pose constraints on the Proposed Project was compiled. These include:

- USEPA Superfund sites on the National Priorities List (NPL);
- Known historic landfills;
- Groundwater CEAs (see **Section 3.16.3.2**);
- Known Contaminated Sites (KCSs); and
- Other potential RECs, including active underground storage tank (UST) remediation sites, automobile filling stations and service stations, and NJDEP-mapped historic fill.

3.20.3.1 USEPA Superfund Sites on NPL

Three USEPA Superfund sites are located within, or in close proximity to, the Project Area: Scientific Chemical Processing (SCP), Ventron/Velsicol, and Universal Oil Products (UOP). The Ventron/Velsicol site is a large, complex site on the NPL that has been broken down into Operable Units (OUs). OUs are smaller, more manageable portions of the site often defined by the type and location of the contamination relative to the original area of discovery (also known as the source area). The

Ventron/Velsicol OU2 site is known as the BCSA; it encompasses a large part of the western portion of the Project Area along Berry's Creek, as well as all three of the Superfund sites identified herein (see **Figure 3.20-1**).

Scientific Chemical Processing

SCP is a former waste processing facility that operated prior to 1980 and accepted various wastes for recovery and disposal. SCP operated on a 6-acre parcel in the Borough of Carlstadt at 216 Paterson Plank Road. This property is located on the southern banks of Peach Island Creek, which is a tributary to Berry's Creek. During operations, SCP stored approximately 375,000 gallons of hazardous substances onsite in tanks, drums, and tank trailers. The facility closed in 1980 in response to a court order and was placed on the NPL in 1983. Investigations beginning in 1987 revealed potential contaminants of concern in soil and groundwater, including VOCs, SVOCs, PCBs, pesticides, inorganics, and metals (USEPA 2012b). The site is currently vacant.

The 1990 USEPA ROD for OU1 of SCP defined it as "contaminated soils and groundwater above the clay layer" within the 6-acre SCP parcel. The primary objective of the ROD was to reduce the migration of hazardous substances into the groundwater and surface water of Peach Island Creek until a permanent remedy for the site was selected. The fully implemented, interim remedy for OU1 included a containment wall, a barrier covering the property, a retaining wall along Peach Island Creek, a groundwater extraction system, groundwater sampling and monitoring, and a fence around the site's perimeter (Golder Associates Inc. 2009).

The August 2002 USEPA ROD for OU2 of SCP included soil, groundwater, and sludge (mud-like material resulting from industrial or refining processes) above the clay layer throughout much of the 6-acre parcel. The fully implemented, final remedy for OU2 included new groundwater treatment systems at the site, the installation of a cover system over the fill area, improvements to the existing groundwater extraction system implemented during OU1, the installation of additional groundwater monitoring wells, improvements to the retaining wall installed during OU1 along Peach Island Creek, and restrictions for future use of the property (USEPA 2012b).

The September 2012 USEPA ROD for OU3 of SCP addressed off-property and deep groundwater contamination. Contamination of Peach Island Creek will be addressed as part of the remedy selected for the BCSA. The selected remedies that remain to be implemented are in-place groundwater treatment technologies, natural degradation of site contaminants over time, and further property use restrictions (USEPA 2012b).

Ventron/Velsicol

The Ventron/Velsicol site is a former mercury processing and manufacturing plant that operated between 1927 and 1974 at a 38-acre property in the Boroughs of Carlstadt and Wood-Ridge. Ventron/Velsicol is located south of Ethel Boulevard and on the western bank of Berry's Creek. The western side of the West Riser Tide Gate touches the eastern boundary of the site. Disposal of approximately 160 tons of process wastes, including mercury, resulted in soil, sediment, groundwater, and surface water contamination of the site and Berry's Creek. Several investigations have been conducted since the initial involvement of NJDEP in the 1970s. Regulatory oversight was transferred to the USEPA when the site was placed on the NPL in 1984 (USEPA n.d.).

The Ventron/Velsicol site consists of two OUs. OU1 is designated as a 7-acre developed area and 19-acre undeveloped area. OU2 is designated as the Berry's Creek watershed, which represents the

BCSA. Potential contaminants of concern in soil, sediments, and onsite groundwater in OU1 include metals, VOCs, and SVOCs (Exponent 2004). Air samples collected in the 1970s detected mercury in ambient air exceeding environmental guidelines (NJDEP 2015b); however, resampling in 1997 and 1998 determined gaseous mercury levels were below recommended exposure limits (Exponent 2004). The remediation of OU1 was completed in December 2010 (NJDEP 2015b).

Mercury contamination from the Ventron/Velsicol site impacted Berry's Creek, its tidally influenced tributaries, and the Hackensack River. Further, investigation and delineation of offsite contamination of Nevertouch Creek and Diamond Shamrock/Henkel Ditches is ongoing (NJDEP 2015b).

The BCSA boundary is the limit of the Berry's Creek Watershed within the Boroughs of Rutherford, East Rutherford, Carlstadt, Wood-Ridge, Moonachie, and Teterboro. Within the BCSA boundary are two Superfund sites, SCP and UOP, in addition to the BCSA designation as OU2 of the Ventron/Velsicol Superfund site (see **Figure 3.20-1**). Portions of the BCSA located in the Project Area include Upper Berry's Creek, East Riser Ditch, West Riser Ditch, and Upper Peach Island Creek (USEPA 2008).

