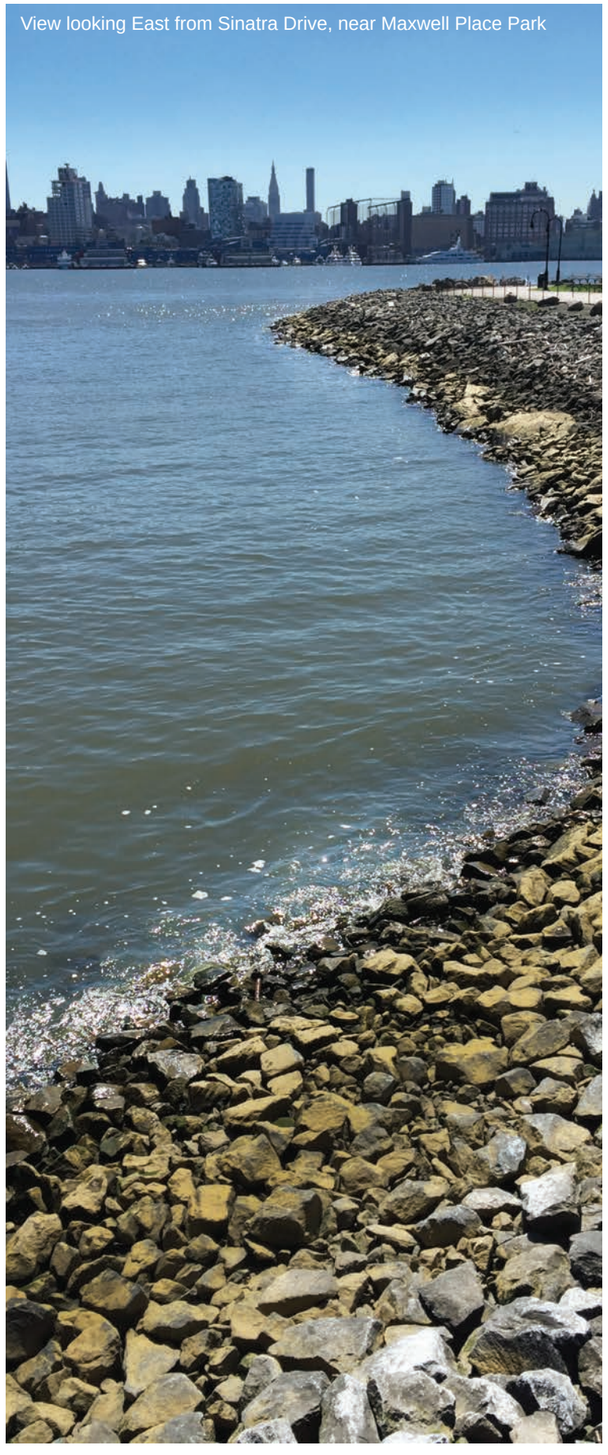
View looking East from Sinatra Drive, near Maxwell Place Park

5.0 CUMULATIVE IMPACTS

Cumulative impacts result when the effects of an action are aggregated or interact with other effects in the same geographic boundary or within a particular timeframe. The cumulative impacts analysis focuses on the combination of these effects and any resulting environmental degradation. The cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource regardless of the entity (federal, non-federal, or private) taking the actions. The methods for evaluating cumulative impacts of the Project follow the guidelines provided in the Council on Environmental Quality (CEQ) handbook: Considering Cumulative Effects under the National Environmental Policy Act (1997), as well as guidance published by the Environmental Protection Agency (EPA): Consideration of Cumulative Impacts in EPA Review of NEPA Documents (1999). The CEQ regulations implement the National Environmental Policy Act (NEPA) and define three types of effects: direct, indirect, and cumulative.

"**Direct impacts** are caused by the action and occur at the same time and place," (40 CFR 1508.8). Examples of direct impacts include displacements resulting from the acquisition of right-of-way or the fill placed in wetlands in order to construct a roadway improvement.

"**Indirect effects** are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems," (40 CFR 1508.8).

"**Cumulative impact** is the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time," (40 CFR 1508.7).

The direct and indirect effects (i.e., encroachment and alteration effects) from the Project have been documented in Section 4, Affected Environment and Environmental Consequences. Growth-inducing effects are not expected to result from the Project, as it is designed to provide flood risk reduction for the existing and densely developed Study Area and the construction of the Resist structure does not spur further development. All future development is to be consistent with local master plans and would occur with or without the Project.

5.1 Methodology

Identifying cumulative impacts associated with a project involves the following steps:

- Identifying the direct and indirect effects of the proposed action (see Section 4.0);
- Identifying the resources including ecosystems and human communities that are affected to develop the geographic scope of analysis (existing conditions);
- Determining the overall condition of those resources to develop the temporal scope of the analysis (existing conditions);
- Identifying potential impacts to the resources within the geographic (Study Area) and temporal boundaries (time frame) from other reasonably foreseeable future actions; and
- Determining the magnitude or significance of the cumulative impacts to those resources (environmental consequences).
- Suggesting mitigation (in case of cumulative impacts).

Cumulative Impacts Study Area

The geographic boundary for this assessment expands beyond the boundaries of the Project Study Area, as shown in Figure 5.1. The study area boundary of the cumulative impact assessment aligns with natural boundaries as suggested by the CEQ handbook in order to evaluate the potential for cumulative impacts. Natural boundaries include airsheds, watersheds, ecosystems, wildlife

management areas, and other types of areas that may be bound by geology or topography. As indicated in the CEQ handbook, choosing the appropriate scale to use depends on the resource or system experiencing impacts. Because water resources are the focus of this project, the geographic boundary was developed by examining the topography, watersheds, and floodplains in which the Project is located.

The Project falls within Watershed Management Area (WMA) 5, which has a drainage area of approximately 165 square miles and is comprised of three watersheds: Hackensack River Watershed, Hudson River Watershed, and Pascack Brook Watershed. The WMA is divided into several subwatersheds, each referred to as a "HUC 14". "HUC" is the acronym for Hydrologic Unit Code and the code has 14 digits. The HUC 14 was selected because it is the most detailed level of watershed mapping based on elevations and stream courses from the USGS 1:24,000 quadrangle maps.

Specifically, the geographic boundary for this cumulative impacts study is the 100-year floodplain within HUC 14 numbered 02030101170030. The 100-year floodplain was selected because it is physically isolated from the rest of the HUC 14 by the Palisades. Located at a lower elevation, it is the portion of this HUC 14 that is most vulnerable to storm surges from the Hudson River, as well as direct and indirect effects from the Project. The eastern boundary of this HUC 14 runs through the center of the Hudson River (see **Photograph 5.1**), while its western boundary follows the highest elevation points within the subwatershed area. As shown in **Figure 5.1**, this includes portions of Englewood Cliffs, Fort Lee, Edgewater (Bergen County) and North Bergen, Guttenberg, West New York, Weehawken, Hoboken, and Jersey City in Hudson County.

The direct and indirect effects of the Project are evaluated (within the appropriate analysis area defined for each resource) in combination with other past, present, and reasonably foreseeable future projects that may affect the same resources within the 100-year floodplain of this HUC 14 to determine the cumulative effects on these resources. The present and reasonably foreseeable future projects are listed in **Table 5.1**. Present and reasonably foreseeable future projects were identified based on a desktop review of online resources including local master plans, zoning ordinances, redevelopment plans, planning board meeting minutes and resolutions, news articles, and other planning documents. This information was also used to determine whether a reasonably foreseeable future project was developed enough to allow for a meaningful analysis as part of this cumulative impacts discussion. Furthermore, there was also consultation with HUD, NJDEP and the relevant municipalities within the cumulative impacts study area. To avoid confusion with the reasonably foreseeable future projects listed in **Table 5.1**, the Project will be referred to as "Rebuild by Design-Hudson River (RBD-HR)" for the remainder of the cumulative impacts analysis.

