

A. INTRODUCTION

This chapter describes how alternatives for the East Side Coastal Resiliency (ESCR) Project (the proposed project) were developed, considered, and reviewed, and then selected for analysis in this Final Environmental Impact Statement (FEIS).

B. BACKGROUND OF DESIGN AND ALTERNATIVES DEVELOPMENT**INTRODUCTION**

This section describes the process that led to the development of alternatives to the proposed project and summarizes the planning background relevant to the development of various coastal protection, resiliency, and waterfront access measures that have been under consideration for the proposed project area and vicinity both before and after Hurricane Sandy. This section also discusses the related plans and policies in existence prior to Hurricane Sandy, those that evolved post-hurricane, and how these initiatives, plans, and policies shaped the development of alternatives to the proposed project.

One purpose of the proposed project is to integrate coastal flood protection with waterfront open space improvements. For decades, the City has been committed to improving public access to its waterfront, including along the proposed project area. Before Hurricane Sandy, several initiatives were developed for this stretch of the East River waterfront that were aimed at improving and expanding public open spaces and recreational opportunities. Among these initiatives were the East River Esplanade Project, *A People's Plan for the East River Waterfront*, and the community engagement and planning design for a Pier 42 Park. After Hurricane Sandy, these waterfront open space planning studies served as the starting point for coastal resiliency and flood protection planning along the proposed project area.

PRE-HURRICANE SANDY WATERFRONT PLANNING*EAST RIVER WATERFRONT ESPLANADE PROJECT*

The design for the East River Waterfront Esplanade was developed by the New York City Economic Development Corporation (NYCEDC) in consultation with the City's Departments of City Planning (DCP), Transportation (NYCDOT), and Parks and Recreation (NYC Parks), along with the local community and their elected officials, civic associations, and City and New York State (State) agencies. During the course of developing the East River Waterfront Esplanade Project, the design and City teams participated in over 70 separate meetings with community boards, tenant associations, civic leaders, maritime experts, and elected officials.

The East River Waterfront Esplanade concept was to create a continuous, publicly accessible walkway extending for approximately two miles along the East River from The Battery on the south to Pier 42 north of Jackson Street on the north with pavilions below the elevated Franklin

Delano Roosevelt East River Drive (FDR Drive) to house community programs and activities. The design also included an “eco-park” at Pier 35, improvements to waterfront blocks of streets that connect to the river, and a public park at Pier 42. The first phase of the esplanade, along the East River waterfront of Lower Manhattan (i.e., south of the Manhattan Bridge to approximately the Battery Maritime Building), was completed in 2011, and the section to the north, between Pike Slip and Pier 35, is currently under construction. The Pier 42 improvements are also in the design stages in preparation for implementation (see below).

A PEOPLE’S PLAN FOR THE EAST RIVER WATERFRONT

The People’s Plan for the East River Waterfront (the People’s Plan) was developed by Organizing and Uniting Residents (O.U.R.) Waterfront, a coalition of community-based organizations and tenant associations representing residents of the Lower East Side and Chinatown, including: the Committee Against Anti-Asian Violence (CAA AV), Organizing Asian Communities, the Urban Justice Center’s Community Development Project (UJC), Good Old Lower East Side (GOLES), Jews for Racial and Economic Justice (JFREJ), Public Housing Residents of the Lower East Side (PHROLES), Hester Street Collaborative, the Lower East Side (LES) Ecology Center, Two Bridges Neighborhood Council, and University Settlement.

The People’s Plan focused on Piers 35, 36, and 42, and called for free and low-cost sports and recreation opportunities, open space, education and community services, and space for appropriate low-cost businesses to meet resident needs. This plan also highlighted the need for activities, programs, space, and events along the waterfront that celebrate the cultural diversity of the neighborhood and improve local health and quality of life. *The People’s Plan* proposed a park along the three piers connecting to the East River Waterfront Esplanade that features multi-use courts, a filtered river water pool, a community center, open spaces, water access, education space, community gardens, and restrooms. As a result of this plan, NYC Parks advanced comprehensive reuse and park designs for these three piers, only one of which (Pier 42) is located within the project area (see below).

PIER 42 PROJECT

At the southern end of Project Area One, NYC Parks is proposing to construct Pier 42 as a public waterfront open space that would increase accessible open space within the study area. For many years, the Pier 42 property consisted of warehouse space and parking, located just south of East River Park between the East River and the FDR Drive. A masterplan for the overall redevelopment of Pier 42 as an open space was approved by a Community Board 3 sub-committee and the New York City Public Design Commission (PDC). Phase 1A of the Pier 42 redevelopment included the demolition of the pier shed. Phase 1B will include the redevelopment of the upland park (north and east of Phase 1A) with amenities such as an entry garden in the western section, a playground, a comfort station, a grassy knoll rising approximately seven feet above grade, solar powered safety lighting throughout the park, and access from the shared-use path along the FDR Drive service road or Montgomery Street. The Pier 42 project will introduce approximately 2.93 acres of new passive open space to the study area by 2021.

POST-HURRICANE SANDY WATERFRONT PLANNING AND DESIGN

COMMUNITY REBUILDING RESILIENCY PLANS (CRRP) AND COASTAL PROTECTION INITIATIVE 21

Following Hurricane Sandy, the City formed the Special Initiative for Rebuilding and Resiliency (SIRR) to analyze the impacts of the hurricane on the City’s buildings, infrastructure, and people;

to assess climate change risks in the near (2020s) and long term (2050s); and to outline strategies for increasing resiliency citywide. The SIRR identified citywide strategies to protect people, investments, and infrastructure from the impacts of coastal storms and climate change. The culmination of that work is contained in the report *PlaNYC—A Stronger, More Resilient New York*, released in June 2013, which provides CRRP for five particularly vulnerable neighborhoods in the City, including Southern Manhattan and the neighborhoods adjacent to the project area.

The CRRP recommendations for Southern Manhattan outline specific coastal protection measures for buildings and critical infrastructure coupled with community and economic recovery measures. With respect to coastal protection, the proposals were based on a multi-faceted analysis that considered the various types of coastal hazards and their likelihood of occurrence, the potential impact of these hazards on the built environment and critical infrastructure, and the likely effectiveness of proposed measures to address these hazards. In addition, the coastal protection measures presented in *PlaNYC* were informed by DCP's *Urban Waterfront Adaptive Strategies* (UWAS) study, published in June 2013. The UWAS study examined the underlying geomorphology of the various stretches of shoreline, categorized each coastal reach by geomorphic type, and provided an evaluation of coastal resiliency measures that would be appropriate for each reach. The CRRP then built upon the results of the UWAS study to recommend coastal initiatives for each reach, including the proposed project area.

Coastal Protection Initiative 21 (Initiative 21) of the CRRP affirmed the City's commitment to establishing an integrated coastal flood protection system for Southern Manhattan and calls for an integrated coastal flood protection system for targeted reaches along the East River shoreline from Battery Park City on the south to East 14th Street on the north. The first phase of Initiative 21 was identified as the reach from the Brooklyn Bridge north to East 14th Street. This area is home to a large residential population, including one of the greatest concentrations of low- and moderate-income households in the City, with over 12,700 New York City Housing Authority (NYCHA) housing units. In addition, critical infrastructure, including the Con Edison Complex, the New York City Department of Environmental Protection's (DEP) Manhattan Pump Station, and the FDR Drive are all located along this reach. Storm damage to these critical public and private assets, as occurred with Hurricane Sandy, has significant economic, fiscal, and social impacts on the City.

Initiative 21 proposed integrated coastal flood protection for the Lower East Side that would eventually become part of an integrated coastal flood protection system for all of Southern Manhattan. It stated that the City would consider extending the integrated coastal flood protection system south from the Brooklyn Bridge to Lower Manhattan and the waterfront along the Financial District, extending the system along South Street to Battery Park, with a small section running across West Street, north of Battery Park City. Initiative 21 also expressed the City's commitment and support for the Rebuild by Design (RBD) competition, which ultimately shaped the proposed project (see the discussion below).

REBUILD BY DESIGN (RBD) PROCESS

To develop more efficient and effective designs for coastal flood protection in the New York City region affected by Hurricane Sandy, the United States Department of Housing and Urban Development (HUD), in conjunction with the Rockefeller Foundation and others supporting organizations, launched the global RBD competition in June 2013. This competition solicited proposals from around the world with the objective of identifying innovative and implementable coastal flood protection solutions that would respond to the devastation wrought by Hurricane Sandy. Other sponsoring and participating organizations involved with RBD included the Institute

for Public Knowledge at New York University, the Municipal Art Society, the Regional Plan Association, and the Van Alen Institute.

The BIG U Proposal

The BIG U Proposal evolved from a comprehensive examination of the history of resiliency planning in the tri-state area and elsewhere. The research, including the plans and proposals described above, revealed that former resiliency planning initiatives evaluated current conditions, but failed to provide for the growth and changes that are likely to occur in communities over time. As such, the BIG U team, led by the architecture firm Bjarke Ingels Group (BIG), developed designs that were aimed not only at solving current coastal protection and waterfront planning needs, but addressing future issues as well.

The focus of the BIG U Proposal was to evaluate how coastal flood protection infrastructure can both enhance and stabilize underserved neighborhoods, not only protecting this densely populated City against flooding and stormwater, but also providing social, economic, and environmental benefits to the community.

Because physical and social conditions vary in Southern Manhattan, the BIG U team created three compartments that, while connected, could function independently to provide flood protection while blending in with the neighborhood landscape. Each compartment would then be equipped with a variety of design features that respond to the particular need and wishes of that particular community. Along the East River waterfront of Manhattan, these compartments included the following:

- Compartment 1—Lower East Side North (East 23rd Street to Montgomery Street)
- Compartment 2—Two Bridges (Montgomery Street to the Brooklyn Bridge)
- Compartment 3—Battery Park Financial District (Brooklyn Bridge to Battery Place)

The design development process involved several workshops per compartment, in which initial workshops consisted of discussing possible design solutions, followed by design solutions proposals suited to each location. In addition, the team incorporated various waterfront access and open space designs, as well as coastal flood protection alternatives previously developed by the City and local communities. These alternatives included beautifying the affordable housing community, increasing green infrastructure and linkages to the waterfront and park, and augmenting community programs, such as adding a community pool and free-to-low-cost recreational activities.

The BIG U design focused on combinations of berms, bridging berms, and closure structures (i.e., a floodgate across a street or sidewalk that is deployed during a storm event) to provide flood reduction. The design also proposed improving the connectivity of the adjacent residential neighborhood to the waterfront. Key design objectives included providing access to East River Park through gentle ramps, enhancing park access through improved landscaping; providing a new shared and meandering multi-purpose path along the waterfront; addressing safety concerns by improving lighting; providing new signage; and reprogramming the land beneath the elevated sections of the FDR Drive.

For Compartment 1, closure structures were contemplated in the East 23rd Street area given the number of street and FDR Drive access connections. Moving south, a series of pavilions were programmed under the elevated FDR Drive to provide various commercial functions with closure structures linking these pavilions. Near the Con Edison Complex, a new bridge structure with a berm was proposed to provide a new link to East River Park via a proposed berm along the service

road in East River Park that parallels the FDR Drive. The berm was shaped to preserve the existing recreational fields in the park with landscaped bridges connecting East River Park to the inland community. The coastal flood protection would then continue southward to Montgomery Street where a closure structure was proposed to be installed beneath the FDR Drive at the ramp entrance and also along South Street. Other alternatives considered during this process were coastal flood protection alignments located along the west side of the FDR Drive, decking over the FDR Drive to create a large, new open space as part of East River Park, and elevating the waterfront edge of East River Park.

Throughout the visioning sessions and public engagement workshops, with assistance from GOLES, the community identified various existing constraints to public access and enjoyment of East River Park, including access limitations due to the FDR Drive, which physically separates the park from the residential neighborhoods to the west. While the existing pedestrian bridges into East River Park provide limited access, a landscaped bridging berm, as envisioned by the BIG U, would allow for additional points of access, increasing the connectivity between the residential community and East River Park.

The BIG U identified the existing accessway to the Delancey Street pedestrian bridge as particularly deficient for both pedestrians and bicyclists due to its minimal signage, lighting, landscaping, and a narrow width that both restricts two-way pedestrian and bicycle traffic and is challenging for strollers and wheelchair accessibility. In addition, sharp turns on the ramps severely limit bicycle travel and require bicyclists to either partially or fully dismount. The aesthetic quality of the bridge is also compromised by high chain-link fencing. Finally, the landing in East River Park is adjacent to the FDR Drive, which constrains and detracts from the experience of arriving at an open space.