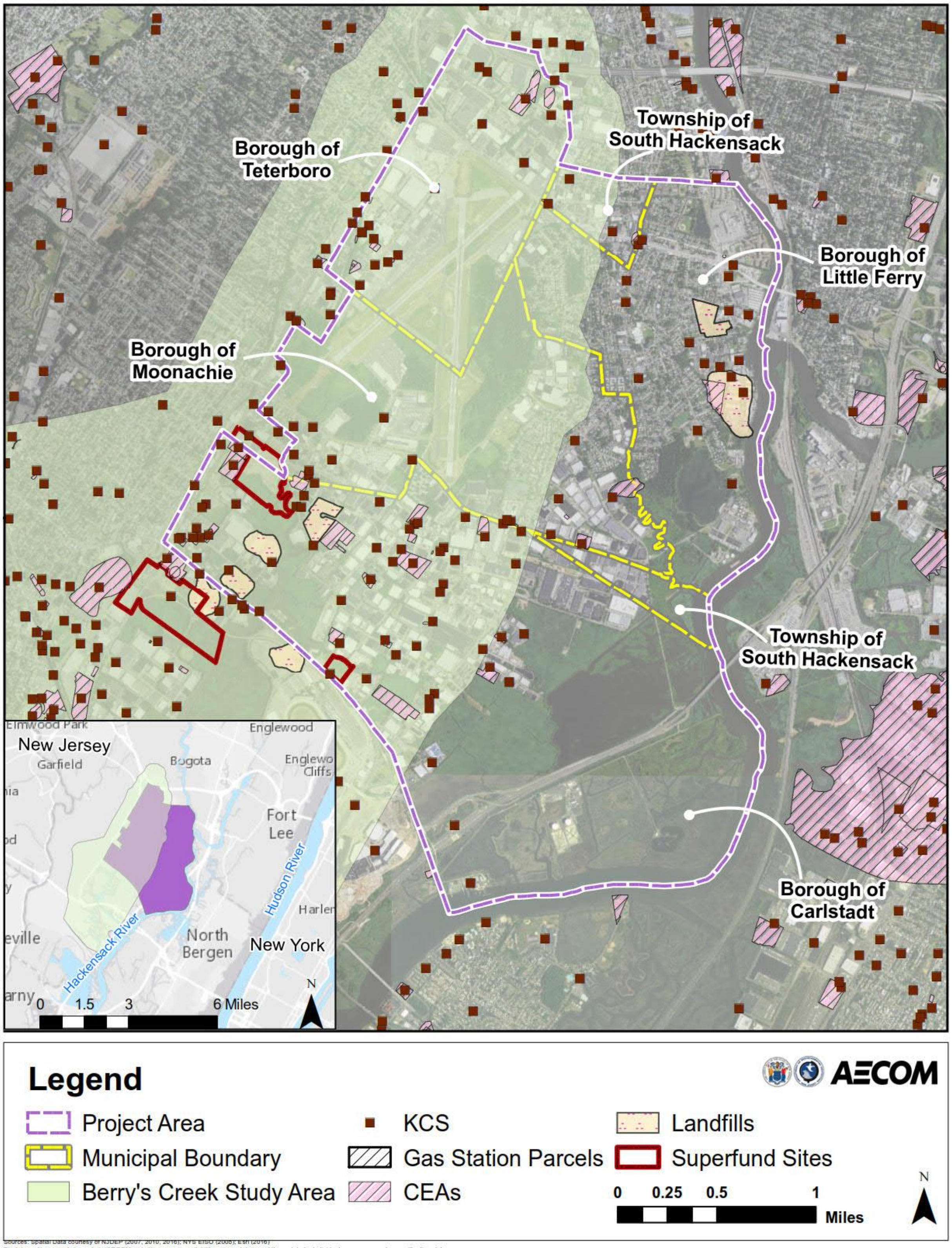
Industrial discharges, sewage treatment plant discharges, and landfills resulted in contamination in the BCSA. Elevated concentrations of mercury and PCBs are present in waterway and marsh sediments within the Upper Peach Island Creek and Upper Berry's Creek areas. Ongoing sources of contamination to BCSA include upland groundwater and stormwater runoff, permitted and unpermitted surface water and groundwater discharges, atmospheric deposition, and contaminant flux from other sources within the Hackensack River estuary. Contamination is further dispersed by the tidal forces of the estuary, potentially resulting in impacts to sediment and soils in additional locations.

Universal Oil Products

The UOP site is a former chemical manufacturing facility that operated between 1932 and 1970. It encompasses approximately 74 acres. Operations ranged from use as an aroma chemical laboratory to handling of chemical wastes and solvent recovery. Approximately 4.5 million gallons of waste solvents and solid chemical wastes were discarded into two unlined lagoons during the facility's operation, resulting in soil, surface water, and groundwater contamination. UOP was placed onto the NPL in September 1983. NJDEP was the lead agency for the site between 1982 and 2008. USEPA assumed the role of lead agency in July 2008 (USEPA 2016r).

UOP includes two OUs. OU1 consists of the upland areas of the site, located in the western and northern portions of the parcel; OU1 is addressing soil and groundwater contamination. Contaminants of concern include VOC, PAH, PCB, and lead in soil, and VOCs in leachate/shallow groundwater. The major components of the selected remedy included excavation of soil, on-site treatment by thermal desorption, thermally enhanced vapor extraction, soil cover/impermeable caps, deed restrictions, leachate collection, and discharge of treated effluent to groundwater. As of September 2016, remediation of OU1 was not complete. The final remedy for the OU1 portion of the site will be provided in the OU2 ROD (USEPA 2016r).