Analysis Timeframe

The CEQ Handbook suggests establishing a

Photograph 5.1 View of Hoboken from New York City

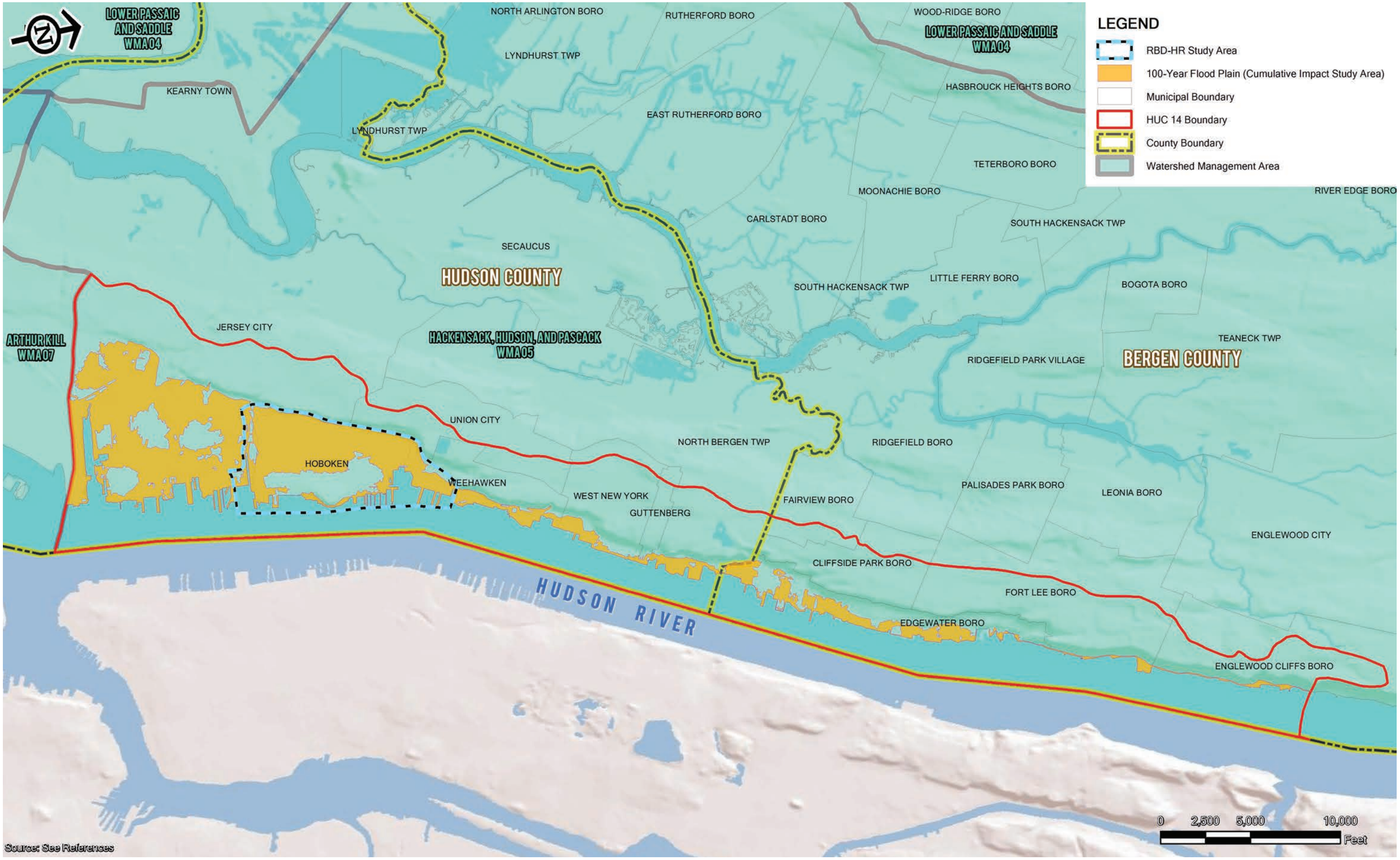

Figure 5.1 Cumulative Impacts Study Area

timeframe to bind the cumulative effects analysis. The RBD-HR Benefit Cost Analysis and the Feasibility Assessment assume that the useful life of the project is 50 years. In order to be consistent with these studies, this cumulative impact assessment assumes the same timeframe. Guidance published by EPA in 1999 explains that the timeframe should extend "as long as the effects may singly, or in combination with other anticipated effects, be significant on the resources of concern". Because the most significant impacts resulting from this project are based on the flood risk reduction provided by the project itself, it is logical that the 50-year life span of the project applies to this analysis as well.

No applicable long-term planning documents or reports were appropriate references for an alternative timeline. Therefore, the timeframe for this cumulative impact analysis extends to the year 2072 and every effort has been made to capture and define the projects that are reasonably foreseeable in consideration of cumulative effects analysis for this project within the geographic area.

5.2 Existing Conditions

The following information is presented to define the baseline conditions within the HUC 14 100-year floodplain. A description of land use and parks is provided first in order to orient the reader and give context for the remaining discussions particularly with regard to the densely developed nature of the cumulative impacts study area.

5.2.1 Land Use and Parks

This section provides a brief overview of existing land use, redevelopment plans, parks, and open space located in the cumulative impacts study area, not covered in Section 4. If a redevelopment plan consists of a particular defined project that has not yet been constructed, that project is listed as reasonably foreseeable in **Table 5.1**.

According to 2012 NJDEP Modified Anderson System of land use classification, 93 percent of the land in the cumulative impacts study area is designated as "urban". Desktop aerial review of this data indicates that the current percentage of urban land may actually be higher because some parcels not marked as "urban" in 2012 have since been developed.

The HUC 14 northern boundary starts in Englewood Cliffs where the land is undeveloped and consists of steep Interstate Parkland. The only portion of Englewood Cliffs that is in the 100-year floodplain is the Englewood Boat Basin. Continuing south along the coastline, the only part of Fort Lee within the 100-year floodplain is the Ross Dock Picnic Area. The Hudson River Waterfront Walkway extends along the entire coast of the cumulative impacts study area. Some locations are not yet fully developed, but NJDEP Coastal Zone Management rules establish specific criteria for its development. When complete, it will connect the George Washington Bridge in Fort Lee with the Bayonne Bridge in Bayonne.

The majority of the narrow borough of Edgewater falls within the 100-year floodplain. The northern part of Edgewater is mainly dominated by luxury residential development (Hudson Harbour Condominiums) with docks and marinas located within the 100-year floodplain (east of River Road). Veterans Field is a large athletic park currently undergoing remediation that is located directly on the waterfront in Edgewater. South of Veteran's Field, land use in Edgewater becomes more mixed use in nature. There are commercial parcels with large parking lots interspersed with condominiums. Two vacant sites are proposed for redevelopment in Edgewater and are discussed further in Section 5.4.

Only small coastal portions of North Bergen, Guttenberg, and West New York fall within the 100-

Table 5.1 Present and Reasonably Foreseeable Future Projects

PROJECT NAME	LOCATION	AGENCY/ENTITY	STATUS
Hudson Tunnel Project	Hudson River	Federal Railroad Administration	Anticipated completion 2022
Long Slip Fill and Rail Enhancement Project	Hoboken	NJ TRANSIT	Active
Urban Coastal Defense and Stormwater Mitigation System	Jersey City	Jersey City	Due: 2020
NHSA Long Term Control Plan (LTCP)	North Hudson County	NHSA	Completed March 2017
Hoboken Wet Weather Pump Station H5	Hoboken	Hoboken	Due: 2020
Jersey City Sewer Improvements and LTCP	Jersey City	Jersey City MUA	Future
Hoboken Green Infrastructure Strategic Plan	Hoboken	Hoboken	Future
1600 Park and Cove	Hoboken	Hoboken	Active
Tidewater Basin District	Jersey City	JC Redevelopment	Anticipated Completion January 2018
Hudson Exchange West	Jersey City	JC Redevelopment	Planning
Monarch Shipyard Development	Hoboken	Private	Pending litigation
Riverview Development	North Bergen	Private	Pending litigation
Binghamton II	Edgewater	Private	Active
Hess Terminal Site	Edgewater	Private	Future
Quanta Resources Site	Edgewater	Private	Future

Source: Dewberry, 2015-2017

year floodplain of the HUC 14. There is one large undeveloped parcel in North Bergen that is discussed further in Section 5.4 called Riverview. South of the Riverview parcel, the waterfront is developed with luxury condominiums, townhouses, and mid-rise residential units mixed with commercial and retail. At the town border is the North Bergen and Guttenberg Waterfront Park, which opened in 2014 located at 7100 River Road. This park, along with condominiums/townhomes, make up the Guttenberg waterfront. The waterfront of West New York was designated as a redevelopment area in 1996 to be advanced as a mixed residential community consisting of approximately 4,060 apartment and condominium units, 100,000 square feet of neighborhood retail space, and associated uses including roadways, parking facilities, walkways, parks, and other recreational amenities. Development is still underway north of Riverwalk Place.

Continuing south, River Road becomes Port Imperial Boulevard and waterfront development consists of luxury residential units interspersed with occasional green spaces and retail services. Crossing into Weehawken, Port Imperial Ferry Terminal is surrounded by large impervious parking lots for commuter parking. New medium-rise luxury apartment buildings and townhomes follow along Port Imperial Boulevard on the waterfront within the 100-year floodplain. South of these new developments is Weehawken Waterfront Park and Recreation Area, a 10.5-acre waterfront park that opened in 2007. South of this park is Lincoln Harbor and the Hoboken Waterfront, which is described in detail in Section 4.8, along with the Weehawken Liberty Harbor Redevelopment Plan, Hoboken Yard Redevelopment Plan, the Western Edge Redevelopment Plan, Jersey City's Jersey Avenue Light Rail Redevelopment Plan, the Hoboken Avenue Redevelopment Plan, and the Newport Redevelopment Plan. Currently, Newport is building the new Ellipse Tower positioned on a peninsula jutting out into the Hudson River. In anticipation of the next Sandy scale disaster, the ground floor needed to be brought up 13 feet; requiring 50,000 tons of dirt to be trucked into the site.