In addition, the BIG U recognized the existing East Houston Street overpass as difficult to navigate with its series of road crossings, absence of traffic signals, and substantial vehicular and pedestrian conflicts resulting from limited space (i.e., existing access to East River Park via the overpass is only through a single, three-foot-wide cut in a concrete barrier).

Selection of the RBD Project

In June 2014, following a year-long process during which the design teams met with regional experts, including government agencies, elected officials, community organizations, local groups, and individuals, HUD announced the winning RBD projects located throughout the Hurricane Sandy-affected area. The winning proposal for Manhattan was the BIG U—specifically, Compartment 1, from Montgomery Street on the south to East 23rd Street on the north. This compartment was selected for funding that would advance it through conceptual design and then to implementation and represents the subject area for this Environmental Impact Statement (EIS).

EXAMINATION OF POTENTIAL COASTAL FLOOD PROTECTION APPROACHES

Prior to initiation of the proposed project's design in late 2014, the City evaluated and reviewed the coastal protection initiatives that were considered for New York City, Southern Manhattan, and the proposed project area, including those described above to identify any potential fatal flaws of the initiatives or incompatibility with the objectives of the proposed project. This review and comparison formed the basis of the screening process that identified initial alternatives for potential coastal protection measures as part of the proposed project.

Flood protection strategies developed by the United States Army Corps of Engineers (USACE) were reviewed and compared with initiatives that the City had considered as part of its post hurricane coastal planning to increase resiliency. The *North Atlantic Coast Comprehensive Study*:

Resilient Adaptation to Increasing Risk was a comprehensive study that examined opportunities for reducing flood risks to vulnerable coastal populations, promoting resilient coastal communities, and maintaining a sustainable and robust coastal system.¹ The report identified a total of 20 different strategies within three categories for managing risk of future coastal floods: non-structural, structural, and natural/nature-based strategies:

NON-STRUCTURAL STRATEGIES

- Acquisition and Relocation (i.e., of individuals and properties out of the coastal flood risk area)
- Building Retrofit
- Enhanced Flood Warning and Evacuation System
- Land Use Management
- Zoning
- Flood Insurance

STRUCTURAL STRATEGIES

- Closure Structures
- Floodwalls and Levees
- Seawalls
- Revetments
- Bulkheads
- Storm Surge Barriers

NATURAL AND NATURE BASED FEATURES

- Beach Nourishment/Restoration
- Dune Construction and Replenishment
- Beach Restoration and Off-Shore Breakwaters
- Beach Restoration and Groins
- Drainage Improvements
- Overwash Fans
- Submerged Aquatic Vegetation
- Wetlands, Reefs, and Living Shorelines

SUMMARY OF USACE RESILIENT ADAPTATION STUDY SCREENING PROCESS

The review of the coastal protection strategies listed above revealed that non-structural measures, such as acquisition and relocation, are neither appropriate nor implementable in a densely populated urban setting such as the proposed project area. Additionally, the City and region already have advance storm warnings and emergency preparedness plans. The City already

¹ https://www.nad.usace.army.mil/Portals/40/docs/NACCS/NACCS_main_report.pdf, last visited 8/19.

participates in the National Flood Insurance Program² and is also implementing zoning policies³ as one strategy aimed at reducing flood risk in the neighborhoods adjacent to the proposed project area; these measures alone, however, cannot fully address the coastal protection needs of these neighborhoods. Similarly, the natural and nature-based approaches would not be suitable along the proposed project area, which is juxtaposed between a developed urban setting and the East River. Certain structural approaches, such as seawalls, are typically large structures that could not be integrated into East River Park and Stuyvesant Cove Park, or revetments that would require extensive filling of the East River.

Floodwalls, levees, and closure structures were identified as viable flood protection strategies for the proposed project area. Multi-purpose raised landscapes can support other uses such as open space and were identified as appropriate approaches to providing coastal flood reduction along the proposed project area as part of the *PlaNYC: A Stronger, More Resilient New York* planning process, and were also identified in the BIG U proposal. These coastal protection systems would then be supported by improvements to the existing in-place drainage infrastructure, described further below.

DEVELOPMENT OF COASTAL FLOOD PROTECTION DESIGNS

As refined through the City's efforts during the development of the *PlaNYC* plan and the HUD selection of the Big U Compartment 1 proposal, the coastal flood protection measures that were deemed suitable to use in the development of designs included:

- Floodwalls;
- Levees;
- Closure structures; and
- Drainage improvements.

These elements would be coupled with additional urban design and open space enhancements to integrate the flood protection system into the urban setting that characterizes the 2.4-mile-long project area.

DESIGN PROCESS

To advance the BIG U Compartment 1 plan, the City initiated a design process in December 2014 that examined combinations of coastal flood protection systems in greater detail from planning, urban design, and engineering perspectives. This design process included three phases: conceptual design, preliminary design, and final design. The conceptual design process continued until the winter of 2015 and resulted in the identification of four design alternatives for the portion of the project area in East River Park, and three design alternatives for the portion of the project area between East 13th Street and East 25th Street. The conceptual design process also confirmed the design storm for the proposed project, which corresponds to the United States Federal Emergency Management Agency (FEMA) 100-year flood event with 90th percentile 2050s sea level rise

² Participation in the National Flood Insurance Program satisfies the non-structural flood protection approach of insuring vulnerable properties against damage resulting from coastal flooding events.

³ Examples include provisions in the New York City Waterfront Revitalization Program policies, and new Buildings Department regulations requiring that construction in a FEMA Flood Hazard Area raise critical service/infrastructure elements, like building boilers, above specified flood elevations.

assumptions (protected area).⁴ The protected area is shown on **Figure 2.0-1**. As part of the conceptual design efforts, supporting hydrology and hydrodynamic modeling analyses were undertaken.⁵ Key findings of this modeling included effects of the proposed coastal flood protection system on flood elevations at adjacent properties, and the effects of waves against the proposed flood protection system and wave deflection to adjacent properties.

PRELIMINARY DESIGN PROCESS

Following selection of a final conceptual design approach, the preliminary design process conducted additional site investigations and used that information to further refine and develop the proposed design, spanning from fall 2016 through spring 2018. In spring 2018, a constructability review was conducted to assess options to reduce construction risks associated with the proposed approach. As a result, in October 2018, a design update was developed for Project Area One that involves integrating flood protection with the raising and reconstruction of East River Park. This design update includes additional access improvements and the reconstruction of East River Park to protect this valuable resource from flooding during coastal storm events as well as inundation from sea level rise, which would enhance its value as a recreational resource in addition to providing flood protection to the inland communities.

Identification of project alternatives and design refinement went through a process that integrated input from the community outreach program while further examining site constraints, engineering challenges, cost, constructability, and other factors. Guidance on operations and maintenance was also provided during review meetings with multiple City, State, and federal agencies, as well as local stakeholders, and the preliminary recommendations were included in the design reports.

PROJECT AREAS AND DESIGN REACHES

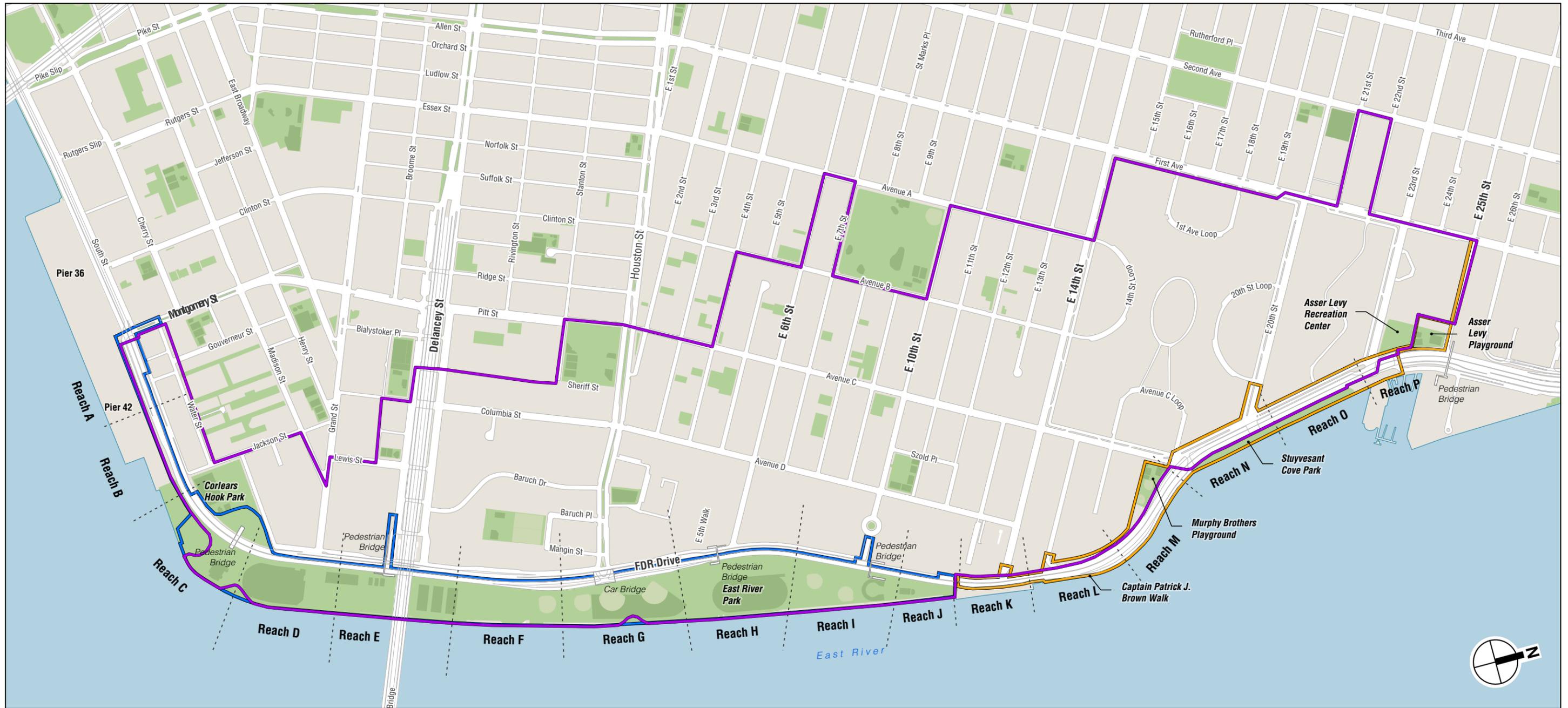
As part of the design process, the proposed project area was divided into 2 project areas and 16 design reaches (see **Figure 2.0-1**). Project Area One comprises 10 design reaches and extends from Montgomery Street on the south to the north end of East River Park (or about East 13th Street). The southerly reaches include City streets, such as Montgomery and South Streets, as well as a segment under the elevated FDR Drive with the majority of Project Area One being within East River Park. Project Area One also includes four existing pedestrian bridges across the FDR Drive to East River Park (the Corlears Hook, Delancey Street, East 6th Street, and East 10th Street Bridges) and the East Houston Street overpass. Project Area Two comprises seven design reaches (Reach J spans both Project Areas One and Two) and extends north and east from Project Area One, from East 13th Street to East 25th Street. In addition to the FDR Drive right-of-way, Project Area Two includes the Con Edison Complex, Murphy Brothers Playground, Stuyvesant Cove Park, street segments along and under the FDR Drive and Asser Levy Playground, and the Veteran Affairs (VA) Medical Center. The 16 reaches comprising the project area are described below, segregated into Project Area One and Project Area Two.

Project Area One Design Reaches

Reaches A and B: Montgomery Street Tie-Back and Pier 42. Reaches A and B extend from Montgomery Street in the south to the park maintenance area located just north of Jackson Street

⁴ Sea level rise estimate represents the 90th percentile value for the 2050s as presented by the New York City Panel on Climate Change. See below for additional details on design principals and sea level rise.

⁵ East Side Coastal Resiliency Project, Coastal Hydraulics Report, Arcadis, 2015.



- Project Area One
- Project Area Two
- Protected Area
- Proposed Project Design Reaches
- Existing Pedestrian Bridges

0 1,000 FEET

and Pier 42. This reach includes a southward extension of East River Park adjacent to the FDR Drive.