OU2 consists of the areas located in the southeastern portions of the parcel, and extends eastward to Berry's Creek. Some remedial actions, including groundwater collection, excavation, thermal treatment, and multimedia caps, have been performed in OU2 during remediation of OU1. However, no ROD has been finalized as of September 2016 (USEPA 2016r).



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2005); Esri (2016)
Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completenessof these data for individual use or aggregate usewith other data.
This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.20-1: Locations of Superfund Sites, CEAs, KCSs, and Landfills within the Project Area

3.20.3.2 Historic Landfills

Seven historic landfills are located within 3,000 feet of the Build Alternative footprints and are considered RECs:

- Two Zurn Section G landfills located in the southwestern portion of the Project Area, north of Paterson Plank Road and west of Berry's Creek;
- Two Zurn Section H landfills located in the southeastern portion of the Project Area, between the New Jersey Turnpike (I-95) and the Hackensack River;
- Little Ferry Landfill, located near Gates Road along the Hackensack River;
- Willow Lake Park (i.e., Esposito Construction Company); and
- Morris Park Avenue Corporation.

Domestic waste, refuse, and demolition debris in these landfills contain many contaminants of concern, including VOCs, SVOCs, metals, PCBs, and pesticides. **Figure 3.20-1** provides the locations of known landfills within the Project Area.

Zurn Series G and H Landfills

The Series G and H historic landfills contained 10 feet of burned refuse, and 10 feet of semi-burned refuse, respectively (Zurn Environmental Engineers 1970). The Project Area contains two historic landfill locations for each series in the Borough of Carlstadt. The Series G historic landfills are north of Paterson Plank Road between 20th Street and Berry's Creek, adjacent to Berry's Creek and its connected tributaries. The Series H historic landfills are in the southeastern portion of the Project Area, between the New Jersey Turnpike (I-95) and the Hackensack River.

Little Ferry Landfill

The 35-acre Little Ferry landfill located in the Borough of Little Ferry, adjacent to the Hackensack River, south of Industrial Avenue, operated prior to 1968 and was closed in 1970. The site accepted approximately 700 tons of solid waste per week, consisting of approximately 5 percent domestic waste and 95 percent demolition waste (Zurn Environmental Engineers 1970).

Willow Lake Park

A brickyard occupied the present Willow Lake Park site until the 1930s in the Borough of Little Ferry. Between the 1930s and the 1970s, Willow Lake was approximately the size of the parcel defined by the current boundary of Willow Lake Park. In the early 1970s, the Borough of Little Ferry added fill material consisting of "approved earth and noncombustible demolition material" to reduce the size of the lake to its present area (Borough of Little Ferry 1971-1972). The NJDEP Division of Solid and Hazardous Waste identifies the site as "Esposito Const. Co." on the New Jersey Landfill List.

Morris Park Avenue Corporation

This landfill is located at the Meadowlands Distribution Center, 350 Starke Road, near the West Riser Tide Gate in the Borough of Carlstadt. NJDEP issued several solid waste violations to the Morris Park Avenue Corporation in the 2000s regarding permitting, emissions, and placement of fill without approval.

3.20.3.3 Groundwater Classification Exemption Areas

The Project Area has more than 40 groundwater CEAs. NJDEP defines CEAs as sites with identified groundwater contamination in accordance with NJAC 7:9C-1.6 and 1.9(b). CEAs are geographically defined areas within which specific contaminants have exceeded New Jersey Groundwater Quality

Standards, and for which institutional controls, or administrative and legal controls, have been established.

CEAs are established to provide notice that the pollutant standards for a given aquifer, or body of permeable rock that can contain or transmit groundwater, are not, or will not be, met in a localized area due to natural water quality or anthropogenic influences. CEAs specify that designated aquifer uses are suspended in the affected area for the term of the CEA. CEAs are treated as CRECs in that they are institutional controls for groundwater contamination to remain in place for a specified period of time with approval from NJDEP. Contaminants resulting in the CEA designations within the Project Area primarily include VOCs, SVOCs, metals, and PCBs.

Tables in **Appendix N** summarize the CEAs in the Project Area, including site names, NJDEP Program Interest (PI) numbers, addresses, total sizes of the CEAs, the depths below ground surface of the CEAs, the year the CEAs were established, the duration of the CEAs in years, and the contaminants of concern. **Figure 3.20-1** provides the locations of the CEAs within the Project Area.

3.20.3.4 Known Contaminated Sites

The KCS list contains non-homeowner sites and properties within the State where contamination of soil and/or groundwater has been confirmed at levels equal to or greater than applicable standards. The list may include sites where remediation is either currently underway, required but not yet initiated, or where it has been completed. The KCS list contains most of the contaminated sites within the State, including identified Industrial Site Recovery Act (ISRA) facilities and sites where releases of hazardous substances are known to have occurred. ISRA sites are properties occupied by facilities with specific North American Industry Classification System (NAICS) codes listed in the ISRA regulation. These sites have mandatory remediation requirements when certain business and property transactions occur, which are not always planned (e.g., a business owner dies and the business is sold). Non-ISRA sites where releases of hazardous substances have occurred are known as discharge sites. Discharges (NJAC 7:1E) are unplanned events where contamination has been released onto the lands or waters of the State (e.g., a drum containing chemicals is knocked over outdoors and gets into a stormwater basin).