The cumulative impacts study area includes a large portion of Jersey City (Ward E), which includes the neighborhoods of Newport, Hudson Exchange, The Village, and Paulus Hook. Hoboken and Jersey City are densely developed urban environments. In stark contrast, Liberty State Park, which is located just to the south of the HUC 14 boundary (Morris Canal Basin), serves as a natural water catchment and drainage area consisting of over 1,000 acres of coastal marshlands and estuary. Jersey City has approximately 42 redevelopment areas within the Ward E portion alone. Additional Jersey City redevelopment areas that exist in the waterfront area include the Harsimus Cove Station, Exchange Place North, Colgate, Tidewater, and Liberty Harbor North.

5.2.2 Floodplains

The major stressor on this subwatershed is the continued development in the floodplain and the loss of permeable land available to absorb rainfall. In addition, the continued development within the floodplain means that over time, more development is exposed to the risk of coastal storm surges. As stated previously, approximately 2,431 acres (20 percent) of the land in the HUC 14 falls within the 100-year floodplain. Of this land, 2,256 acres (93 percent) was classified as "urban" land in 2012.

Executive Order 11988 requires that federal agencies 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. The New Jersey Flood Hazard Area Control Act (N.J.S.A. 58:16A) regulates activities in the floodplain at the state level, such as the placement of structures or fill that could block or displace floodwaters. Compliance with state Stormwater Management Regulations (N.J.A.C. 7:8) is required for those projects involving greater than 0.25 acre of new impervious surface coverage or greater than one acre of land disturbance. There are also federal and state requirements for implementation of new municipal separate storm sewer systems known as MS4s. Section 4.1.2.5 provides a further discussion of these regulations and requirements.

5.2.3 Surface Water, Aquatic Ecology and Endangered Species

As described in Section 4.1.2.4, the Lower Hudson River and Estuary support a diverse and productive aquatic community of over 100 species of finfish, more than 100 invertebrate species, and a variety of phytoplankton and zooplankton. It acts as a spawning ground, migratory pathway, and a nursery/foraging area for a wide variety of fish species. There are two marine species in this area listed pursuant to the Endangered Species Act, the shortnose sturgeon and the Atlantic sturgeon. The extensively-developed shorelines of this part of the Hudson River, as well as the swift currents, severely limit colonization of this area by submerged aquatic vegetation.

The Lower Hudson River Estuary is classified by NJDEP as a Class SE2 (fishing/fish propagation) saline/estuarine surface water. The recommended best uses of Class SE2 waters are secondary contact recreation and fishing. The quality of SE2 class water is considered sufficient for maintenance; migration; and propagation of the natural and established biota, migration of diadromous fish, maintenance of wildlife, and any other reasonable uses (see **Photographs 5.2 and 5.3**). Additionally, SE2 waters possess an anti-degradation designation under the classification of Category Two waters, which are protected from any

The Cumulative Impact Study Area includes a large portion of Jersey City (Ward E), which includes the neighborhoods of Newport, Hudson Exchange, The Village, and Paulus Hook. Hoboken and Jersey City are densely developed urban environments.

Photograph 5.2 Recreation along the Hudson River

Photograph 5.3 Wildlife along the Hudson River

measurable change in existing water quality. Aquatic species and vegetation are vulnerable to declining water quality, changes in temperature, dredging, and other maritime activities.

5.2.4 Upland Wildlife and Vegetation, Wetlands

Historic and modern development of the Hoboken area has dramatically altered the environment and removed the predevelopment vegetation and wetlands. Ninety-three percent of the terrestrial landscape of the cumulative impacts study area is heavily urbanized and dominated by impervious surfaces. Large swaths of vegetated land that may provide habitat are more prevalent along the Palisades Ridge in Bergen County where the land is preserved as part of the Palisades Interstate Park.

Undisturbed habitats are not present in the area of RBD-HR and most of the available habitat to wildlife is constrained to small residential yards, tree-lined streets, and recreational parks in close proximity to people. Terrestrial wildlife communities in the cumulative impacts study area are largely composed of disturbance-tolerant species that are associated with fragmented habitats and forest edges and that can co-exist with anthropogenic activities in highly disturbed areas. Nonetheless, the removal of any native vegetation and/or wetlands is a stressor to the entire resource due to their scarcity and any upland wildlife that utilize these limited communities. The introduction of incompatible and competitive invasive species of plants and insects is also a stressor to this resource.

5.2.5 Cultural Resources

The cumulative impacts study area contains extensive historic properties distributed along the western shore of the Hudson River. The types of historic properties present and designated historic districts can be grouped into general themes related to the historic development and occupation of New Jersey's eastern border fronting New York City. Such themes would include: transportation related resources, including but not limited to the Holland Tunnel (a National Historic Landmark), The George Washington Bridge, the U.S. Routes 1 & 9 Historic District, the Morris Canal, and the Erie Railroad Main Line Historic District; industrial development of the waterfront, including the Warehouse Historic District and the Whitlock Cordage Company Buildings Historic District in Jersey City; and residential development and occupation of the area, including, but not limited to, multiple historic districts in Jersey City such as the Hamilton Park Historic District, Harsimus Cove Historic District, Paulus Hook Historic District, Lafayette Gardens Historic District, Lower Newark Avenue Historic District, and the Van Vorst Historic District. Private development projects that are not required to comply with Section 106 or state requirements and are incompatible and/or insensitive in their design are stressors that threaten the integrity of historic districts. Private projects that do not require the recordation of artifact discoveries threaten the ability to study and preserve archaeological resources.

5.2.6 Air Quality

The entire state of New Jersey is classified as Ozone (O3) nonattainment, including Hudson and Bergen Counties. Both counties are designated as attainment for NO2, Pb, SO2, and PM10. Both counties are in maintenance for PM2.5 and CO, which means that the area was previously in nonattainment but now meets federal standards. The designation of maintenance status is evidence that the region's air quality is showing improvement, which is likely attributed to state and federal regulation of emissions. Any new sources of emissions and the failure to retrofit existing emission sources is a further stressor to the region's air quality and the contribution of greenhouse gases to climate change.

5.2.7 Contaminated Sites

Based on a review of the EDR® Report, NJDEP's GIS data layers, NJDEP's Data Miner online database, and the EPA website, there are numerous contaminated sites, including parcels with soil and groundwater contamination, located within the RBD-HR Study Area. In addition, almost the entire Study Area is underlain by historic fill material and based on NJDEP's Historic Fill Material Technical Guidance, it can be assumed that this material contains contaminants typical of historic fill including elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) and metals. Due to the cost of acquiring this type of information, reporting for the entire cumulative impacts study area was not obtained; however, the presence of hazardous waste sites within the larger cumulative

impacts study area is anticipated to be similar to that documented for the RBD-HR Study Area.

5.2.8 Population and Demographics

Data from the 2014 American Community Survey 5-Year Estimates, which is based on 2010 Census data, shows that approximately 132,999 people live within the 92 census block groups that comprise the cumulative impacts study area. The Hudson County portion of the cumulative impacts study area has a significantly higher population (122,208) than the Bergen County portion (10,791).

According to American Community Survey (ACS) 2014 5-year estimates, the racial composition of the entire cumulative impacts study area is approximately 63 percent white, 23.6 percent Asian, 6.6 percent Black, 3.6 percent Some Other Race, and 3.2 percent Two or More Races. Less than one percent of the population identify as American Indian, Alaskan Native, Native Hawaiian, or Pacific Islander. Approximately 19.5 percent of the population identifies as Hispanic or Latino. The median age of the population is 33.25 years old. ACS estimates the median household income in the past 12 months ranges from $96,250 to $103,610.

5.3 Past, Present, and Reasonably Foreseeable Future Actions

The CEQ regulations describe cumulative effects analysis in terms of "actions," rather than "proposals." In addition, CEQ guidance explains that "in general, future actions can be excluded from the analysis of cumulative effects if the action will not affect resources that are the subject of the cumulative effects analysis, or [if] including the action would be arbitrary;" furthermore, "proximity of other actions to the proposed action is not the decisive factor for including these action in an analysis; these actions must have some influence on the resources affected by the proposed action".

Table 5.1 lists the present and reasonably foreseeable future actions within the cumulative impacts Study Area that were identified based on a desktop review of online resources including local master plans, zoning ordinances, redevelopment plans, planning board meeting minutes and resolutions, news articles, and other planning documents (**see Figure 5.1)**. This information was also used to determine whether a reasonably foreseeable future action was developed enough to allow for a meaningful analysis as part of this cumulative impacts discussion including whether the action has a sponsor and/or a source of funding or has secured certain regulatory approvals. There was also consultation with HUD, NJDEP and the planning, zoning and building departments of the municipalities to identify projects within the cumulative impacts study area.