Reaches C and D: East River Park Compost Yard and South Ballfields. Reaches C and D extend from the south end of East River Park, north to Ball Fields Nos. 1 and 2 and the shared-use path just south of the Delancey Street pedestrian bridge. This reach also includes the East River Park Compost Yard, the Corlears Hook Bridge, and the amphitheater.

Reach E: East River Park—Delancey Street Pedestrian Bridge and Tennis Courts. Reach E extends from the volleyball courts in the park adjacent to the pathway between the shared-use path and promenade, north to the tennis court complex located just north of the Williamsburg Bridge, and includes the Delancey Street pedestrian bridge.

Reaches F and G: East River Park—Reflections Labyrinth and East Houston Street Ballfields. Reaches F and G extend northward from the tennis court complex to Ball Fields Nos. 3, 4, 5, and 6, and includes the East Houston Street overpass.

Reach H: East River Park—Track and Field Complex. Reach H extends from the northern edge of Ball Field No. 6 to a park maintenance area located just north of the Track and Field Complex and includes the East 6th Street pedestrian bridge.

Reaches I and J: East River Park—East 10th Street Ballfields and Children’s Playground. Reaches I and J extend from Ball Fields Nos. 7 and 8 just north of the Track and Field Complex to the north end of East River Park at approximately East 13th Street and includes the East 10th Street pedestrian bridge and the barbeque areas.

Project Area Two Design Reaches

Reaches J and K: FDR Drive Crossing to Con Edison East River Complex. Reaches J and K include crossing the FDR Drive, the FDR Drive right-of-way in front of the Con Edison East 13th Street Substation and the crossing of East 14th Street and connections to the flood protection system in Con Edison’s East River Generating Station. This design reach includes the FDR Drive (which is at-grade in this design reach) and the portion of the Con Edison Complex bounded by East 13th Street on the south and East 15th Street on the north.

Reaches L and M: East 15th Street to Murphy Brothers Playground. Reaches L and M include the pa Workout Facility north of the Con Edison East River Generating Station to Murphy Brothers Playground, Captain Patrick J. Brown Walk, and the adjacent FDR Drive.

Reach N: FDR Drive Crossing and Stuyvesant Cove Park. Reach N begins at the intersection of the FDR Drive and East 18th Street and includes the design reach under the FDR Drive (the FDR Drive is elevated in this design reach) between Avenue C and Stuyvesant Cove Park and continues northward in Stuyvesant Cove Park to just north of East 20th Street.

Reach O: Stuyvesant Cove Park and Solar One. Reach O begins north of the East 20th Street between the East River and Avenue C, and runs along the northern portion of Stuyvesant Cove Park, ending just south of the intersection of East 23rd Street and the FDR Drive ramps (the FDR Drive is elevated in this design reach).

Reach P: East 25th Street Tie-Back. Reach P begins at the intersection of East 23rd Street and the FDR Drive ramps and continues north along the FDR Drive service road, where it turns inland (west) and includes the northern portion of Asser Levy Playground and the connection to the existing VA Medical Center proposed floodwall that continues along East 25th Street.

COMPONENTS OF THE PROPOSED PROJECT

The proposed project incorporates a combination of coastal flood protection components comprised of floodwalls, levees, and closure structures, with infrastructure improvements. Provided below are descriptions of these systems.

Coastal Flood Protection System Components

Floodwall. Floodwalls are narrow, vertical structures with a below-grade foundation that are designed to withstand both tidal storm surges and waves. They are typically constructed of steel, reinforced concrete, or a combination of materials with a reinforced concrete cap. Floodwalls can be used where there are horizontal space limitations for levees and where there is a design objective to have a narrow footprint of the flood protection system. Typical floodwall designs include I-walls (partially embedded in the ground) and L-walls (foundation base slab supported by a pile foundation), each providing differing degrees of structural protection to withstand tidal surge and wave forces (see **Figure 2.0-2** for a cross section of a typical floodwall).

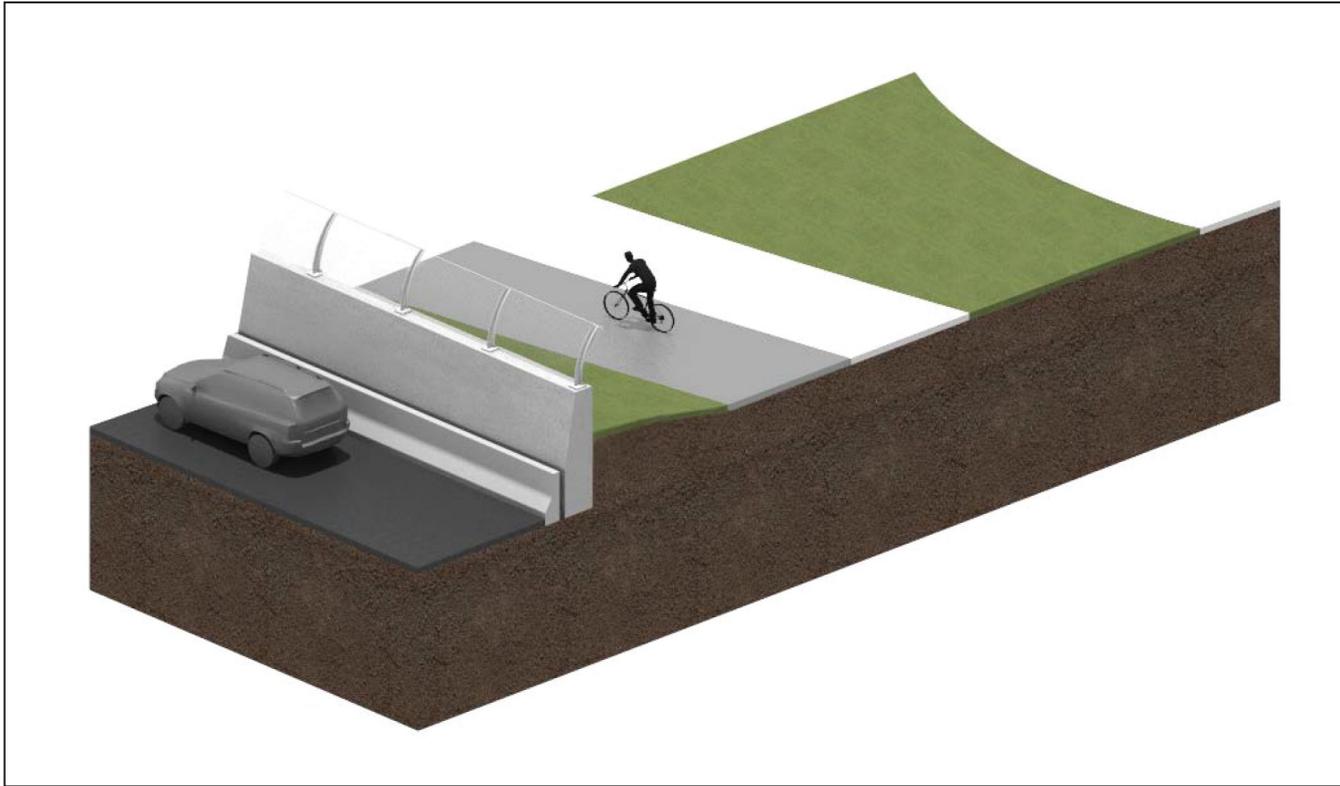
Levee. Levees elevate the existing topography forming a barrier or line of coastal flood protection. In general, levees have a relatively wide footprint when installed. They are typically constructed of a core of compacted fill material, capped by stiff clay to withstand storm waves, along with a stabilizing landscaped cover. The slopes are designed to maintain the structural stability of the levee under design loading conditions, considering drainage and utilities. To avoid seepage, the coastal flood reduction levee has an interior cutoff wall that is constructed of either a stiff clay or slurry (see **Figure 2.0-3** for a cross section of a typical levee).

Closure Structure. In many flood protection systems, it is necessary to provide an opening to accommodate day-to-day vehicular or pedestrian circulation along a street or sidewalk. In these instances, closure structures are installed to close the openings prior to the anticipated arrival of a design storm event and require active deployment. There are two types of closure structures that have been considered as part of the proposed project, each of which is made of steel and structurally reinforced. These closure structures include the following deployable gates:

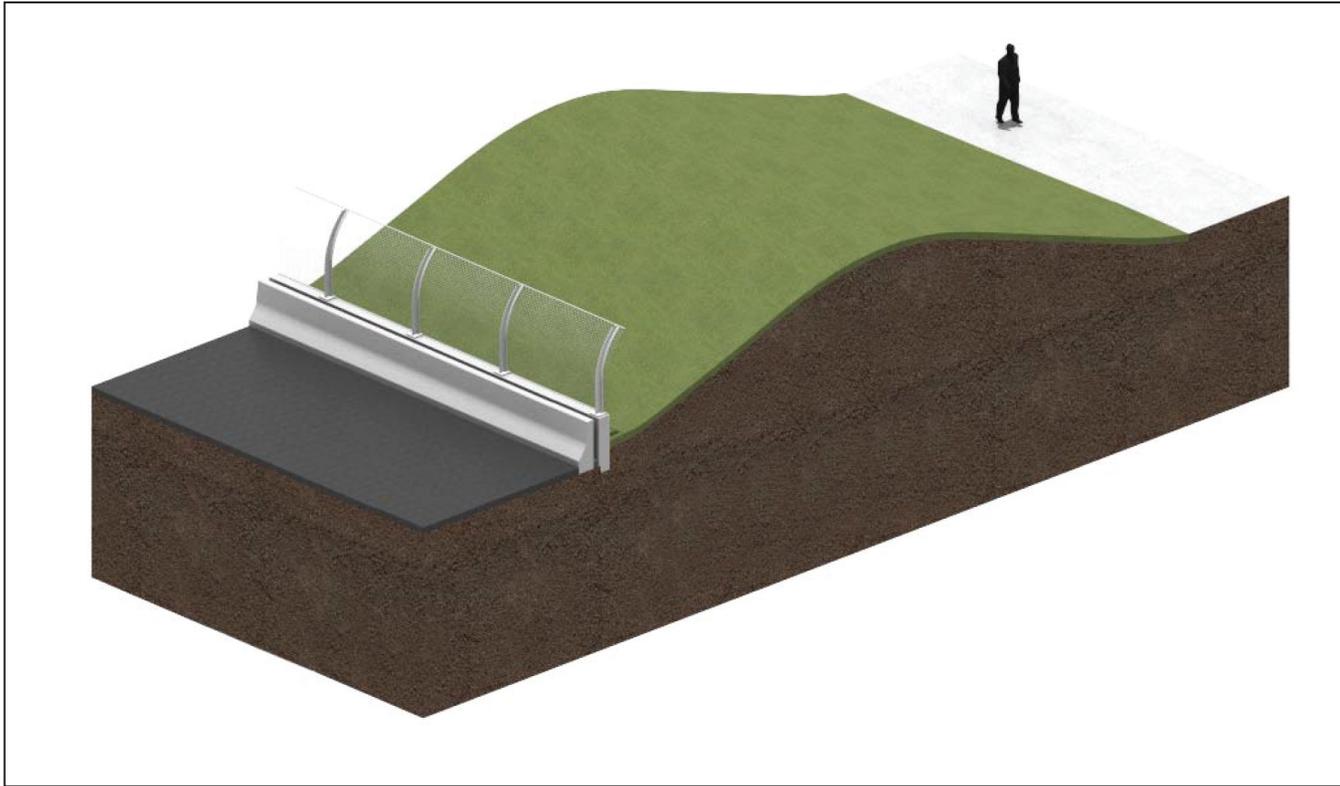
- **Swing Floodgates.** Swing floodgates operate like hinged doors and are moved to the closed position prior to the anticipated arrival of a design storm event. The span limit for these systems is generally around 40 feet (see **Figure 2.0-4** for a cross section of a typical swing floodgate). This type of floodgate is a site fixture, meaning it remains on-site and is kept in the open position when not in use.
- **Roller Floodgates.** Roller floodgates are closure structures that can be used in openings with spans up to 72 feet. They are stabilized with a single or double line of wheels and are slid into their protection position prior to the anticipated arrival of a design storm event (see **Figure 2.0-5** for a cross section of a typical roller floodgate). This type of floodgate is kept in the open position when not in use.