KCSs where remediation has not yet been completed are treated as RECs. KCSs where Deed Notices and/or CEAs have been established are treated as CRECs, as engineering and/or institutional controls are in place to address contaminated soil and/or groundwater. In addition, KCSs that have been issued Restricted Use NFA letters (previously issued by the NJDEP) or Limited Restricted Use or Restricted Use Response Action Outcomes (RAOs; issued under the current New Jersey Licensed Site Remediation Professional [LSRP] program) are treated as remediated; however, they include engineering and/or institutional controls and are, therefore, considered CRECs. KCSs that have been issued Unrestricted Use NFA letters or Unrestricted Use RAOs are treated as remediated and, therefore, are considered HRECs. There are more than 100 sites on the KCS list in the Project Area. Tables in **Appendix N** summarize the sites on the KCS list that were determined to have the greatest potential to be impacted by the Build Alternatives and No Action Alternative based on professional judgment of the available data for each site. **Figure 3.20-1** depicts the locations of the sites on the KCS list.

3.20.3.5 Other Potential RECs

Other potential RECs identified within the Project Area included UST Active Remediation sites, gasoline filling stations and automobile service stations, and areas containing historic fill material.

USTs are generally used to store petroleum products such as heating and motor fuel underground, but may also be used for the storage of other compounds. Corrosion, damage, and loose fittings may result in leaks that impact the subsurface. Surface spills result from overfilling. These releases of petroleum and other substances to the environment require remediation. The UST Active Remediation Sites list includes dozens of sites in the Project Area with leaking USTs where remediation has not yet been completed. These sites would be considered RECs in the Project Area because the remediation is still ongoing.

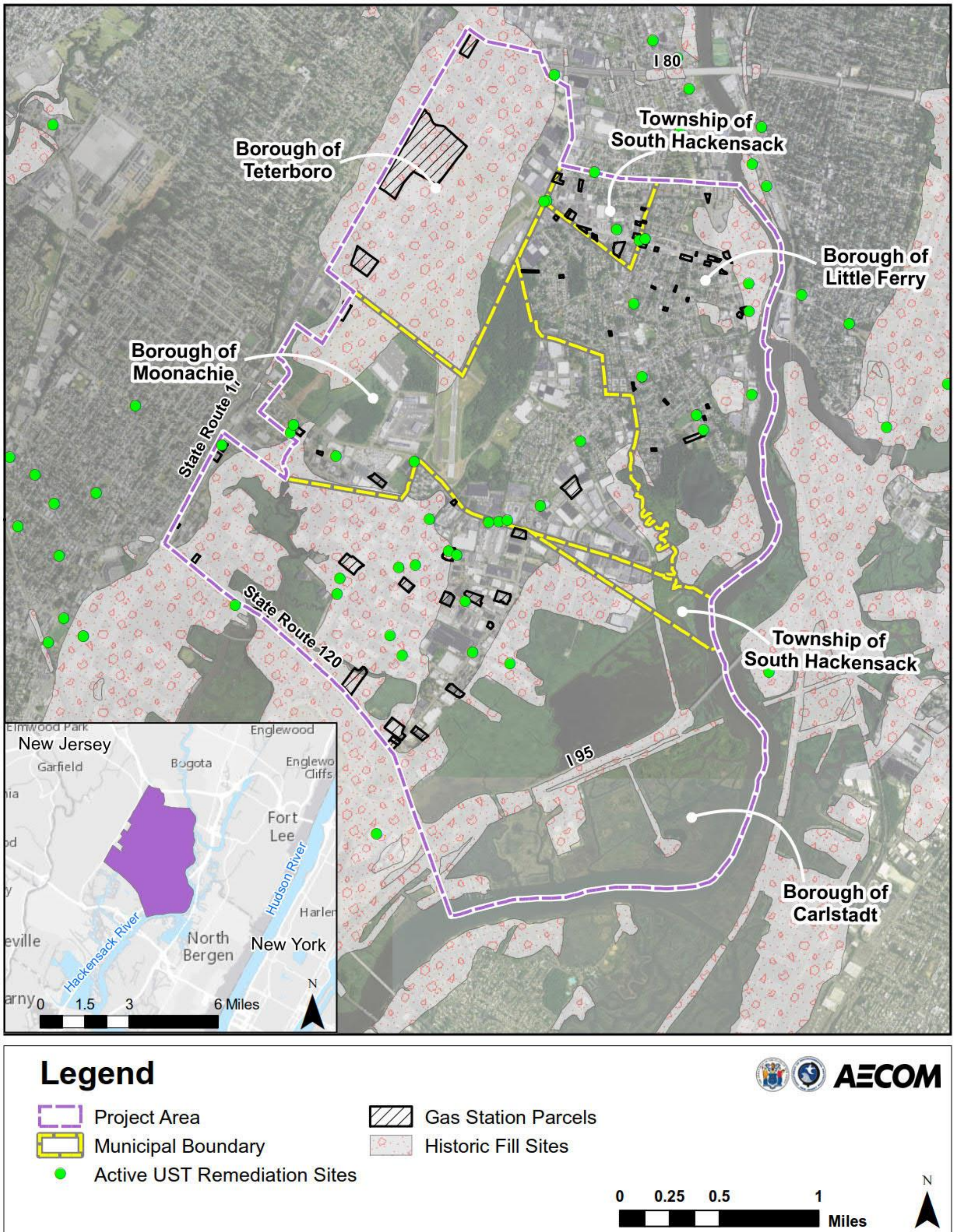
Several gasoline filling stations and automobile service stations are located within the Project Area. UST failures are common at gasoline filling station sites. Surface spills result from automobile fluid discharges and fueling overfills. The releases of petroleum products and metal fuel additives (e.g., lead) to the environment require remediation. These known gasoline filling station and automobile service station sites would be considered RECs in the Project Area due to the high likelihood of contamination.