With regard to past actions, the most significant action that has led to the current flooding concerns in the cumulative impacts study area is the filling and development of the wetlands and marshlands in Hoboken and Jersey City. Historically, Castle Point was one of the only developable lands in Hoboken but as the population grew in the 1800's the wetlands and marshlands were filled in and developed. The past action of filling low, wetlands to create more upland has caused the current conditions of poor drainage and flooding in the cumulative impacts study area-especially the southern portion (see **Photograph 5.4**). The following descriptions include current and future actions that are located within the 100-year floodplain of the HUC 14 boundary, which serves as the cumulative impacts study area. These projects were selected because they are expected to impact the same resources as RBD-HR and/or their impact zones overlap areas occupied by resources affected by RBD-HR.

Photograph 5.4 View of Hoboken Meadows looking Southeast, circa 1897

5.3.1 Project Description

The Hudson Tunnel Project (Secaucus, NJ to Manhattan, NY)

The Federal Railroad Administration (FRA) and NJ TRANSIT are currently studying environmental impacts associated with the proposed Hudson Tunnel Project which would consist of two new rail tunnels under the Hudson River. Although mostly subterranean and subaqueous, the project would consist of two above-ground ventilation facility sites,

one of which would be located in Hoboken and the other on Twelfth Avenue in midtown Manhattan. The Hoboken vent shaft and fan plant is proposed to be located along the northern boundary of Hoboken; just north of the HBLR line and south of The Shades neighborhood. The currently vacant site in Hoboken will be used for construction staging by the Hudson Tunnel Project over a period of approximately seven years with varying degrees of activity.

Long Slip Fill and Rail Enhancement Project (Jersey City)

As part of its overall resiliency program, NJ TRANSIT is proposing to construct the Long Slip Fill and Rail Enhancement Project, which includes the filling in of a former freight barge channel known as the Long Slip Canal to construct additional tracks and platforms for the Hoboken Station. The project involves the filling of a canal that will result in an additional 4.3 acres of impervious surface in Hoboken. The Long Slip Fill Project would also extend the Jersey City Combined Sewer Overflow (CSO), which currently discharges into the canal, to instead discharge directly into the Hudson River. The project received a Finding of No Significant Impact (FONSI) from the Federal Transit Administration (FTA) on October 20, 2016. Filling the Long Slip Canal will require a USACE Section 10/404 Individual Permit; an NJDEP Waterfront Development Permit; and Compensatory Mitigation, which are currently pending.

Comprehensive Resiliency Planning Initiative (Jersey City)

As part of a series of documents in this Initiative, Jersey City published the Draft Adaptation Master Plan in March 2017, in an effort to further identify implementation measures that will improve the flood resiliency of Jersey City. The Draft Adaptation Master Plan evaluates the feasibility of previously identified adaptation measures that were modeled and published in January 2015 as a partnership between the City and Stevens Institute of Technology. This study - The Collaborative Climate Adaptation Planning for Urban Coastal Flooding (CCAPUCF) - mapped the effect of projected sea level rise and storm surge on one percent annual chance flood hazard areas and identified 27 potential coastal protection measures that would mitigate storm surge. The report that followed: Visualizations of Adaptation Scenarios and Next Steps White Paper (2015) attempted to make the measures identified in the CCAPUCF report understandable to the public through graphic illustrations and conceptual renderings. The study considered adaptation measures such as:

- Earthen berm levees or embankments constructed of compacted earthen materials with no infrastructure on their crest;
- Boardwalk levees where barriers are constructed with boardwalks on top for pedestrian and bicycle conveyance;
- Strategic land rise using fill;
- Street levees where a flood protection barrier is constructed and the roadway sits on top of the barrier; and
- Surge barriers designed to prevent storm surge-related flooding from penetrating behind the barrier.

The Draft Adaptation Master Plan (2017) evaluates the feasibility of these measures, identifies any gaps in the analysis, and studies the costs and effectiveness of the solutions put forth to understand what measures will be most viable and likely to succeed. The Draft Adaptation Master Plan makes recommendations based on “priority areas” identified in the Draft Resiliency Master Plan which was also published in March 2017 as part of the Resiliency Planning Initiative.

Located just south of Hoboken within the cumulative impacts study area are priority areas D, E and F where independent berms, street levees, boardwalk levees, flood protection barriers and wet weather pumping stations are among the recommendations for these areas. Specifically, a street raise is recommended at Dudley and Washington Streets, a boardwalk levee is recommended: raising the Waterfront Walkway, and a flood barrier is recommended along the south side of the NJ TRANSIT rail yards.

North Hudson Sewerage Authority Long Term Control Plan

In accordance with the issuance of CSO permits in 2015 for Adams Street and River Road treatment plants, the North Hudson Sewerage Authority (NHSA) is required to develop long-term control strategies, as part of a Long Term Control Plan (LTCP), in compliance with the requirements of the Clean Water Act. The LTCP will consist of nine elements including public participation and an implementation schedule. The LTCP will be developed over the course of 59 months beginning with the submittal of a Selection and Implementation of Alternatives Report in the Final LTCP by June 1, 2020.

Jersey City Sewer Improvements

Jersey City has 21 CSOs and is also required to develop an LTCP in compliance with the Clean Water Act. In addition to the development of this Plan, the Jersey City Municipal Utilities Authority (JCMUA) has undertaken a five-year capital plan to install pumps at outfalls to push water out of the sewer system during high tide and storm surge events, as well as to extend the Sixth Street outfall to deeper water in the Hudson River and the 18th Street outfall into the Long Slip Canal. Other JCMUA improvements include Regulator Outfall Repair, Claremont-Carteret Outfall, East Side Plant, and Outfall Chambers. JCMUA received state loan funds from NJ Environmental Infrastructure Trust.

Hoboken Wet Weather Pump Station H5

This wet weather pump station project is designed to alleviate rainfall flooding in the H5 sewershed in northwest Hoboken (see discussion of sewersheds in Section 1.4). To alleviate flooding, the H5 wet weather pump station will pump flow to the Hudson River when conditions exist that prevent gravity flow. The pump station and transition vault are located within the 100 year flood plain and will operate regardless of street

View of New York City from Pier C Park

flooding in, around, and on top of the H5 wet weather pump station, located at the eastern end of 11th Street adjacent to Maxwell Place. The pump is currently operational.

Hoboken Green Infrastructure Strategic Plan

In 2013, NJ TRANSIT, as part of Together North Jersey (the HUD-funded regional planning effort for the 13-county northern NJ region), initiated the Hoboken Green Infrastructure Strategic Plan, as part of the Regional Plan for Sustainable Development. The Plan includes best management practices (BMPs) for handling stormwater within Hoboken's ongoing redevelopment plans including constructed wetlands, permeable pavements, vegetated swales, rainwater harvesting and reuse, basins or ponds, rain gardens, subsurface storage, and the use of green roofs. The plan includes new park sites known as Southwest Park and 7th and Jackson Park, which are currently under construction. The use of the BASF site as a park, which is described under the Delay, Store, Discharge (DSD) component of RBD-HR, was also suggested under this Strategic Plan.

1600 Park and Cove (Hoboken)

In September 2013, Hoboken opened a 2.1-acre park, located at 1600 Park Avenue, featuring a multi-use field, restrooms, dog run, viewing mound, and slide hill. This was the first phase of a master plan for four acres of active and passive space along the northern waterfront that includes a boathouse to facilitate kayaking, sailing, and other water uses. Funding partners for this $7.1-million purchase included the City of Hoboken, Hudson County, the state Green Acres Program, and the federal Land and Water Conservation Fund.

Liberty Harbor North Redevelopment (Jersey City)

A new 20-acre neighborhood within the Liberty Harbor North Redevelopment Area is proposed that includes eight high-rise development blocks; 6,440 residential units; plus retail and restaurants with marina, park, and parking is proposed. This site is located just north of the Morris Canal Basin and Liberty State Park.

Hudson Exchange West (Jersey City)

Hudson Exchange West, the residential complex being built at the former Metro Plaza site, recently celebrated the topping out of its first residential tower. The mixed-use tower will consist of 421 units, 20 percent of which will be affordable. The tower will include 10,000 square feet of retail, a seven-story parking garage, rooftop pool, amenity deck, bike paths, and various street improvements in the surrounding area. It is the first of 11 towers that will ultimately form Hudson Exchange West. The first tower is scheduled for completion by January 2018. This development is within the Harsimus Cove Station Redevelopment Area (just south of Newport).