Other Components

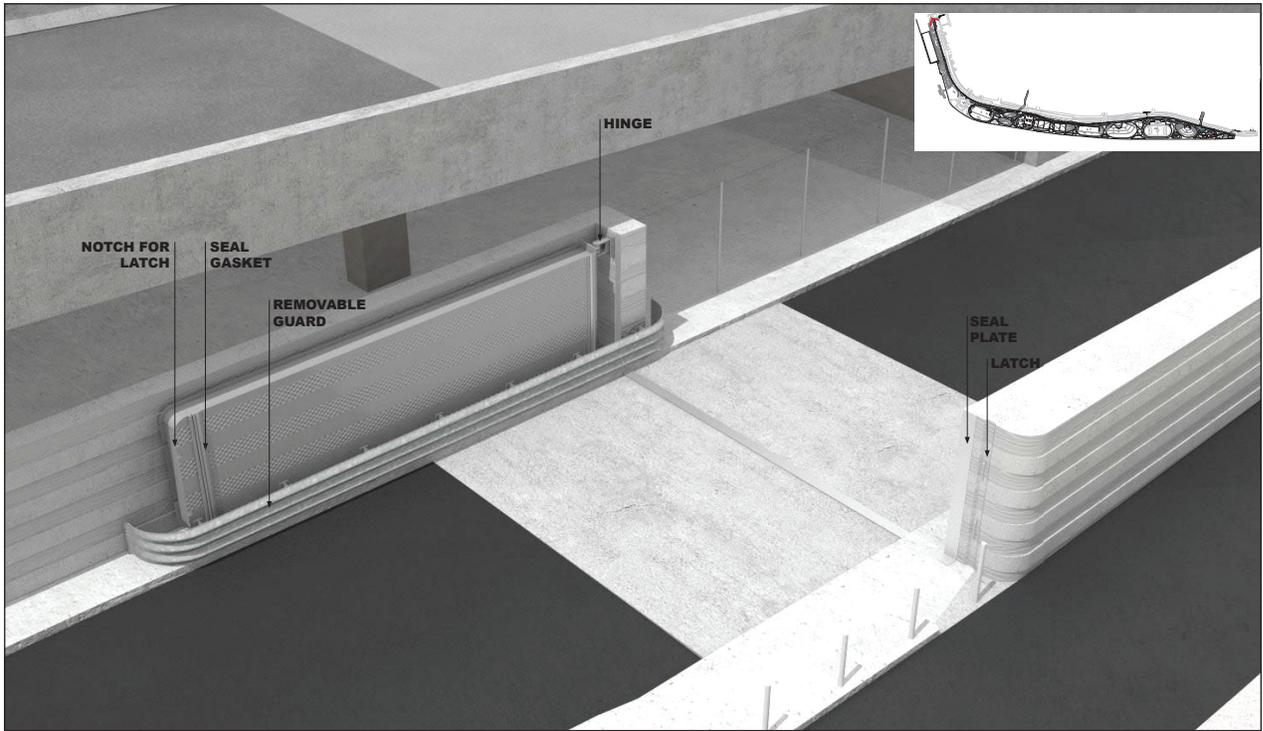
Infrastructure Improvements. The flood protection components described above would prevent coastal flooding from entering the protected area. The protected area lies within a large sewershed served by a combined sewer system that conveys a combination of sanitary sewage and stormwater through a network of pipes to the Manhattan Pump Station where it is then pumped to the Newtown Creek Wastewater Treatment Plant (WWTP) for treatment and discharge to the East River. Additional improvements are required to modify the existing combined sewer infrastructure to hydraulically isolate the protected area (drainage isolation) as well as to protect against inland



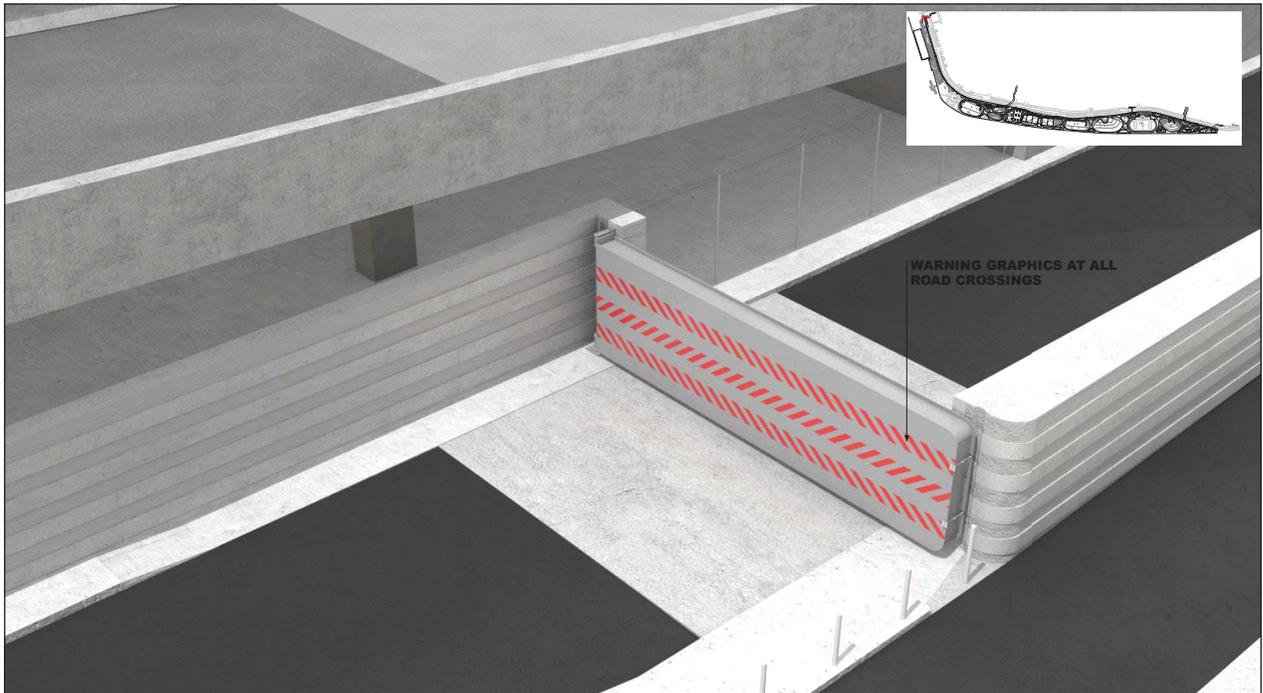
NOTE: Preliminary Illustrative Design Concept



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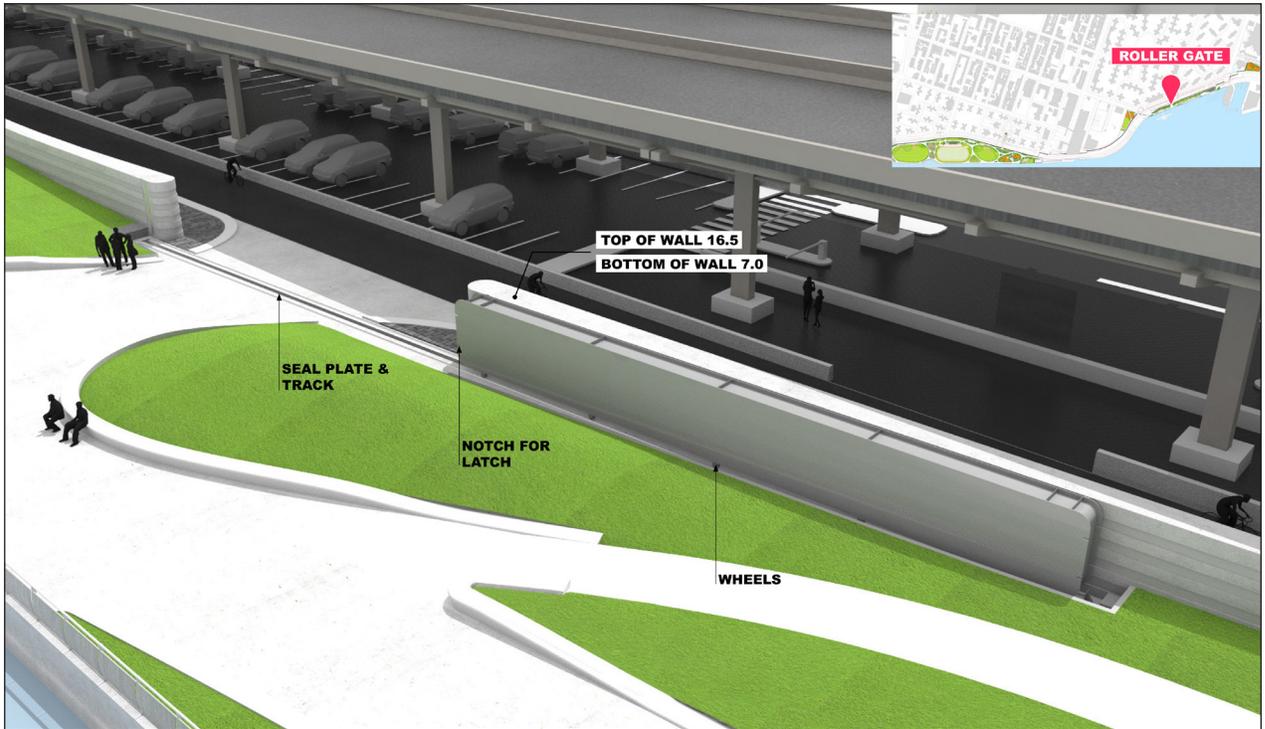


Open position

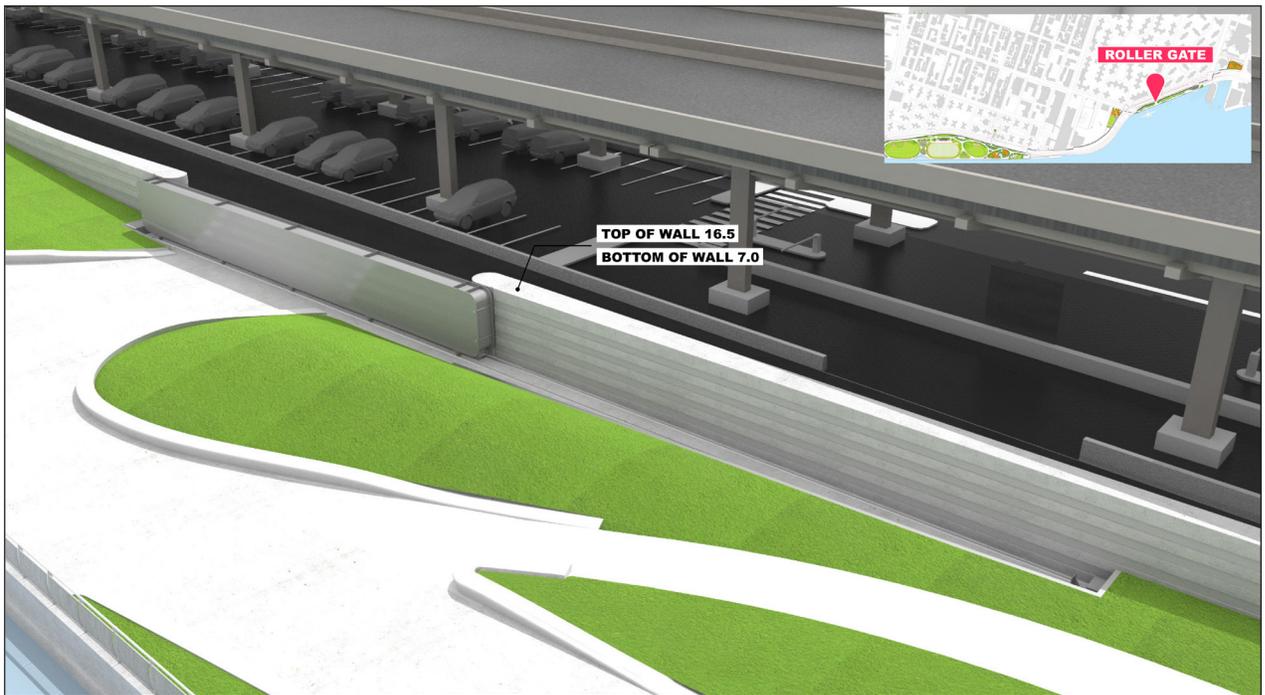


Closed position

NOTE: Preliminary Illustrative Design Concept



Open position



Closed position

NOTE: Preliminary Illustrative Design Concept

flooding during the simultaneous occurrence of a rain event with a storm surge event (drainage management) (see **Figure 2.0-6** for an overview of infrastructure improvements).