The Project Area contains approximately 1,850 acres of NJDEP-mapped historic fill. According to NJDEP, "historic fill material means non-indigenous [non-native] material, deposited to raise the topographic elevation of the site, which was contaminated prior to emplacement, and is in no way connected with the operations at the location of emplacement and which includes, without limitation, construction debris, dredge spoils, incinerator residue, demolition debris, fly ash, or non-hazardous solid waste. Historic fill material does not include any material that is substantially chromate chemical production waste or any other chemical production waste or waste from processing of metal or mineral ores, residues, slag or tailings. In addition, historic fill material does not include a municipal solid waste landfill site" (NJAC 7:26E-1.8). Historic fill material commonly contains elevated concentrations of SVOCs and metals, and is treated as a REC unless it is capped/covered. A CREC designation may be appropriate for capped historic fill. Tables in **Appendix N** summarize other potential RECs. **Figure 3.20-2** provides a map of UST Active Remediation sites, gasoline filling stations and automobile service stations, and historic fill as delineated by NJDEP (NJDEP 2004b).

3.20.3.6 Aboveground Storage Tanks (ASTs)

While all existing hazards and hazardous materials were identified for their spatial relation to Proposed Project components, HUD policy requires an explosive and flammable operations evaluation of the Project Area for public threat (24 CFR Part 51C). Specifically, this requires the evaluation of the distance that existing ASTs are from the Proposed Project features that would have a draw or increase in public use, such as a public park or recreational component. As such, this Acceptable Separation Distance (ASD) evaluation was performed in accordance with 24 CFR Part 51C and HUD's Acceptable Separation Distance Guidebook (HUD 2011). Using both aerial imagery and site reconnaissance, the presence, size, contents, and condition were determined for ASTs that could impact the Proposed Project. The Preliminary Acceptable Separation Distance Technical Report for the Proposed Project is included in **Appendix O**.

A total of 41 potential AST sites were identified during the desktop review, of which a total of 19 facilities with ASTs were confirmed during the site visit (see **Table O-1** in **Appendix O**). Field-assessed ASTs were photo-documented (see Attachment 1 to **Appendix O**). The ASTs range in size from 1,000 gallons to 250,000 gallons. AST contents that are not under pressure include petroleum products (e.g., diesel, gasoline, heating oil, or waste oil), solvents (e.g., toluene, ethyl acetate, or normal butyl acetate), polyethylene resin, or chlorine. Pressurized AST contents include liquid oxygen, liquid nitrogen, or an unknown gas. The site investigation revealed that five of the facilities have ASTs with secondary containment (i.e., AST 1, 6, 11, 14, and 15) in the form of a fabricated containment wall.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016)
Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completenessof these data for individual use or aggregate usewith other data.
This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.20-2: Historic Fill, Gas Stations, and UST Remediation Sites within the Project Area

3.21 Mineral and Energy Resources

3.21.1 Introduction

Mineral resources are concentrations of nonfuel-based materials that can be extracted from the Earth, typically through mining or quarrying operations. Examples of mineral resources include gold, aluminum, copper, limestone, clay, precious stones/gems, gravel, and sand. These materials have economic value and are used in construction and industrial processes. A mineral-producing area has mineral commodities that are mined, quarried, or otherwise extracted or generated as domestic product. Mineral resources would be required to construct the Proposed Project and adequate resources are not available in the Project Area. Accordingly, the Study Area for mineral resources includes the Project Area, as well as locations of quarries and material suppliers in the region, extending up to 30 miles from the Project Area (see **Figure 3.21-1**).

Energy resources include both non-renewable and renewable sources of energy and associated electric power generation facilities. Non-renewable energy resources are those for which there is a finite supply and include fossil fuels such as petroleum, natural gas, and coal, as well as nuclear power. Renewable energy sources are those that can be naturally replenished and include solar, wind, and hydroelectric power. The Study Area for energy resources includes the Project Area, and nearby electric power generating stations located in Bergen, Hudson, and Essex Counties in New Jersey (USEIA 2016b).

No fieldwork was conducted for this study. Information on mineral and energy resources was obtained from regional, State, and Federal government sources such as planning documents, mineral inventories, and private sources, such as utility station locations from the website of the applicable major regional utility company (PSE&G or NJSEA; see **Table 3.21-1**). Identifying and assessing energy and mineral resources is crucial to improving long-term planning and avoiding unforeseen resource shortages.

3.21.2 Regulatory Context

There are multiple Federal, State, and local regulations that apply to the extraction of mineral resources; however, they do not pertain to the use of such materials. As such, no specific regulations pertaining to mineral resources are applicable to the Proposed Project.

Potential impacts to existing energy resources and the potential to limit the future development of energy resources is addressed in several regional planning documents. Applicable policies and planning documents that pertain to the Proposed Project are as follows:

- The New Jersey’s Energy Master Plan Statute (NJSA 52:27F-14), enacted in 1977, identifies the requirement of a 10-year Master Plan for the “production, distribution, and conservation of energy in this State.” The current New Jersey Energy Master Plan, established in 2011 and updated in 2015, lays out the vision for the use, management, and development of energy in New Jersey over the next decade (State of New Jersey 2011).
- The New Jersey's Renewable Portfolio Standard, first adopted in 1999, establishes the requirements for increasing clean and renewable energy production in the State through the use of solar, wind, geothermal, and sustainable biomass resources.
- The NJSEA (formerly the NJMC) Energy Master Plan (NJSEA 2008) sets forth guidance to “maximize the Meadowlands District’s energy conservation and efficiency to achieve reductions in energy consumption.”