Crescent Park (Jersey City)

A large, multi-phased residential and retail project is proposed for 246 Johnston Avenue and the surrounding lots, just east of Interstate 78 in the Grand Jersey Redevelopment Area. As of January 2017, approximately 2,150 residential units are proposed along with 50,000 square feet of retail space. In addition, plans include a cleanup of the Mill Creek Outfall in cooperation with the Jersey City Municipal Utility Authority. The Crescent Park plan also involves a new 5 million gallon stormwater holding tank to be built, with a new public city park on top.

Monarch Development (Hoboken)

The proposed development consists of two high rise towers located at Sinatra Drive and Shipyard Lane in Hoboken on a Pier adjacent to the Hudson Tea Building. The project is pending litigation and

Table 5.2 Summary of Cumulative Impacts

RESOURCE	RBD-HR IMPACTS		OTHER PROJECT IMPACTS	CUMULATIVE IMPACTS
	SHORT-TERM	LONG-TERM		
Geology	Negligible		Local geology	No cumulative impact expected.
Soils	Minor		Projects with ground disturbance have the potential to contribute to erosion	Potential erosion, loss of soils, and possible temporary surface water impacts.
Groundwater	Minor		Dewatering during construction in shallow areas- localized lower of water table only.	No cumulative impact expected.
Surface Water	Minor	Negligible adverse	New outfalls and discharges can cause additional strain on system and potential CSO events.	Potential cumulative impact on surface water quality: adverse or beneficial depending on treatment of discharge.
Floodplains		Minor adverse	New development in the floodplain	Potential cumulative impact on entire floodplain from addition of new structures.
Aquatic Ecology	Minor		Alternation of the shoreline and/or disturbance during in-water work. (Long Slip and Jersey City Adaptation Measures)	Potential adverse cumulative impacts on species that are sensitive to disturbance.
Wetlands		Minor adverse	Most redevelopment projects are in previously disturbed areas.	Due to the scarcity of wetlands in this area, any loss is significant with regards to capacity to absorb rainfall and coastal storm surges.
Upland Wildlife and Vegetation	Negligible to Minor		Only impacts to man-made parks and/or landscaped vegetation	Due to the limited amount of vegetation and absence of habitat in the area, a minor beneficial cumulative impact may occur by establishing additional areas of vegetation.
Endangered and Protected Species	Negligible to Minor		(Aquatic) Disturbances from construction on shoreline and/or in-water work. Shoreline alteration.	Can have adverse cumulative impacts on species that are sensitive to disturbance. Shoreline alteration may remove foraging habitat.
Archaeological Resources		Potential adverse	Potential impacts depending on level of prior disturbance	Potential cumulative impact to overall understanding of regional archaeology.
Historic Architecture		Minor adverse Hoboken HD, Stevens HD	Potential to impact the Hoboken Historic District: Long Slip, NHSA LTCP	Cumulative impact to context, historic character and setting of the Hoboken Historic District.
Air Quality & GHG	Minor		Emissions from equipment during construction. Residential building boilers, furnaces, generators, etc.	All GHG emissions cumulatively contribute to climate change and sea level rise..
Noise	Moderate		Construction noise- localized and temporary	Potentially overlapping construction periods can result in short term cumulative noise impacts to sensitive receptors.
Vibration	Minor to Severe		Vibration may occur during construction	Potentially overlapping construction periods can result in cumulative vibration impacts to sensitive receptors.
Contaminated Sites		Moderate beneficial	New projects can also result in the remediation of previously unknown contaminated sites	Beneficial cumulative impact of fewer contaminated sites if properly remediated.
Population and Demographics		Major beneficial	Other flood risk reduction efforts provide similar benefit	Cumulative benefit. Reduced flood risk to population with cooperative effort.
Minority and Low Income Pop		Major beneficial	Other flood risk reduction efforts provide similar benefit	Cumulative benefit. Reduced flood risk to population with cooperative effort.
Public Health		Major beneficial	Other flood risk reduction efforts provide similar benefit	Cumulative benefit. Reduced flood risk to population with cooperative effort.
Economic Conditions	Minor	Major beneficial	Other flood risk reduction efforts provide similar benefit	Cumulative benefit, dependent on successful implementation and coordination.
Land Use and Zoning	Minor	Negligible	Urban land dominates 94% of the cumulative impacts study area. No change is expected.	No cumulative impact.
Viewshed		Major adverse (Alt 1 only)	Waterfront projects may block views	Cumulative impact obstructing the view of the Hudson River.
Parks		Minor Beneficial	Additional open space: Green Infrastructure Plan, 1600 Park and Cove	Beneficial cumulative impact.
Transportation (Traffic)	Moderate		Construction traffic	Potentially overlapping construction periods can result in short term traffic impacts.
Infrastructure	Minor to Moderate		Construction utility interruptions	No cumulative impact expected.

Source: Dewberry, 2015-2017

depending on the outcome would still require issuance of a NJDEP waterfront development permit.

Riverview Development (North Bergen)
This development proposes 233 units of housing at 8200-8516 River Road in three high rise buildings (9-11 stories) located on the Hudson River waterfront. The North Bergen Planning Board approved the development in April 2013; however, the action is currently pending determination as to whether it complies with Coastal Zone Management Rules, specifically for High Rise Structures at (N.J.A.C. 7:7E-7.14.)

Hess Site (Edgewater)
In 2015, the Hess Corporation terminal at 615 River Road was cleared of its structures for redevelopment. This site is described as being the largest undeveloped waterfront site north of Hoboken and is anticipated to be developed as a mixed-use project. Remediation was completed in late 2016 and the application for development of the site is currently in litigation.

Quanta Resources (Edgewater)
This superfund site is adjacent to 115 River Road. Because the site is severely contaminated, the time frame for completion of remediation is unknown; however, upon successful completion of environmental remediation requirements, it is expected to be developed as a residential and mixed-use property.

Binghamton II (Edgewater)
The former Binghamton ferryboat restaurant is being removed and will be replaced by an extended pier, new docks and floating restaurant in the Hudson River.

5.4 Potential Cumulative Impacts

Direct impacts resulting from RBD-HR are detailed in Section 4 and summarized in the table in Section 4.10, Summary of Environmental Consequences. **Table 5.2** lists the short-term, long-term, and potential for cumulative impacts as they apply to each resource.

As indicated in **Table 5.2**, the RBD-HR Resist feature will not impact land use, zoning, or development. While minor land use changes will occur upon implementation of two new park spaces under DSD, this does not result in a cumulative impact to land use within the cumulative impacts study area. The cumulative impacts study area is considered "built out" and any areas that are not currently developed are bound to existing redevelopment plans. Local zoning ordinances and existing and proposed redevelopment plans will provide the framework for new development. Specifically, these requirements outline the floor area ratio, density, building height limits, and other bulk standards. These zoning standards are not being reevaluated; nor are they proposed to be, as a result of the implementation of the Preferred Alternative.

No cumulative impacts are expected to geology, groundwater, or infrastructure. Any impacts to these resources as a result of RBD-HR would be short term and localized to the extent that they would not have the opportunity to accumulate and result in cumulative impacts.

5.4.1 Short-Term Impacts

Short-term impacts are mainly the result of construction activities. As shown in **Table 5.2**, short term impacts of RBD-HR include soils, air quality, noise, vibration, and traffic impacts all occurring during construction. While these impacts will be mitigated so as not to extend beyond the construction period of the Resist feature or the construction/installation of a particular DSD element, this analysis recognizes that there is always the potential for construction to overlap resulting in more significant short-term impacts.

This could include unplanned emergency construction for repairs or maintenance, or the eventual construction of transportation projects that are currently in the planning stages.

Depending on the type of project, construction methods and equipment will vary and their timeframes have yet to be determined. The exact construction specifications, timing, and location of these projects requires a level of speculation that would not provide a meaningful analysis beyond acknowledging that they may occur and will be mitigated at the local level.

The construction of the Hudson Tunnel, which is expected to commence in mid-2019, may overlap with construction of RBD-HR elements, contributing to vehicular traffic, construction noise and vibration, pollutant and greenhouse gas emissions, and congestion to the surrounding communities, particularly in northern Hoboken. The focus of Hudson Tunnel activities in the cumulative impact study area will be at the proposed site of the vent shaft located in Northern Hoboken directly south of The Shades neighborhood in Weehawken.

Since Superstorm Sandy hit the east coast in 2012, federal agencies and numerous state and local partnerships have put forth tremendous efforts toward studying and proposing resiliency efforts aimed at protecting the affected region.

The tunnel alignment will cross beneath the RBD-HR resist structure near the waterfront of Weehawken Cove. Coordination between the RBD-HR and Hudson Tunnel Project design teams is ongoing to make sure that the two projects can proceed without conflicts. If construction occurs concurrently, the contractors will coordinate to make sure that adverse traffic impacts are avoided or mitigated.