- **Drainage Isolation.** Modifications to existing sewer infrastructure would ensure that this infrastructure would not act as a conduit through which tidal surge water from the East River can enter the protected area. These modifications include installing gates on the existing large-diameter sewer pipe (interceptor) that collects and conveys flow through the system and flood-proofing components of the existing sewer infrastructure (such as catch basins and manholes) on the unprotected side of the proposed flood protection system.
- **Drainage Management.** During a design storm event, depending on the nature of coincident rainfall, and with the tide gates closed, the sewer system conveyance pipes can reach capacity, potentially resulting in backups that cause inland flooding. Measures to address the potential flooding include the installation of additional parallel conveyance pipes and other improvements to enhance the existing conveyance capacity of the sewer system.
- **Infrastructure Reconstruction within East River Park.** The infrastructure within East River Park—including outfalls, regulators, tide gates and chambers, and other infrastructure, as well as the park’s drainage collection system and water supply system—is proposed to be reconstructed under the Preferred Alternative and Alternative 5.

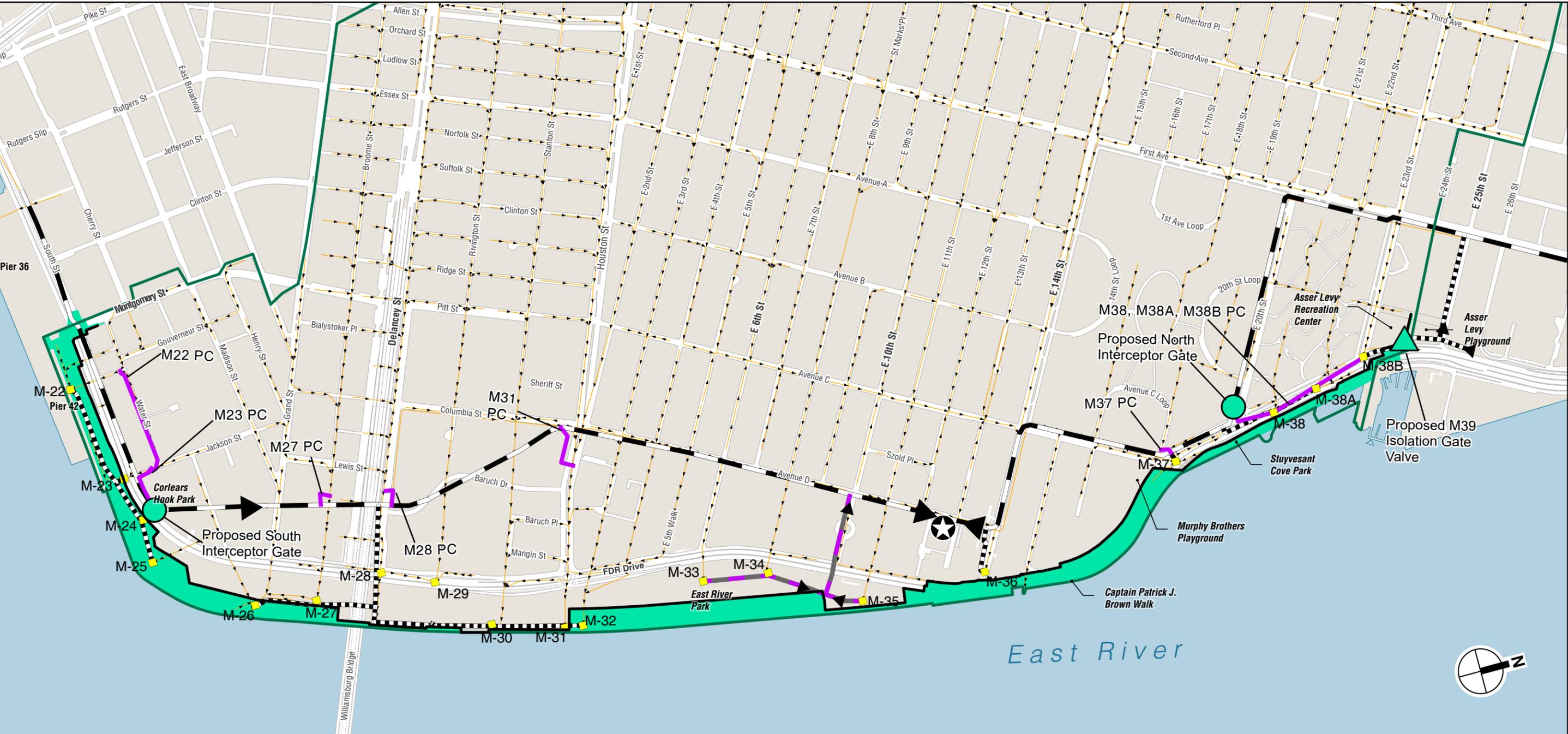
Con Edison high-voltage transmission lines within the project area present a variety of challenges to the design and construction of flood protection measures. These lines are currently buried at a depth that allows effective heat dissipation, which is critical to the efficient functioning of electrical transmission in Lower Manhattan. During construction of the proposed project, Con Edison would undertake the wrapping of their existing live transmission lines located belowground in a protective carbon fiber material. The carbon fiber wrapping approach would protect the transmission lines during construction and ensure long-term viability and access.

DEVELOPMENT OF THE PREFERRED ALTERNATIVE

The City evaluated and reviewed the proposed alternatives’ conceptual design against the principal objectives for the project, including providing a reliable flood protection system for the protected area, improving access to and enhancing open space resources along the waterfront, and meeting HUD funding deadlines for federal spending, along with the goal to minimize potential environmental effects and disruptions to the community. With the implementation of the Preferred Alternative, which is described in further detail below, East River Park would experience significant risk reduction from flooding and inundation from sea level rise in addition to substantial enhancements to its value as a recreational resource and providing flood protection to the inland communities. Park user experience would be enhanced with the reconstruction of East River Park and the reconstruction of pedestrian bridges, and the relocation of two embayments to improve park user access to the water’s edge and provide for improved aquatic habitat conditions. The Corlears Hook Bridge and the East Houston Street overpass would lead the park user directly to newly designed embayments, providing maximum opportunities for the community to connect with the waterfront. Additionally, a long-standing deficiency along the East River Greenway near the Con Edison’s East River Dock would be remedied with the construction of a shared-use pedestrian/bicyclist flyover bridge linking East River Park and Captain Patrick J. Brown Walk, substantially improving the City’s greenway network. In addition, Stuyvesant Cove Park, Murphy Brothers Playground, and Asser Levy Playground would be reconstructed and improved, resulting in enhanced recreational spaces throughout the project area. The selection of this alternative also allows for a shorter construction duration and park closure, earlier deployment of the flood

8/29/2019

AKRF/KSE JV & NYCDEP



Drainage Isolation

- Proposed Isolation Gate Valve at Regulator M-39
- Proposed Interceptor Gate
- Proposed Floodproofing of Unprotected Sewer Infrastructure

Drainage Management

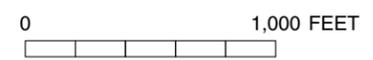
- Proposed Parallel Conveyance (PC)
- Proposed Upsized Branch Interceptor

Existing Regulators

- Existing Regulators
- Existing Lateral Sewers in Drainage Protected Area
- Existing Branch Interceptors
- Existing Interceptor

Manhattan Pump Station

- Manhattan Pump Station
- Drainage Protected Area
- Flood Protection Alignment



protection system (which is expected to be completed in mid-2023), and reduced construction disruption along the FDR Drive.

C. ALTERNATIVES ANALYZED IN THE EIS

This section describes the alternatives to the proposed project that are evaluated in this EIS. Each of the With Action alternatives (i.e., all alternatives except the No Action Alternative), assume the no action projects identified in **Appendix A1**, and propose varying configurations and combinations of the coastal flood protection components described above. The With Action Alternatives were developed to meet the project purpose and need (as outlined in Chapter 1.0, “Purpose and Need”) to respond quickly to the need for reliable coastal flood protection and resiliency for the design storm and improve access to and enhance open space resources along the waterfront. These build alternatives vary in the degree to which the coastal flood protection system is integrated with the park landscape enhancements and improvements to neighborhood connections. As described in further details below, the Flood Protection System on the West Side of East River Park Baseline Alternative (Alternative 2) would provide flood protection but with limited open space improvements. The Flood Protection System on the West Side of East River Park – Enhanced Park and Access Alternative (Alternative 3) builds upon Alternative 2 with additional enhancements to open spaces and improvements to access to these open spaces. The Flood Protection System with a Raised East River Park Alternative (Alternative 4 – the Preferred Alternative) would integrate the flood protection in Project Area One within an elevated East River Park, providing the opportunity for a holistic reconstruction, reimagining, and expansion of the types of user experiences in the park, while also enhancing neighborhood connectivity and resiliency. The Flood Protection System East of FDR Drive Alternative (Alternative 5) is similar to the Preferred Alternative but would shift the alignment of a portion the flood protection system in Project Area Two from west of the FDR Drive to the east of the FDR Drive. In addition, since the line of protection would be closer to the shoreline under the Preferred Alternative and Alternative 5, the majority of East River Park would be protected from design storm events and inundation from sea level rise.

The build year for the proposed project is 2025. Under the Preferred Alternative, the flood protection, reconstruction of three existing pedestrian bridges, foundations for a new shared-use flyover bridge, and park access features are expected to be completed in 2023, which would provide the flood protection in an accelerated timeframe compared to other alternatives that would have flood protection installed by 2025. Under the Preferred Alternative, the superstructure of the shared-use flyover bridge would then be completed in 2025.

This shorter construction duration for the flood protection under the Preferred Alternative is primarily due to elimination of the need of the majority of flood protection construction be performed during night-time single-lane closures of the FDR Drive and in close proximity to sensitive Con Edison transmission lines, since the flood protection alignment under this alternative is primarily along the existing esplanade of East River Park. Closures of the FDR Drive would need to meet requirements set forth by NYCDOT and would be limited to approximately 6 hours of single-lane closure of the FDR Drive per night.

Below is a description of the alternatives that are analyzed in this EIS.

NO ACTION ALTERNATIVE (ALTERNATIVE 1)

The No Action Alternative assumes that no new comprehensive coastal protection system is installed in the proposed project area by the 2025 analysis year presented in this EIS. The No

Action Alternative establishes the context to assess and compare the effects among the alternatives. In the absence of this system, the existing neighborhoods within the protected area would remain at risk to coastal flooding during design storm events. Independent of the proposed project, there would be limited improvements to open space resources and access to both East River Park and the East River waterfront from other planned projects or targeted resiliency projects. Specific improvements in the project area anticipated to occur in the absence of the proposed project include the Pier 42 project and the Solar One Environmental Education Center project in Stuyvesant Cove Park.

The No Action Alternative describes the conditions that would exist in the future without the proposed project by 2025 analysis year. In an urban environment such as the protected area, there are both broad development trends and site-specific development projects that would affect conditions in the future. This additional development (i.e., the No Action projects) includes projects currently under construction or in development that can reasonably be expected to be constructed by 2025 due to their status in the planning and public approval process, along with proposals for rezoning and public policy initiatives likely to be undertaken. The No Action projects relevant for analyses within this EIS include various improvements to existing facilities, amenities, and infrastructure; site-specific resiliency projects; and development projects. The full range of planned and potential development projects and proposed actions are provided in **Appendix A1**.

IMPROVEMENTS TO EXISTING FACILITIES, AMENITIES AND INFRASTRUCTURE

Several projects to upgrade or improve existing facilities, amenities, and infrastructure within the protected area that are expected to be completed by 2025 include the following: reconstruction of Pier 42 as publicly accessible open space (2021) and the redevelopment of the Solar One Environmental Education Center (2019). These projects are discussed further below.

As described above, at the southern end of Project Area One, NYC Parks is proposing to construct Pier 42 as a public waterfront open space that would increase accessible open space. For many years, the Pier 42 property consisted of warehouse space and parking, located just south of East River Park between the East River and the FDR Drive. A masterplan for the overall redevelopment of Pier 42 as an open space was approved by a Community Board 3 sub-committee and PDC. Phase 1A of the Pier 42 redevelopment included the demolition of the pier shed. Phase 1B will include the redevelopment of the upland park (north and east of Phase 1A) with amenities such as an entry garden in the western section, a playground, a comfort station, a grassy knoll rising approximately seven feet above grade, solar powered safety lighting throughout the park, and access from the shared-use path along the FDR Drive service road or Montgomery Street. The Pier 42 project will introduce approximately 2.93 acres of new passive open space by 2021.