More detailed information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

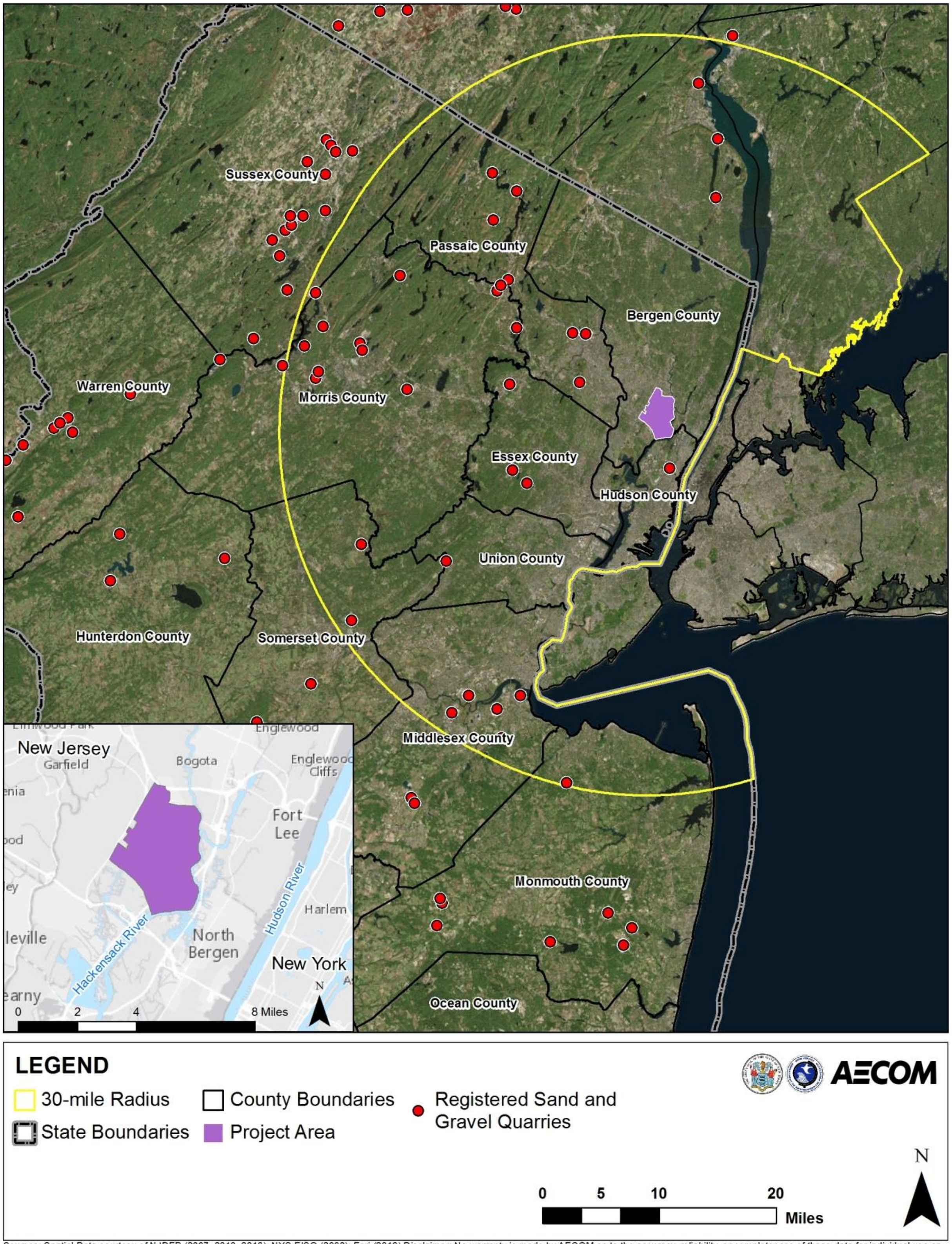
3.21.3 Existing Conditions

3.21.3.1 Mineral Resources

Bergen County is not identified as a principal mineral producing area (USGS 2015). There are no commercial mineral resources in the Project Area. The mineral resources, such as stone, concrete, and soil used to construct the Proposed Project would need to come from local and regional sources and suppliers. Based upon available GIS information (NYSDEC 2015, NJGS and NJDEP 2006) and local knowledge of active quarries, the leading local and regional suppliers of mineral resources operate and/or utilize the following quarries found throughout the State for their production of mineral supplies:

- Haledon Quarry (rock, stone, asphalt, recycling products) Passaic County;
- Ringwood Quarry (sand, gravel) Passaic County;
- Franklin Quarry (limestone, sand, stone) Sussex County;
- Sparta Quarry (limestone) Sussex County;
- Mount Hope Quarry (iron) Morris County;
- Pompton Lakes Quarry (granite) Passaic County;
- Riverdale Quarry (granite) Morris County; and
- Byram Quarry (granite), Sussex County.