Short-term cumulative impacts to water quality can also be expected to result from soil erosion during construction and until vegetation is established. These short-term impacts can be exacerbated by

Figure 5.2 BASF Site - Design Concepts

Figure 5.3 Block 10 - Design Concepts

simultaneous flooding events and the construction of other projects within the floodplain, especially those that are located on or near the waterfront. Long-term impacts to water quality as a result of discharges directly into the Hudson River are discussed below under surface water impacts.

5.4.2 Long-Term Impacts

The following discussion describes the potential long-term cumulative impacts that may occur as a result of RBD-HR and the reasonably foreseeable future actions listed in **Table 5.1**. This discussion is meant to elaborate on **Table 5.2** and the discussion combines resources where they may have some co-dependency or correlation with one another. Beneficial cumulative impacts are expected for upland vegetation, contaminated sites, population (including Environmental Justice populations), public health, economic conditions, and parks. Potentially adverse cumulative impacts may occur for surface water, floodplains, aquatic ecology, wetlands, endangered and protected species, cultural resources, viewshed, and air quality. Air quality equates to greenhouse gas emissions and climate change and are evaluated together as such.

Surface Water

Potential cumulative impacts to water quality are related to the proposed discharge of stormwater into the Hudson River. While the discharge of stormwater is unavoidable, efforts are underway throughout the HUC 14 to proactively treat and handle the stormwater before it travels into the Hudson River. Properly handled stormwater discharges will result in improved water quality for the ecosystem of the Lower Hudson River and the municipalities downstream.

As described in the RBD-HR Project Background Statement, the Hoboken/Weehawken/Jersey City area is approximately 93 percent impervious. This is the result of building footprints and paved areas such as streets, sidewalks, and parking lots. The area's high impervious cover means that almost all of the rainfall that reaches the ground is funneled rapidly into the combined sewer system through building downspouts and street-level storm drains, instead of being discharged onto permeable ground for gradual infiltration.

Most redevelopment projects in the area are being intentionally designed to incorporate Best Management Practices in stormwater management, such as the proposed redevelopment of the Hoboken Rail Yard and the Western Edge Redevelopment Plan. In the Bergen County portion of the HUC 14, the low-lying areas consist mostly of existing residential development, except in the southern portion of Edgewater where two large parcels are being prepared for redevelopment. If implemented with green infrastructure and proper stormwater management techniques, these former industrial parcels could further improve some stormwater management along the waterfront and have a beneficial cumulative impact on water quality.

The conversion of paved parcels to permeable

surfaces and park spaces including the BASF site, Block 10, (see **Figures 5.2 and 5.3**) and Block 12 (Southwest Park) will cumulatively increase the pervious surface of Hoboken by at least eight acres, providing further capacity to absorb rainfall events and lessen the amount of discharge directly into the Hudson River. The DSD portion of RBD-HR, combined with the City of Hoboken's implementation of the Green Infrastructure Strategic Plan and the Master Plan for 1600 Park Avenue and Cove, will result in a beneficial cumulative effect of improved resiliency during and after rainfall events by adding more pervious spaces to the area to help control stormwater and its impacts to surface water.

The RBD-HR DSD system is anticipated to reduce the number of CSO discharges from the existing system into the Hudson River, thereby resulting in a minor reduction in the volume of CSO discharges into the Hudson River. Three large stormwater collection sites and a high level storm sewer system is proposed for DSD including two new outfalls in the Cove area. The DSD portion of the RBD-HR project includes a pump at the BASF site that will push water north and discharge through an outfall in Weehawken Cove. This will supplement the current H5 pump project, decreasing the volume of floodwater that the H5 pump would handle from the northwestern Hoboken area. A separate high level storm sewer system is proposed as part of the Resist portion to prevent water intrusion into the existing sewers and prevent sewer backflow under Alternatives 2 and 3. This portion of the high level storm sewer system includes one new outfall near Maxwell Place. Since the NHSA LTCP will be under development and completed in 2020, it will be able to take into consideration the improvements implemented by the City of Hoboken, as well as RBD-HR and make recommendations for infrastructure improvements that compliment these projects. Cumulatively, this will result in a much stronger and more capable stormwater management system for the City of Hoboken.

An LTCP will also be developed by the JCMUA. Currently, the JCMUA pumps wastewater under the Newark Bay to the Passaic Valley Sewerage Commission in Newark, where it is treated and released into the Passaic River. However, when the CSOs back up after a rainfall event, some of them discharge into the Hudson River. Therefore, improvements to the stormwater systems proposed by JCMUA will contribute to cumulative benefits to the Hudson River water quality by separating the sewer from the stormwater system.

To meet the Public Participation Program and other requirements of the LTCP, the JCMUA and the NHSA are part of the New Jersey CSO Group, along with the Cities of Paterson and Newark; the Towns of Guttenberg, Harrison, and Kearny; the Borough of East Newark; Bayonne MUA; North Bergen MUA; and Passaic Valley Sewerage Commissioners. The formation of the New Jersey CSO Group is a positive step toward approaching this issue from a regional perspective and toward producing positive cumulative impacts on water quality throughout the subwatershed and beyond.

Photograph 5.5 View looking West at Long Slip Canal

Floodplains

Since Superstorm Sandy hit the east coast in 2012, federal agencies including HUD, Federal Emergency Management Agency (FEMA), the U.S. Army Corps of Engineers (USACE), the U.S. Fish and Wildlife Service (USFWS), and numerous state and local partnerships have put forth tremendous efforts toward studying and proposing resiliency efforts aimed at protecting the affected region. Undoubtedly, these efforts will result in improved resiliency and sustainability for the entire region, in terms of both the environment and the economy. However, the results of all of these efforts (including other RBD projects) cannot be fully captured in this cumulative impacts analysis due to their scale and lack of specificity in terms of funding and/or implementation. The magnitude and cost of these types of projects requires that extensive modeling and studies be conducted to fully understand their implications. One of the most important questions that arises is how the actions of individual municipalities will impact neighboring municipalities and the overall subwatershed.

Modeling may serve to predict localized cumulative impacts of these projects; however, other factors such as the gain/loss of permeable green space and the implementation BMPs, green infrastructure, and stormwater improvements all play a role in cumulatively impacting an area's resiliency and are difficult to capture in a large-scale flood model. While larger resiliency efforts like RBD are federally funded, smaller projects that are locally-funded or

> *...the cumulative impact to man-made habitat and landscaped vegetation is expected to be minor and may actually result in a cumulative benefit upon the successful establishment of new vegetation.*

even privately-funded can cumulatively have an effect on the overall resiliency of the area as well. To fully evaluate the impact of these projects and to anticipate the cumulative impacts that could occur, a comprehensive inventory and flooding study would need to be conducted, taking into consideration the implementation of each project at the regional, state, and local level. At this time, such information is either incomplete or unavailable as defined by the CEQ's NEPA regulations at 40 CFR 1502.22. As such, for this cumulative analysis, a literature review was conducted to provide a description of modeling studies that have been developed. The existing modeling studies that are currently available and relevant to this evaluation of cumulative impacts regarding flooding are summarized chronologically below.

Strategies for Flood Risk Reduction for Vulnerable Coastal Populations along Hudson River at Hoboken and Jersey City

In 2014, the Davidson Laboratory at Stevens Institute of Technology performed a regional hydrologic assessment of an approximately 12-mile segment of the Hudson River waterfront from Bayonne to Weehawken to simulate the impacts of Sandy and to assess potential regional measures to reduce tidal surges. In this study, model simulations with flood interventions located at the north and south side of Hoboken, Long Slip Canal, Morris Canal, and along the Jersey City Hudson River were examined individually and in combination. Results indicate that all storm surge flooding could be eliminated in Hoboken and northwest Jersey City through the construction of north and south floodwalls and the filling of the Long Slip Canal.

The 2014 Stevens study found that filling the Long Slip Canal alone will not significantly reduce the flooding that occurred in the Hoboken Rail Yard and Terminal and in the City of Hoboken during Sandy; however, filling the canal does delay the entrance of floodwater into southern Hoboken and northern Jersey City (see **Photograph 5.5**). This delay reduces the maximum flood depths reached during Sandy. The study found that filling the Canal, in combination with the construction of flood walls along the northern and southern portions of Hoboken, would eliminate nearly all of the flooding that occurred in Hoboken and the northwest portion of Jersey City during Sandy.

Collaborative Design and Dynamic Modeling for Urban Coastal Flood Adaptation (Jersey City)

In 2015, The Stevens Institute modeled a total of five Adaptation Scenarios developed for Jersey City that combined various measures (earthen berms, boardwalk levees, land rise on fill, street levees, and surge barriers). After a process of model experimentation and evaluation, the study focused on two scenarios: Scenario 5, which included land rise and boardwalk levees for planned developments, and Scenario 4, which targeted city-wide flood risk reduction and included components such as levees located at Washington Street, in Liberty State Park, and along Route 440; surge barriers at the Tidewater Basin; and planned land rise for developments.