Stuyvesant Cove Park, located in Project Area Two, is home to the Solar One organization, which provides environmental education programs to create a more sustainable and resilient urban environment. Solar One's mission is to provide education on energy, sustainability, and resilience. Solar One is proposing an upgrade to their Solar One Environmental Education Center. Located at the northern end of Stuyvesant Cove Park, the existing facility is proposed to be replaced with a new green arts and energy education center.

SITE-SPECIFIC RESILIENCY PROJECTS

Projects to upgrade or improve existing facilities, amenities, and infrastructure within and near the protected area that are expected to be completed by 2025, including those proposed at nearby NYCHA properties and the adjacent Lower Manhattan Coastal Resiliency (LMCR)-Two Bridges project. These projects are discussed further below. In addition, there are several resiliency

projects that have been completed at the Con Edison East River Complex and the VA Medical Center.

NYCHA Resiliency Projects

The NYCHA Manhattan Campus project proposes resiliency measures at multiple NYCHA campuses within the protected area that were damaged during Hurricane Sandy: the Bernard Baruch Houses, Lillian Wald Houses, Jacob Riis Houses, and Jacob Riis II Houses, as well as Campos Plaza II. At the Bernard Baruch Houses, NYCHA proposes to install a floodwall along the west side of Baruch Drive, individually floodproof the buildings east of Baruch Drive, construct an electrical annex to each building east of Baruch Drive, and construct a new boiler plant in the center of the housing complex. At the Lillian Wald, Jacob Riis, and Jacob Riis II Houses, NYCHA proposes to floodproof each building and construct an electrical annex to each building. At Campos Plaza II, NYCHA proposes to floodproof the building and install stand-by generators. Site restoration will also be undertaken at each housing complex.

Overall, these resiliency projects would help prevent coastal flooding only in certain parts of the protected area but would not prevent coastal flooding for the remainder of the neighborhood within the current and future FEMA 100-year flood plain, accounting for projections of sea level rise.

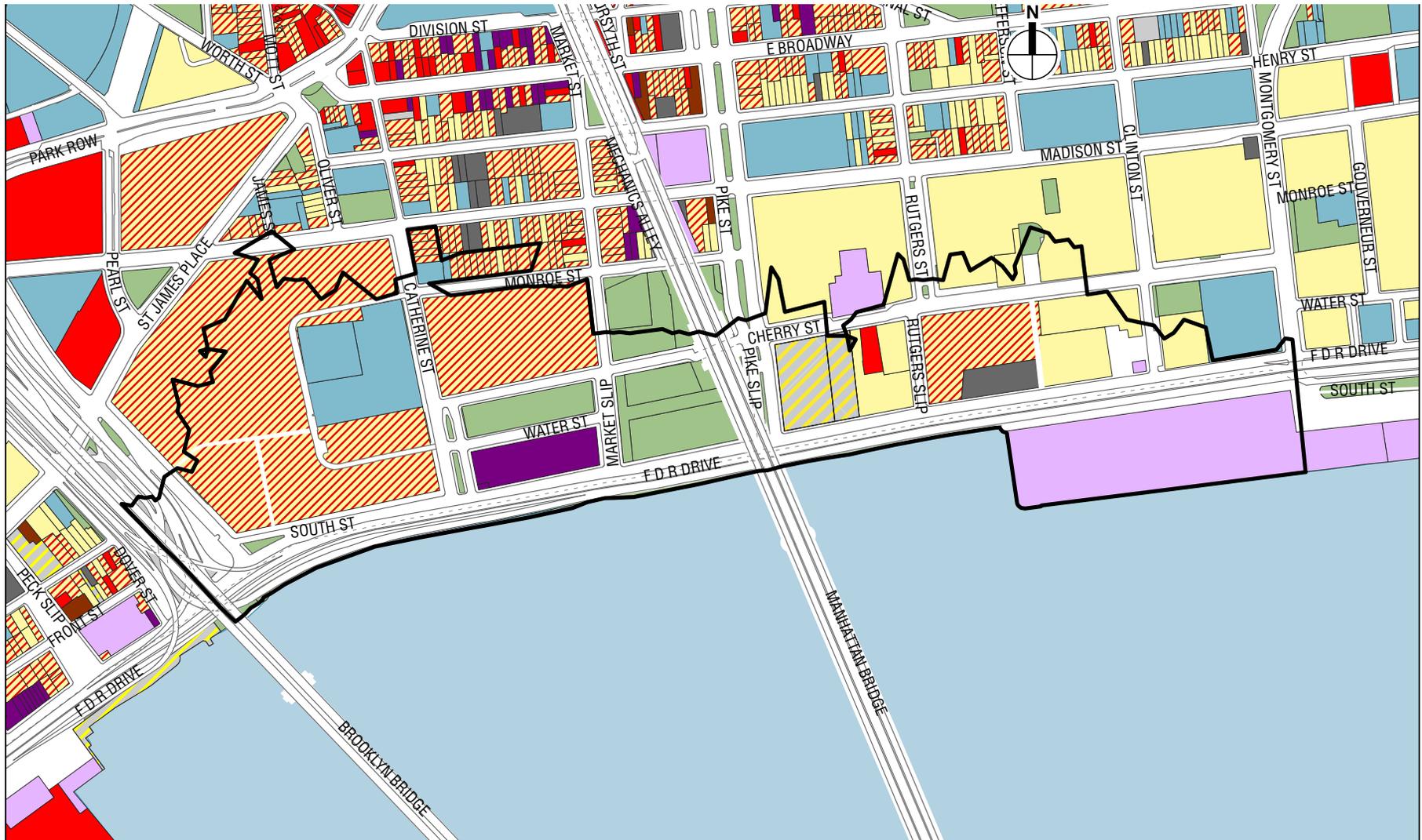
Lower Manhattan Coastal Resiliency (LMCR) – Two Bridges Project

In addition to the proposed project, resiliency measures are being developed for the Two Bridges neighborhood immediately south of the proposed project area. The study area for the Two Bridges project is bounded by Montgomery Street on the north and the Brooklyn Bridge to the south and includes the esplanade under the FDR Drive, two crossings across South Street for the tie-backs, Pier 35/36, and the East River Waterfront (see **Figure 2.0-7**). The City received funding through HUD's National Disaster Resilience Competition (NDRC) to initiate a coastal flood mitigation project in this area. The LMCR-Two Bridges Project is in the design phase. It proposes improvements that would similarly protect from coastal flooding and would create opportunities for new programming and enhanced community access (where possible) in the Two Bridges neighborhood. The approaches to providing flood protection with this project would be similar to those under the proposed project, include floodwalls and closure structures, and also include deployable flip-up barrier.

Additionally, as part of the LMCR-Two Bridges Project and funded by HUD's NRDC, the Trust for Public Land (TPL) school playground project consists of renovation and improvement of existing playground facilities at two public schools, Public School 2 (P.S. 2) – Meyer London and Public School 184 (P.S. 184) – Shuang Wen, in the Two Bridges neighborhood. This project would result in redesigned play spaces, which may include features such as running tracks; athletic courts; upgraded play equipment; trees, gardens and plantings; gazebos; outdoor classrooms; benches and other seating; game tables; student artwork; signage; trash and recycling receptacles; and drinking fountains. This project would also incorporate green infrastructure features—such as artificial turf fields with gravel underlays, bioswales, permeable pavers, and rain gardens—into the project design. The build year would be approximately 2021 for this TPL school playground project.

DEVELOPMENT PROJECTS

In 2008, the City rezoned portions of the East Village and Lower East Side to facilitate the development of new residential projects with ground-floor retail. The limits of these rezoning actions were between East 13th Street on the north; Avenue D to the east; East Houston Street,



- | | |
|-----------------------------------|------------------------------------|
| Study Area | Public Facilities and Institutions |
| Commercial and Office Buildings | Residential |
| Hotels | Residential with Commercial Below |
| Industrial and Manufacturing | Transportation and Utility |
| Open Space and Outdoor Recreation | Vacant Land |
| Parking Facilities | Under Construction |

Lower Manhattan Coastal Resiliency (LMCR) - Two Bridges
 Project Location and Land Use
 Figure 2.0-7

Delancey Street, and Grand Street on the south; and the Bowery and Third Avenue on the west. According to the 2008 *East Village/Lower East Side Rezoning Final Environmental Impact Statement (FEIS)*, there are an estimated 770 potential mixed-use development projects resulting from the rezoning. As shown in **Appendix A1**, there are a number of projected development sites identified in the 2008 *East Village/Lower East Side Rezoning FEIS* that are relevant to the analyses in this EIS, the majority of which are residential projects.

Large-Scale Development Projects outside the Protected Area

In addition to the No Action projects described above, there are three major projects just outside the protected area that have been considered as part of the background condition for the analyses in this EIS: City University of New York (CUNY) Hunter Brookdale Campus, Alexandria Center for Life Sciences, and Essex Crossing.

CUNY Hunter Brookdale Campus

The City of New York is redeveloping the block generally bounded by First Avenue, East 25th Street, FDR Drive, and a private drive (formerly East 26th Street). The property is currently the Brookdale Campus of Hunter College (CUNY Hunter). The New York City Department of Sanitation (DSNY) is proposing to use the central portion of the site to construct a garage complex to store equipment and provide personnel support services for Manhattan Districts 6 and 8, support street cleaning for Districts 3, 6, and 8, and house the Manhattan Borough Command Offices. The remainder of the site will be a commercial development or mixed-use development in accordance with a request for proposals managed by NYCEDC.

Alexandria Center for Life Sciences

The Alexandria Center for Life Sciences, at East 29th Street and the FDR Drive, is proposing a third building of approximately 550,000 square feet. Additionally, a City-owned building at East 26th Street and First Avenue is proposed to be converted to a bioscience research center with lab space.

Essex Crossing

At full buildout, the Essex Crossing project, which is a phased development project, would result in approximately 2 million gross square feet of mixed-use development on nine separate sites located along Essex, Grand, and Delancey Streets. The Essex Crossing project would provide residential units, some of which would be affordable units and affordable senior housing units. In addition, the proposed Essex Crossing program would introduce commercial space and other commercial uses that include commercial office space, a gym, a bowling alley, and a movie theater. There would also be community facility uses and publicly accessible open space on Broome Street between Suffolk and Clinton Streets.

PREFERRED ALTERNATIVE (ALTERNATIVE 4): FLOOD PROTECTION SYSTEM WITH A RAISED EAST RIVER PARK

The Flood Protection System with a Raised East River Park Alternative best meets the principal objectives for the project and therefore was selected as the Preferred Alternative. The selection of this alternative also allows for a shorter construction duration and park closure, earlier deployment of the flood protection system (which is expected to be completed in mid-2023), and reduce construction disruption along the FDR Drive.

DESIGN OBJECTIVES

The Preferred Alternative is a flood protection system comprised of a combination of floodwalls, 18 closure structures (i.e., swing and roller floodgates), and supporting infrastructure

improvements that together would reduce risk of damage from coastal storms in the area proposed for protection. The inland limits of the proposed protection area are generally along First Avenue, Avenue B, Avenue C, Avenue D, and Columbia Street and includes private and public properties and streets within the Lower East Side, East Village, Stuyvesant Town, Peter Cooper Village and Kips Bay communities that are currently in the East River coastal flood hazard area. The design flood elevation for the project is 16.5 feet NAVD88, which is generally 8 to 9 feet above the existing land surface along the project alignment but diminishes in height along the inland alignments (e.g., along Montgomery Street). This design elevation was developed based on the 100-year FEMA flood level and adding to that wave effects and the 90th percentile projection for sea level rise through to the 2050s (30 inches).

As described in greater detail below, a key element of the Preferred Alternative is elevating and reconstructing John V. Lindsay East River Park (East River Park) to make it more resilient to coastal storms. The proposed project also includes integrating flood protection with open space improvements at other parks along the flood protection alignment including Murphy Brothers Playground, Stuyvesant Cove Park, and Asser Levy Playground, with an improved shared-use path (bikeway/walkway) along the entire project length (from East 23rd Street to Montgomery Street), and a new shared-use flyover bridge (see **Figures 2.0-8 and 2.0-9**) to address the narrow and substandard waterfront public access along the segment near the East River Dock (on the east side of the FDR Drive) known as the “pinch point.”