The list of quarries above includes the larger quarries in New Jersey, but does not include all quarries in the region that may be used to source materials. All sand and gravel quarries within and in the vicinity of the Study Area are illustrated in **Figure 3.21-1**, which includes a 30-mile radius around the Project Area. A 30-mile radius was selected for the Study Area because it encompasses a number of the larger quarries and would minimize transportation costs associated with longer haul distances. However, the final locations of quarries used to supply the material would be selected by the construction contractor.



Sources: Spatial Data courtesy of NJDEP (2007, 2010, 2016); NYS EISO (2008); Esri (2016) Disclaimer: No warranty is made by AECOM as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document", in that it is intended to change as new data become available and is incorporated into the GIS database.

Figure 3.21-1: Sand and Gravel Quarries in the Study Area

3.21.3.2 Energy Resources

As discussed above, the Study Area for energy resources included the Project Area, and nearby electric power generating stations located in Bergen, Hudson, and Essex Counties, New Jersey. No non-renewable energy sources, production facilities, or electric generating stations occur in the Project Area (USEIA 2016b). Generating stations, LNG storage facilities, and solar projects in the Study Area are listed in **Table 3.21-1**.

Table 3.21-1: Generating Stations and Renewable Energy Facilities in the Study Area

Facility Name	County	Location	Type and Capacity (Megawatt [MW])	Approximate Distance from Project Area (Miles)
PSE&G Hackensack	Bergen	City of Hackensack	Solar 1.06 MW	<5
NJSEA Administration Building Carport Canopy	Bergen	Township of Lyndhurst	Solar 120 MW	5
NJSEA Science Center Rooftop Solar	Bergen	Township of Lyndhurst	Solar	5
NJSEA Borough of Little Ferry Solar Cooperative	Bergen	Borough of Little Ferry	Solar 76.5 KW	In Project Area
PSE&G Bergen Generating Station	Bergen	Borough of Ridgefield	Gas 1229 MW	<5
PSE&G Essex Generating Station	Essex	City of Newark	Gas 81 MW	12
NJSEA 1A Landfill System / Kearny Landfill Solar Farm	Hudson	Town of Kearny	Solar 3 MW	10
NJSEA Town of Secaucus Solar Cooperative	Hudson	Town of Secaucus	Solar 770 KW	6
PSE&G Hudson Generating Station	Hudson	City of Jersey City	Coal, Gas 620 MW	10
PSE&G Kearny Generating Station	Hudson	Town of Kearny	Gas 456 MW	12
PSE&G Linden Cogeneration Plant	Union	City of Linden	Unpublished	21
PSE&G Linden Generating Station	Union	City of Linden	Gas 1578 MW	23

The nearest generating stations include four fossil fuel facilities operated by PSE&G (PSE&G Fossil LLC 2016). The Hudson, Bergen, and Essex Generating Stations are located on or across the Hackensack and/or Passaic Rivers from the Project Area. The Kearny Generating Station is located south of the Project Area, on the peninsula between the Hackensack and Passaic Rivers. Approximate distances of these generating stations from the Project Area are listed in **Table 3.21-1**.

A LNG storage facility is located in the Borough of Carlstadt within the Project Area. This storage facility is owned and operated by Transcontinental Gas & Pipeline Corp. (Transco), a subsidiary of the Williams

Companies, Inc., and is supplied by a network of pipelines that extend well beyond the Project Area (NJSEA 2004). Additional transmission pipelines operated by PSE&G roughly parallel the western spur of the New Jersey Turnpike, also terminating at the Transco LNG facility (NPMS 2016). The network is owned by Williams and operated as the Transcontinental Gas Pipeline Corporation (Transco). PSE&G operates the pipeline and controls the distribution of gas throughout the Meadowlands District (NJSEA 2004).

Four solar projects occur in or near the Project Area (PSE&G 2012). The approximate distances from the Project Area and their respective generation capacity are included in **Table 3.21-1**.

3.22 Agricultural Resources and Prime Farmlands

3.22.1 Introduction

The evaluation of agricultural resources and prime farmland was conducted by reviewing Federal, State and local maps, regulations and rules, guidance and policies, municipal information pertaining to agricultural practices and community gardens, and habitat mapping, and visual inspection of natural areas. Given the Project Area's close proximity to Manhattan, agricultural resources are limited within the Project Area and surrounding region.

3.22.2 Regulatory Context

Important farmlands, including lands identified with soils that are prime, unique, or statewide or locally important farmland, are subject to the provisions of the Farmland Protection Policy Act (FPPA). The Act is intended to minimize the impact of Federal programs on the conversion of farmland for nonagricultural purposes. Under the FPPA, Federal agencies that intend to convert, build/develop on, or otherwise use farmland for nonagricultural purposes are required to follow all State, local, and private regulations and policies that protect farmland. Further, land protected under the FPPA does not have to currently be in use for agriculture (USDA NRCS 2016a). FPPA protections are excluded for land that is already in, or committed to, urban development or water storage. As described under 7 CFR Part 658, farmland does not include:

- Land with a density of 30 structures per 40-acre area,
- Land identified as an "urbanized area" (UA) on the Census Bureau Map,
- Urban areas (pink tint-overprint) on USGS topographical maps; or
- Areas identified as "urban built-up" on the US Department of Agriculture (USDA) Important Farmland Maps in the NRCS Web Soil Survey.