For the purpose of modeling these scenarios for Jersey City, the Stevens Institute assumed the completed construction of the RBD-HR Resist structure, as well as a storm scenario similar to Sandy plus 31 inches of sea level rise (a high end projection) by 2055. The results showed that the city-wide flood adaptation plan (Scenario 4), while likely expensive, could protect Jersey City against flooding from extreme storms like Sandy. The 2015 Report points out that protective measures in one neighborhood could raise the flood level for another neighborhood which further emphasizes the need for regional coordination:

"The model results show a typical side-effect of the Scenario 4 protection of Jersey City (and Hoboken) is a 0.5 to 1.0 inch increase in the peak flood level in the Hudson River, for nearby areas. While this is locally a minor change, if all local municipalities were to build similar protections for the floodplains along the Hudson, then the combined effect will likely be an even larger increase in flood heights at unprotected areas of the coastline."

The study concluded that wall and berm-building only provide temporary and incomplete protection against flooding and that additional measures should be taken including green infrastructure, special zoning of floodplain areas, etc.

RBD-HR Hydrology and Flood Risk Assessment

In 2016, on behalf of NJDEP, Dewberry conducted modeling to predict the impacts of RBD-HR. The MIKE 21 coastal model developed by Dewberry uses NOAA's 2075 intermediate high scenario for future sea level rise of 28 inches in development of the design flood elevation (DFE). The domain of the model covered a portion of the Hudson River from Battery Park, NY to Albany, NY. The modeling included the assumption that Long Slip would be filled and that the undeveloped Newport parcel to the south would be elevated. The model shows that all three Build Alternatives will provide varying levels of flood risk reduction benefits for the Study Area with minimal residual flood impacts. Alternative 1 (Waterfront) provides the maximum flood risk reduction benefits, followed by Alternative 2 (15th Street), and Alternative 3 (Alleyway), respectively. Alternative 1 potentially has the least number of properties impacted by modeled increases in flooding, whereas both Alternative 2 and Alternative 3 include five properties that have modeled increased flood depths during the peak of the one-percent annual chance coastal storm surge event.

One of these properties expected to see increased flooding is the Hoboken Terminal and rail yard. RBD-HR is expected to increase flooding in the Hoboken

Yard by up to approximately 6.5 inches (see Section 4.9.3.1) which potentially could expand the extent of flooding within the yard and potentially increase the extent of damage to (and reduce the useful life of) low lying transit infrastructure in that portion of the yard. While recent and proposed investments in transit flood resiliency at the yard (including the NJ TRANSIT Long Slip project) will mitigate against most of this aggregated flooding, there is still potential for additional flood damage compared to the current condition. A coordinated inventory and modeling effort will be performed as this project progresses into final design. This effort, along with ongoing coordination between NJ TRANSIT and NJDEP as the project moves forward, is anticipated to address these potential concerns.

At the time of this analysis, no other flood resiliency efforts are reasonably foreseeable within the cumulative impacts study area. As described, several efforts are recommended for Jersey City, but are still in the draft planning stages. The results of the existing modeling efforts substantiate that any future efforts would need to be coordinated among all coastal municipalities to make sure that flood resist structures/barriers/levees or other methods work together and complement other resiliency efforts to provide maximum benefits to the community and the environment.

Wetlands

RBD-HR is expected to impact approximately 230 square feet of wetlands. Similarly, new development and redevelopment in Jersey City in and around the Morris Canal Basin (Crescent Park) may impact wetlands; however, the exact number and location of any potential impacts are unknown without field research and delineations. While these impacts may be unavoidable, the removal of wetlands is contradictory to the purpose of resiliency. It is critical that wetland mitigation involve the replacement or re-creation of wetlands within the same watershed so that the benefit of functional wetlands can be retained.

Upland Wildlife and Vegetation

Undisturbed habitats are not present in urban areas and most of the habitat available to wildlife is limited to small residential yards, tree-lined streets, and recreational parks (man-made habitats). These are the types of vegetation that are expected to be impacted by RBD-HR. Likewise, 1600 Park and Cove and other projects under the Green Infrastructure Strategic Plan may initially impact similar types of man-made habitats and vegetation, but their main goal is to re-establish or even increase vegetation in order to provide for more resiliency within the floodplain. As noted previously, large swaths of vegetated land that may provide habitat are more prevalent along the Palisades Ridge in Bergen County. This land is undevelopable due to its steep elevation and no projects are proposed upon it at this time. Therefore, the cumulative impact to man-made habitat and landscaped vegetation is expected to be minor and may actually result in a cumulative benefit upon the successful establishment of native vegetation.

Aquatic Ecology and Protected Species

The Hudson River provides habitat to various aquatic species, as described in Section 4.1.2.6, and RBD-HR is expected to have minor impacts on aquatic ecology during in-water and/or shoreline construction of the Resist structure. Jersey City redevelopment along the Morris Canal Basin would likely have similar impacts if there is an in-water work component or any features that disturb the shoreline. These direct impacts must be mitigated through design and/or during construction. However, the potential still exists for cumulative impacts on aquatic ecology (including protected species) that rely on the Hudson River habitat and are already stressed by the maritime activities that occur in this portion of the Study Area.

The only federally-listed endangered species that has the potential to be impacted by RBD-HR is the shortnose sturgeon. There is the potential for it to be affected by noise and vibration associated with pile driving for the waterfront Resist structure under RBD-HR Alternative 1. Waterfront redevelopment and the recommended “boardwalk levee” in Jersey City also has the potential to cumulatively impact this species if similar construction methods are used. The sturgeon are able to move away from the disturbance; however, if the disturbance is occurring in multiple areas simultaneously this could result in an adverse cumulative impact. However, the construction periods are not expected to overlap for these two projects because the Jersey City Adaptation Measures have not yet begun preliminary design.

One of the positive direct impacts that would result from RBD-HR is the cleanup of contaminated sites that may contain hazardous materials throughout the Study Area.

Three birds that are species of special concern in the area include the glossy Ibis, the little blue heron, and snowy egret. However, these species require shallow shoreline areas in which to wade and forage. The developed shoreline of the Study Area provides limited opportunities for this type of activity and these species would not be expected to be found along the bulkhead shorelines; however, they could make use of abandoned piers. If the Alternative 1 Resist feature were constructed it would modify the shoreline as would the Long Slip project and the recommended “boardwalk levee” in Jersey City. Cumulatively this would have the potential to further alter the type of shoreline that provides suitable foraging habitat and cumulatively negatively impact these avian species of special concern.

Cultural Resources

Regarding historic architecture, the placement of the RBD-HR Resist structure is expected to create adverse impacts to both the Stevens Historic District and the Hoboken Historic District under Alternative 1, or the Hoboken Historic District under Alternatives 2 and 3. The Long Slip project and sewer construction elements of the NHSA LTCP may also impact the

Hoboken Historic District. All other foreseeable projects are located outside known historic properties relevant to RBD-HR.

Regarding archaeology, on the basis of existing soil boring data and historic documentary research for the project, there is potential for prehistoric archaeological deposits eligible for listing in the National Register (NR) to be located within portions of RBDH. Given the scarcity of known prehistoric deposits within the Study Area, any new deposits, if encountered, would likely be eligible for listing in the NR. The specificity of archaeological impacts from RBDH would be refined following execution of the project-specific Programmatic Agreement.

With regard to future redevelopment projects, areas of historic occupation that have not been previously redeveloped have the potential to contain undocumented historic architectural and/or archaeological resources. Archaeological resources could also be located within the streetbeds of historically occupied urban centers in the form of potentially NR-significant historic infrastructure examples. On the other hand, areas that have been subjected to significant redevelopment would likely lack potential to contain historic architectural or archaeological resources due to prior disturbances from construction and excavation. New discoveries have the potential to create a broader understanding of the area's cultural resources context if the analyses of identified cultural resources are commingled, producing a large-scale analysis of the human occupation of coastal Hudson County.

Air Quality, Greenhouse Gasses, and Climate Change

On August 1, 2016, the CEQ issued a memorandum containing final guidance to assist federal agencies in their consideration of the effects of proposed projects on greenhouse gas (GHG) emissions and the impact of climate change on proposed projects. The emission of GHG from all sources contributes to cumulative climate change impacts. As described in Section 4.6, GHG emissions associated with the operational phase of RBD-HR were calculated to be 18 mtCO2e per year, due to the use of generators for pumps associated with DSD. Emissions of GHG during construction of the RBD-HR Resist components from 2019 to 2022 were calculated to range from approximately 7,500 to 11,750 metric tons due to the use of fossil fuel burning construction vehicles. Once constructed, the Resist feature has no emissions.

Climate change exacerbates sea level rise, which could eventually compromise the efficacy of the Resist structure and increase the risk of flooding for local communities. One of RBD-HR's project goals is to take into account the projected impacts from climate change, particularly as it relates to sea level rise and its impacts on the frequency and degree of flooding in compliance with the 2013 Executive Order on Preparing the United States for the Impacts of Climate Change.