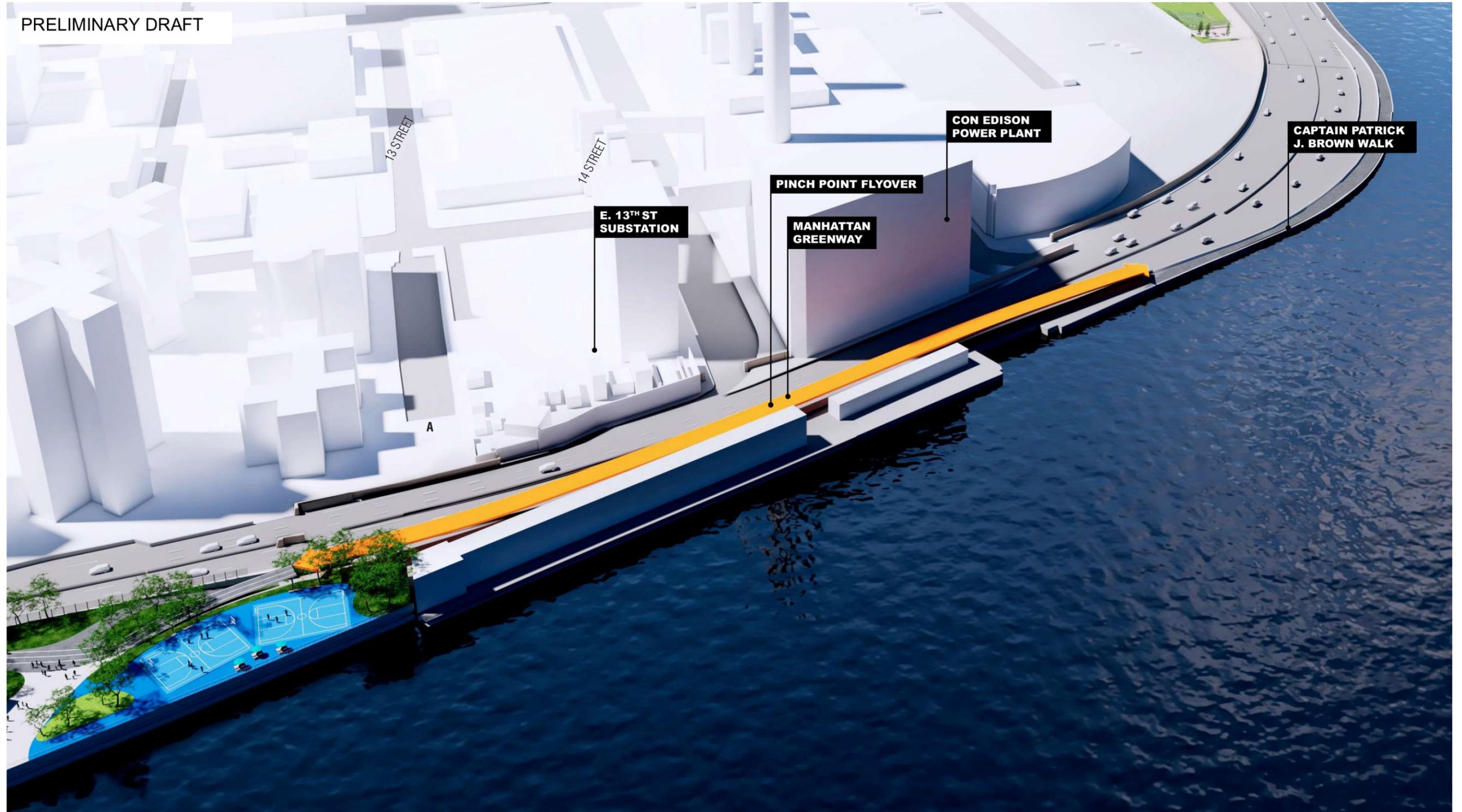
Also proposed are redesigned and enhanced connections to the waterfront and East River Park, with the reconstruction of the Corlears Hook Bridge, the replacement of the Delancey and East 10th Street Bridges, and the above-mentioned flyover bridge. These proposed bridge improvements would create more inviting and accessible crossings over the FDR Drive to the reconstructed East River Park and the East River waterfront, including the waterfront shared-use path. With the proposed project, the reconstructed bridges at Delancey and East 10th Street have also been designed to provide more community-oriented access that supports and encourages public access to the waterfront with gentler grades that are consistent with the principle of universal access. Within the park, the bridge landings would provide an elevated gateway with expanded views of the reconstructed park and the river.

FLOOD PROTECTION ALIGNMENT AND DESIGN

The description below summarizes flood protection alignment and design for the Preferred Alternative. **Figure 2.0-10** shows the proposed alignment and schematic layout of the Preferred Alternative, Conceptual design sections of the Preferred Alternative are provided in **Appendix C1**, which show approximate elevations and heights at numerous locations in each of the project reaches.

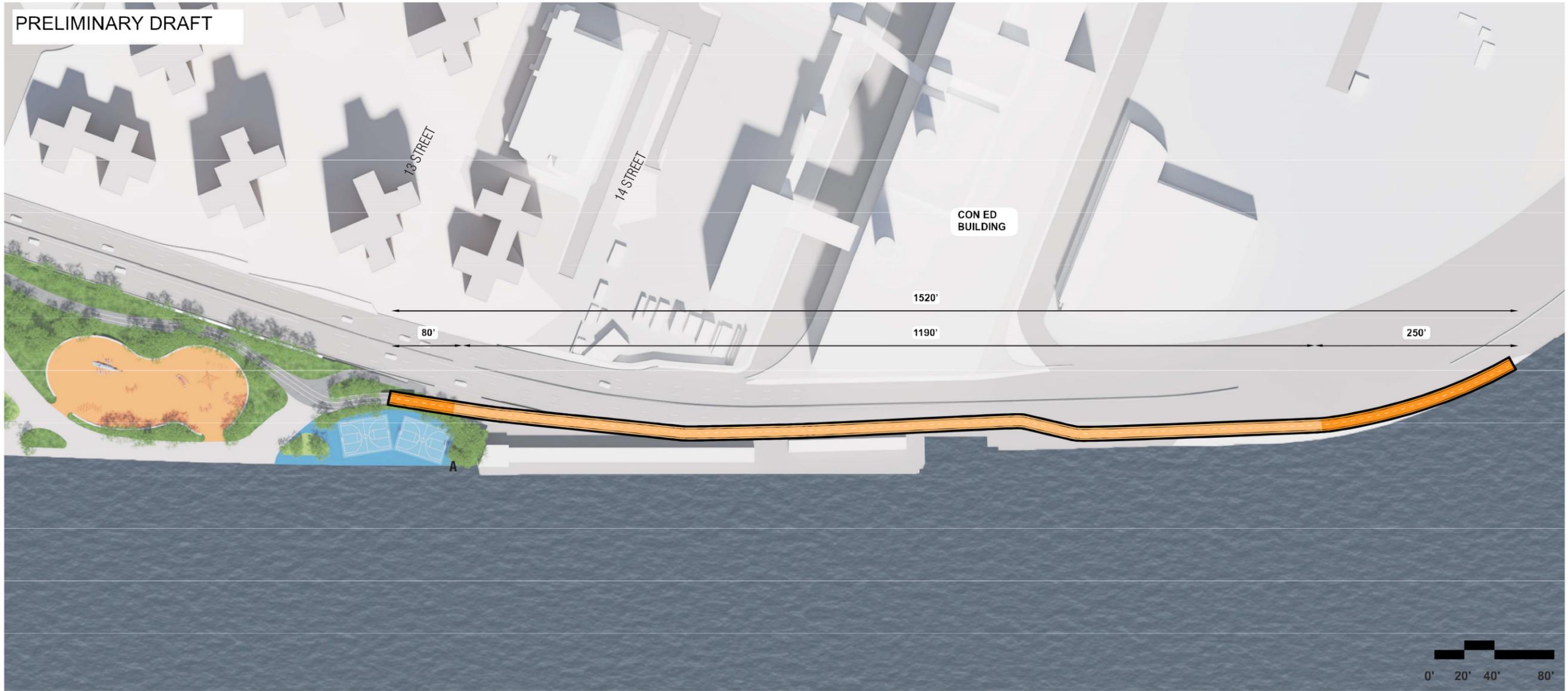
Project Area One – South of East River Park

The proposed flood protection alignment begins at its southerly tieback along Montgomery about 130 feet west of South Street; at South Street the system turns north along for a distance of about 50 linear feet and then east, crossing under the FDR Drive to the east side of the highway with a pair of swing floodgates. Once on the east side of the highway, the flood protection system turns north and runs adjacent to the FDR Drive, continuing north into East River Park.

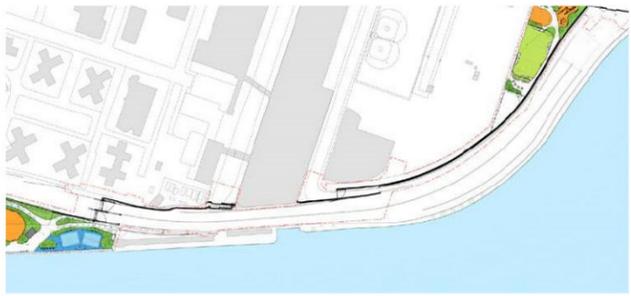


NOTE: Preliminary Conceptual Design

PRELIMINARY DRAFT



- FLYOVER BRIDGE
- BRIDGE APPROACH



NOTE: Preliminary Conceptual Design



Project Elements

— Proposed Floodwall

Redesigned Open Spaces

NOTE: Based on Preliminary Draft Design Concept. See Appendix C3 for additional design details on this alternative. Design includes flyover bridge.

Project Area One – East River Park

Once in East River Park, the proposed flood protection alignment starts to turn east towards the East River, near the existing amphitheater. From here, the alignment continues north and the system parallels the East River Park bulkhead.

Within East River Park, the proposed project includes the following key design elements:

- Installing a below-grade flood protection structure (i.e., floodwall) running parallel to the existing East River Park bulkhead coupled with the elevation of a majority of East River Park (with the exception of the Fireboat House), generally beginning at the existing amphitheater and continuing northward to the northern end of the park near East 13th Street, thereby protecting park facilities and recreational spaces from design storm events and sea level rise inundation;
- Installing the floodwall below-grade to soften the visual effect of the flood protection system;
- Raising the majority of park grade with an increase in elevation from west (the FDR Drive) to east (the East River bulkhead) to attain the flood protection design elevation, accompanied by the reconstruction of the park open space including all fields and passive spaces, and incorporating resilient landscaping and substantial tree replanting that envisions a more diverse, resilient, and ecologically robust habitat;
- Reconstructing the Tennis House, Track and Field House and East 10 Street comfort stations;
- Reconstructing most of the East River Esplanade within East River Park to increase the deck elevation to match the raised park and protect the esplanade from design storms and sea level rise;
- Improving north/south access along the waterfront with a new shared-use flyover bridge connecting the north end of East River Park with Captain Patrick J. Brown Walk;
- Improving access to the waterfront by reconstructing the Corlears Hook Bridge over the FDR Drive and replacing the existing Delancey Street and East 10th Street Bridges to be universally accessible;
- Creating an expanded and reconfigured park-side East Houston Street landing and entryway to the waterfront;
- Relocating the two existing embayments in the park to increase community access to the water's edge, a principal objective of the proposed project, and provide adequate space to site heavily utilized active recreation facilities. Redesigned park entrances at the Corlears Hook Bridge and the Houston Street overpass and would lead the park user directly to newly designed embayments, providing maximum opportunities for the community to connect with the waterfront;
- Reconstructing the amphitheater as an outdoor theater space; and
- Reconstructing all water and sewer infrastructure in the park, some of which is reaching the end of the serviceable life, including the outfalls and associated pipes that cross the park to the East River bulkhead.

It is an objective of the design to improve the ecology of East River Park, which is susceptible to the effects of sea level rise, storm surge, and heavy rainfall events. Storm surge from severe events like Hurricane Sandy can overwhelm the park. Moreover, the threat from gradually increasing sea level rise adds to the risk of more frequent flooding from everyday storms or high tides. This flooding not only interrupts the ability for parks visitors to enjoy and utilize the amenities within

East River Park, but also affects its ecology. In 2014 alone, NYC Parks removed 258 trees from East River Park due to salt water damage from Hurricane Sandy.