In New Jersey, the State Department of Agriculture regulates farmland activity through several laws and regulations including the Right to Farm Act (NJSA 4:1C-1 *et seq*.), Agriculture Retention and Development Act (NJSA 4:1C-11), Garden State Preservation Trust Act (NJSA 13:8C-1), State Transfer of Development Rights Bank Act (NJSA 4:1C-49 *et seq*.); State Transfer of Development Rights Act (NJSA 40:55D-137 *et seq*.), Transfer of Development Rights Rules (NJAC 2:77), and Farmland Preservation and Right to Farm policies. More detailed information on Federal, State, and local regulatory requirements for the Proposed Project can be found in **Appendix B**.

The Bergen County Farmland Preservation Plan (2014) describes the status of the agricultural land base in the county, the farmland preservation planning, the county preservation program, future farmland preservation, natural resource protection, economic development, and agricultural sustainability, retention, and promotion.

3.22.3 Existing Conditions

Prior to European colonization in the 17th century, Atlantic white cedar swamps blanketed much of the Meadowlands. Beginning in the 17th century into the late 19th century, settlers cleared the forests and constructed dikes and ditches to drain the land and make it suitable for agriculture to supply, grains, vegetables, and fruits to city markets. This drained land was also used for growing salt hay and as pasturage for livestock. However, by 1890 many of the small farms near railroad stations were sold off for other purposes (Bergen County 2016b). Development during the late 19th century changed land use from an agricultural focus to industrial and commercial use.

The trend in the reduction of agriculture in the Project Area is also witnessed throughout New Jersey. As indicated in the Bergen County Farmland Preservation Plan*,* the *"*pressures on the agricultural industry have been particularly evident in New Jersey which is the most urbanized State in the nation, yet one blessed with productive soils and growing conditions." In New Jersey, between 1950 and 2012, the number of operating farms decreased by 63 percent and farmland reduced from 175 million acres to 715,000 acres (Bergen County Department of Planning and Economic Development 2014). Only 0.7 percent of the land area in Bergen County, New Jersey is devoted to farming activity (Bergen County Department of Planning and Economic Development 2014). Per the Bergen County Farmland Preservation Plan, no qualified farms[32], are located in the Project Area (Bergen County Department of Planning and Economic Development 2014).

Agricultural resources do not exist within and/or adjacent to the Project Area. The communities that comprise the Project Area are densely populated with residences, industrial warehousing, and commercial properties. Most open land areas are tidally influenced, disturbed marshes that are unsuitable for agriculture. Contact with municipal officials (town clerks) and review of municipal websites has not yielded any evidence of active community gardens within the Project Area.

During the habitat mapping, scientists traversed all natural areas within the Project Area. No land appeared to be under commercial agricultural cultivation. Any food crop production in the Project Area would be limited to small gardens on residential properties.

The USDA uses a farmland classification system to designate soils as prime farmland, unique farmland, farmland of statewide importance, or farmland of local importance (USDA NRCS 2016b). Prime farmland includes land with "the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses" (USDA NRCS 2016b). Unique farmland includes "land other than prime farmland that is used for production of specific high-value food and fiber crops" (7 USC § 4201(c)(1)(B)). Farmland of statewide or local importance is land that is identified by State or local agencies, respectively, as being important for the production of food, feed, fiber, forage, and/or oilseed crops in the corresponding State or local community (USDA NRCS 2016b). In New Jersey, soils of statewide importance are soils that are nearly prime farmland and economically produce high yields of crops when treated and managed according to acceptable farming methods (USDA NRCS 2016c).

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[32] As used in this document, a qualified farm refers to farmland that qualifies for a tax assessment reduction under New Jersey's Farmland Assessment Act (NJSA. 54:4-23.1 *et seq*.). This Act contains numerous requirements, including being "no less than five acres of farmland actively devoted to an agricultural or horticultural use for the two years immediately preceding the tax year being applied for and [meeting] specific minimum gross income requirements based on the productivity of the land," (New Jersey Department of Agriculture 2016).

A review of the NRCS Web Soil Survey was conducted to determine if the Project Area contains important farmlands (USDA NRCS 2016d). Three soil types in the Project Area are classified as farmland of statewide importance, unique farmland, and prime farmland (**Table 3.22-1**). The prime farmland soil is located entirely within the Maple Grove Cemetery in the Borough of Little Ferry (see **Figure 3.15-4**). Westbrook, Ipswhich, Sandy Hook Soils, 0-2 percent are largely associated with the large tracts of marshes between Commerce Boulevard and Moonachie Avenue and the Hackensack River in the southeast portion of the Project Area. More information on the NRCS soils types within the Project Area can be found in **Section 3.15**.

Table 3.22-1: Prime Farmland Soils within the Project Area

Soil Type	Classification	Total Acres	Percent of the Project Area
Riverhead sandy loam, 3 to 8 percent slopes (RkRB)	Prime Farmland	0.2	<0.1%
Riverhead sandy loam, 8 to 15 percent slopes (RkRC)	Farmland of Statewide Importance	5.0	0.1%
Westbrook, Ipswich, Sandy hook soils, 0 to 2 percent slopes, very frequently flooded (TrkAv)	Unique Farmland	1,306	24.2%

Although the NRCS Web Soil Survey identifies soil that meets farmland criteria (**Table 3.22-1**), these locations are ultimately excluded from consideration as farmland under FPPA as the Project Area has a density of 30 structures per 40-acre area, the Project Area is identified as "UA" on the Census Bureau Map (specifically, within the New York-Newark urbanized area), and the Project Area covered by a pink tint-overprint on the USGS topographical maps denoting an urban area (US Census Bureau 2010c, USGS 2017).

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