Section 65.10 of the National Flood Insurance Program (NFIP) regulations require that for levees to be recognized by FEMA, certain design requirements must be met that demonstrate that the structure will provide protection. The design flood elevation (DFE) for RBD-HR was developed using the base DFE, as required by the NFIP, plus NOAA's 2075 intermediate high scenario for future sea level rise of 2.34 feet. This final DFE determined the heights necessary for the Resist structure to be certified by FEMA, while also adapting to future sea level rise.

In addition to being adaptive to sea-level rise, RBD-HR provides the opportunity to mitigate some of the effects of GHG emissions through carbon sequestration by adding additional parks and vegetation. The DSD component of the project combined with other green infrastructure efforts will result in additional park spaces throughout the area. When park space increases the density of vegetation and foliage, this creates carbon sinks, which can contribute to improved air quality and reduce the heat island effect that is often found in highly urbanized areas with large amounts of impervious surface.

Contaminated Sites

One of the positive direct impacts that would result from RBD-HR is the cleanup of contaminated sites that may contain hazardous materials throughout the Study Area. Similarly, as other development projects are implemented that involve ground disturbance a beneficial cumulative impact can result by addressing previously unknown or unaddressed contaminated sites. With proper implementation and oversight, the remediation of additional sites throughout the cumulative impacts study area will result in a cleaner and healthier environment.

Population: Economic Impacts and Public Health

Economic conditions are expected to benefit from RBD-HR due to the flood risk reduction for existing homes and businesses reducing the cost of property damage and subsequent flood claims. The same benefits extend to Environmental Justice populations.

In addition, beneficial economic impacts due to flood risk reduction translate to a positive cumulative impact on public health. RBD-HR is expected to protect large portions of Hoboken from initial flooding, while providing additional capacity to deal with inland flooding. The Adaptation Recommendations in Jersey City, the NHSA and Jersey City LTCPs, and the Hoboken Wet Weather Pump Station H5 are projects that all work to improve the infrastructure needed to respond to flooding and increase the Study Area's resiliency. With fewer flooding incidences and a more resilient infrastructure, it can be expected that the negative public health effects that occur after flooding would also be diminished. These public health benefits apply to the entire population affected by flooding and poor drainage including Environmental Justice populations.

Viewshed

The view of Manhattan is a valuable resource to the residents and visitors of this region. This viewshed could be adversely impacted as a result of the

placement of RBD-HR waterfront Resist features, depending upon the Build Alternative selected. Similarly, the continued development of Newport, Jersey City and proposed development along the Morris Canal Basin further impact the viewshed. Other waterfront projects include Long Slip, Monarch, Riverview, Quanta, and Hess. The heights allowed in waterfront development are controlled by local zoning ordinances and State regulations. Nonetheless, each new development that is approved along the waterfront diminishes the view of Manhattan for those further inland.

Parks

The DSD portion of RBD-HR is expected to result in the creation of approximately six acres of parkland. In combination with other projects that create additional park space such as 1600 Park and Cove and the Green Infrastructure Plan, the cumulative impact will result in benefits to the community in terms of additional land available for passive and active recreation and additional vegetated and pervious land available to aid in the absorption of rainfall and floodwaters. These beneficial cumulative impacts are also discussed under the surface water discussion. Additionally, increased acreage of green space creates the benefit of carbon sinks as discussed under Climate Change.

5.5 Mitigation

Table 5.2 lists the potential cumulative impacts for each resource area. No cumulative impacts are expected for geology, groundwater, land use, zoning, or infrastructure. Beneficial cumulative impacts are expected for upland vegetation, contaminated sites, population (including Environmental Justice populations), public health, economic conditions and parks. No mitigation is proposed for the resources that experience no cumulative impacts or that experience beneficial impacts.

Potentially adverse cumulative impacts may occur for surface water, floodplains, aquatic ecology, wetlands, endangered and protected species, cultural resources, viewshed, and air quality. Air quality equates to greenhouse gas emissions and climate change and are evaluated together as such.

The short-term impacts discussed previously are the result of construction activities. Project sponsors, developers, and local agencies are accustomed to developing mitigation to lessen the temporary impacts of construction on the community. Mitigation for the noise, air emissions, vibrations, and traffic that occur during construction of RBD-HR will be developed with input from the community and in accordance with the local regulations. If any long-term impacts result specifically from vibration that occurred during the construction of RBD-HR, the project sponsor will be required to mitigate those impacts through repair or replacement.

In order to mitigate impacts associated with surface water, it is critical that shoreline and in-water construction activities are monitored and follow best management practices (BMPs) to limit the amount of disturbance on sensitive aquatic species in the Hudson River due to soil erosion and runoff. Section 4.1.3.6 further identifies these BMPs and mitigation measures that will be developed in compliance with local, state, and federal regulations. In order to mitigate future erosion potential, it is important to consider the landscaping materials used in project design. Vegetation should be native and low-maintenance to allow for successful establishment and limit the need for chemical treatments that can contaminate surface water.

In order to minimize impacts to protected species timing restrictions can be placed on construction in order to avoid impacting sturgeon during the part of the year that they are present in this part of the Hudson River. In order to minimize impacts to wetlands, project sponsors must be made aware of the locations and occurrences of wetlands. This is more difficult for projects that do not require federal or state involvement. Education and awareness are the best tools to prevent impacts to these resources for private projects. If wetland and/or shoreline foraging habitat must be impacted (for bird species of special concern), mitigation should be provided in the form of re-creation within the same watershed to minimize impacts to those species dependent upon these types of habitats.

With regard to cumulative impacts to cultural resources, mitigation can only be recommended if investigations are a requirement placed upon the agency implementing the proposed development. Private development projects would have no requirement to investigate cultural resources unless state permits were required under N.J.A.C. 7:7A. Federal licensing, permitting, or approvals would require compliance with Section 106 of the National Historic Preservation Act (NHPA). Lastly, state-funded projects would require compliance with the NJ Historic Register Act to ensure that the proposed project does not encroach upon SR-listed resources. Despite these protections, private development projects that do not require any of these approvals may have unmitigated impacts to cultural resources. The RBD-HR proposed Programmatic Agreement (PA) outlines measures to document the presence or absence of archaeological resources within the project's area of potential effect (APE). The PA defines avoidance, minimization, and mitigation measures and the development of a cultural resources management plan to manage and protect endangered and exposed cultural resources. In addition, monitoring of construction activities would be conducted to document the project's potential impact to archaeological resources.

Impacts to the views of the Hudson River can only be mitigated through restrictions on waterfront development and height restrictions of development near the waterfront.

Impacts to air quality involving GHGs exacerbating climate change must be mitigated through the modification and adaptation of construction equipment including the use of low-sulfur diesel fuel and emission

control technology.

Coordination

One of the most important cumulative impact considerations is how the actions of individual municipalities will impact neighboring communities and the overall subwatershed when each implements independent flood risk reduction projects. It is critical that resiliency efforts be coordinated between municipalities to implement projects that work together and complement other resiliency efforts.

Mitigation of cumulative impacts includes continued identification and coordination of resiliency projects on the local and regional level. Coordination and communication with federal, state and local partners is critical in the implementation of this project. Recognizing the on-going resiliency work that is being conducted in the Lower Hudson River, NJDEP intends to continue the effort to develop this inventory of projects and coordinate project activities through participation at future Sandy Regional Infrastructure Resilience Coordination (SRIRC) Federal Review and Permitting (FRP) meetings and Coastal Hudson County Technical Coordination Team (TCT) meetings. NJDEP will provide project updates and will meet with these other teams as the project moves forward.

As described in Chapter 7 Public Participation, these committees are federally convened with responsibility for federal review and permitting of complex Sandy infrastructure projects. Appendix F lists Lower Hudson River area projects in varying stages that were gathered through participation in the SRIRC and Coastal Hudson County TCT that will be included in the ongoing coordination for this project.

On the local level, NJDEP has committed to engage local community groups and partners through the Community Advisory Group (CAG) and directly through public workshops and meetings. These community groups will continue to be used throughout the final design and construction phases of the Project. The purpose of this ongoing coordination is to make sure that resiliency projects on the local level continue to be captured and evaluated.

Additionally, an O&M subcommittee, consisting of local and State partners has helped develop an O&M management strategy framework for the Project. The participants in the O&M planning and development currently include, but are not limited to, entities such as the NJDEP, the cities of Hoboken, Jersey City and Weehawken, NJ TRANSIT, Port Authority of New York & New Jersey (PANYNJ), Hudson County, Jersey City Municipal Utilities Authority, North Hudson Sewerage Authority, and the New Jersey Office of Emergency Management. This committee is planned to meet throughout the design and construction phases in which local resiliency projects will be identified.