The Preferred Alternative's landscaping and planting plan is reflective of the popular styles of the late 1930s, when the Park was first designed and completed. The planting design is formal, with a focus on tree geometry and placement that maximizes open spaces for active recreation. Species diversity and ecology were not priorities of the original landscape design: over half of the current tree canopy is comprised of just two species. In the original design, plant selection relied heavily on canopy trees, such as London plane, a non-native species, and oaks. London plane trees in particular were significantly affected by salt inundation post Hurricane Sandy and have comprised most of the tree removals in East River Park since then.

In contrast, the proposed landscaping plan incorporates park resiliency through a design that can withstand a changing climate and consideration of species diversity, habitat, salt spray, wind, maintenance, and care. The landscape restoration plan includes over 50 different species, reflecting research around the benefits of diversifying species to increase resiliency and adaptive capacity in a plant ecosystem. The design also focuses on creating a more layered planting approach, allowing for informal planting areas that have flexibility and plant communities that together improve ecological richness. By elevating the majority of the park and its landscape, and diversifying plant species, the landscape in the park will be more resistant to salt spray exposure and improve resiliency and post-storm functionality over the long term.

Project Area Two

North of East River Park, the proposed flood protection system includes a closure structure across the FDR Drive. Two swing floodgates that when deployed would close this segment of the flood protection system across the highway, but in non-storm conditions would be recessed to the sides of the highway. From there, the floodwall continues northward and aligns along the west (southbound) side of the FDR Drive, connecting into the flood protection system at the Con Edison East River Generating Station (between East 14th and East 15th Streets). A closure structure adjacent to East 14th Street near the FDR Drive would also be installed to allow Con Edison operational access. North of the East River Generating Station, a closure structure is proposed across the FDR Drive East 15th Street ramp, and the floodwall continues northward along the FDR Drive to Murphy Brothers Playground.

At Murphy Brothers Playground the proposed floodwall is aligned along the east side of the park, which would also be reconstructed with new ballfields, active recreational spaces, grading and landscaping.

Beginning at the northeast corner of Murphy Brothers Playground, the proposed flood protection system turns east along Avenue C, heading towards the East River, crossing the FDR Drive ramps (two swing gate closure structures are proposed here) and under the FDR Drive into Stuyvesant Cove Park. Within Stuyvesant Cove Park, the proposed flood protection system turns northward, where it is comprised of a combination of floodwalls with closure structures (roller gates) at the southerly entrance (from Avenue C) and at the East 20th Street entrance to allow public access into the park to the waterfront esplanade during non-storm conditions; design of this segment is also being coordinated with the new design for Solar One Environmental Education Center and existing Citywide Ferry Service ferry landing.

North of Stuyvesant Cove Park, the system again turns west and back under the elevated FDR Drive at East 23rd Street. In this segment, a combination of floodwalls and closure structures (a combination of roller and swing gates) are needed to maintain vehicular and pedestrian circulation

through this intersection during non-storm conditions, including: vehicle access to the FDR Drive ramps and service roads; pedestrian and cyclist access to and along the East River shared-use path; and, vehicle and pedestrian access to Waterside Plaza (including the U.N. School and the British International School of New York), the Skyport Marina and parking garage, and a BP service station. These closure structures are to be recessed except under storm conditions when they would be deployed to provide the proposed flood protection.

North of East 23rd Street and west of the FDR Drive, the proposed flood protection system continues northward along the sidewalk of the southbound FDR Drive service road. The proposed system then turns westward into and across the Asser Levy Park Playground (between the Asser Levy Recreation Center and the outdoor recreational space). Similar to Murphy Brothers Playground, the outdoor recreational space at Asser Levy Playground would be redesigned and reconstructed and a roller floodgate is proposed to connect to the VA Medical Center floodwall. The flood gate would maintain the connection between the playground and the Asser Levy Recreation Center and during a storm condition it would be deployed. The VA Medical Center flood protection system extends north and then west along East 25th Street to complete the northern tieback at First Avenue.

DRAINAGE SYSTEM MODIFICATIONS

Drainage system modifications are also proposed as part of the Preferred Alternative, including measures to control flow into the drainage protected area⁶ from the larger sewershed (i.e., drainage isolation) and measures to manage flooding within the drainage protected area (i.e., drainage management). These modifications would reduce the risk of flooding in the protected area during extreme storm events coincident with rainfall events. As part of the Preferred Alternative, the water and sewer infrastructure would be reconstructed and reconfigured where necessary to ensure that it could withstand the additional loading from the added fill materials once the Park is raised. A summary of each of these measures is provided below.

Drainage Isolation

Measures to isolate the drainage protected area from the unprotected portions of the larger sewershed would be implemented to eliminate potential pathways for storm surge waters to inundate the existing sewer system and flood inland areas. The measures include: (1) installing interceptor gates on the existing 108-inch diameter interceptor at the northern and southern extremes of the drainage protected area sewershed, generally in the vicinity of East 20th Street and Avenue C to the north and between Corlears Hook Park and the FDR Drive to the south; (2) floodproofing the regulators, manholes, and other combined sewer infrastructure on the unprotected side of the flood protection system; (3) replacing existing tide gates on the combined sewer outfall pipes that serve the drainage protected area and rerouting storm drainage; and (4) installing one isolation gate valve in the existing Regulator M-39, located within Asser Levy Playground, to isolate a branch interceptor that crosses the flood protection system alignment at the northern boundary of the drainage protected area. These measures would prevent storm surge water from entering the sewer system through existing combined sewers, the outfall pipes, or through at-grade access points (i.e., manholes and hatches) for existing sewer infrastructure on the portion of the drainage protected area that is unprotected from overland coastal surge events.

⁶ The drainage protected area encompasses the project protected area as well as the lateral sewers, regulators, outfalls, and other sewer infrastructure that serve or are tributary to those that serve the project protected area.

Two interceptor gates are proposed to prevent floodwaters from entering the protected area through the sewer system during a design storm event. The southernmost interceptor gate is proposed in Project Area One, just south of the Corlears Hook Bridge, and would be sited within an existing sidewalk and lawn along the western edge of the FDR Drive right-of-way. The northern interceptor gate in Project Area Two is proposed in the right-of-way and median of East 20th Street, just west of the intersection with Avenue C. During a design storm event, these gates would be operated to allow DEP to control flow from outside the protected area into the protected area via the interceptor sewer. Once the storm surge recedes, the interceptor gates would be returned to their open positions to resume normal operations of the sewer system. While mostly below grade, the interceptor gates each would require a single-story building adjacent to the chamber that contains the controls, electrical, hydraulic, and other ancillary components to operate the interceptor gates.

Drainage isolation for the regulators and other sewer structures would involve replacing each of their existing vented access hatches with lockable vented hatches that could be sealed (i.e., floodproofed) to prevent floodwater water from entering the system. In addition, each regulator would be improved, as needed, which may include lining, patching, jet-grouting, sheet piling, or reinforcing the walls of the structure. There may also be installation of a reinforced concrete slab above each structure and of low-infiltrating fill around each structure. Manhole covers on unprotected sewers would also be floodproofed to protect against loss and/or leakage during a storm event. Manholes that are less structurally stable would be either partially or fully replaced in addition to the replacement of the frame and cover. Manholes requiring additional support would follow the methods described above for external strengthening of the regulators.

To ensure proper functioning of the tide gates during the design storm event, it is proposed that the existing tide gates on the combined sewer outfall pipes that serve the drainage protected area be replaced as part of the Preferred Alternative. In addition, storm drainage that currently connects to the combined sewer system that would be located on the unprotected side of the flood protection system would be rerouted and connected to the outfalls downstream of the tide gates. This would ensure the storm drainage system is isolated from the combined sewer system within the protected area and would eliminate the need for floodproofing storm drains on the unprotected side of the flood protection system.

The Preferred Alternative also proposes that an isolation gate valve be installed within regulator M-39 on an existing sewer segment that crosses from the protected to the unprotected side of the flood protection system at the northern end of the drainage protected area. This conduit has the potential to convey floodwaters from unprotected sewers into the protected area under a design storm event.

Drainage Management

In addition to the isolation measures outlined above, the Preferred Alternative includes drainage management elements to ameliorate the reduced sewer capacity due to outfall closure during a design storm event. The proposed drainage management would reduce the risk of sewer backups and associated flooding within the drainage protected area during a design storm. These drainage elements include installing additional combined sewers, termed “parallel conveyance,” within the drainage protected area to augment the capacity of the existing sewer system. Specifically, nine parallel conveyance connections are proposed.

Parallel conveyance pipes are proposed at 9 locations, for regulators M-22, M-23, M-27, M-28, M-31, M-37, M-38, M-38A, and M-38B, to convey excess combined sewer flows to the

interceptor. Each parallel conveyance pipe would consist of a new upstream connection to a regulator or lateral sewer, a downstream connection to the interceptor, and a connecting length of pipe. The parallel conveyance pipes would range in diameter from 18 to 48 inches and require no above ground features. The parallel conveyance would be sited within City rights-of-way with one exception where some parallel conveyance infrastructure is proposed on private property. The parallel conveyance pipes and connections would include manholes for access, similar to the existing sewer pipes, generally every 200 to 250 feet, at pipe bends, and at all connections to allow access for maintenance and repairs, as needed, and would be sited within streets and paved surfaces (e.g., parking), where possible (the project also includes a drainage improvement on private property, see “Land Use Action,” below).

In addition, similar to the parallel conveyance, this alternative also proposes to increase the size of the branch interceptor in order to increase the conveyance capacity to the Manhattan Pump Station for three sub-drainage areas within the protected area: M-33, M-34, and M-35.

These proposed drainage management system improvements would not alter daily operation of existing sewer infrastructure under non-storm conditions. Under rainfall events or periods of high sewer flow, combined sewer flow would be conveyed to the interceptor via the existing branch interceptors and potentially also via the parallel conveyance.

East River Park Infrastructure Reconstruction

The Preferred Alternative also includes reconstructing the water and sewer infrastructure within the portion of East River Park that would be elevated, including the outfalls, regulators, tide gates and chambers, and sewers and water supply infrastructure, to withstand the added loads of the proposed flood protection system and elevated parkland. The outfalls and regulators within the portion of East River Park to be elevated are also proposed for replacement. In most cases, the existing infrastructure would be abandoned in place and the new infrastructure would be reconstructed adjacent to the existing locations, although the outfalls would be relocated slightly along the East River Park bulkhead. Of the existing 11 outfalls, two would be combined as part of the outfall reconstruction effort.

LANDSCAPE AND TREE RESTORATION PLAN

The landscape restoration plan for the project is comprised of a several elements. First, to the extent practicable, the City would transplant existing park trees that are in excellent condition and, based on prior NYC Parks arborist experiences and approvals, are suitable for a successful transplanting. Second, approximately 1,815 trees are proposed to be planted as part of the landscape design within the project areas, which would result in a net increase of 745 trees over the existing conditions. The value of this restoration plan, in combination with approximately \$32.9 million of restitution, would be in compliance with Chapter 5 of Title 56 of the Rules of New York (NYC Department of Parks and Recreation Rules) and Local Law 3 of 2010. The restitution funds would be used towards targeted tree planting and urban forest enhancements throughout the adjacent communities, including the Lower East Side greening program, which proposes to plant up to 1,000 trees in parks and streets, and create up to 40 bioswales starting in fall of 2019. The planting palette for the proposed park trees will consider size, growth rate, diversity, and resiliency, among other factors, in determining the tree selection. This tree planting plan including the species, distribution, and location will be included in the project’s final design documents.

LAND USE ACTIONS

As described in ULURP application accompanying this FEIS, the proposed project would be developed primarily on City-owned property (e.g., City parkland and street right-of-way). However, the City will also need to acquire easements on non-City-owned property. These acquisitions will allow the City to operate, inspect, and maintain the proposed flood protection system including the flood walls and drainage elements. The properties where this acquisition is proposed includes portions of: Gouverneur Gardens Housing Corporation; East River Housing Corporation; New York City Housing Authority; Con Edison; U.S. Department of Veterans Affairs, and a portion of the FDR Drive under the jurisdiction of the New York State Department of Transportation. In addition, as described below under “Construction Overview,” access agreements will also be necessary at properties to allow temporary construction activities.

A proposed zoning text amendment to Zoning Resolution (ZR) §62-59 would also allow the proposed project to satisfy the visual corridor and design requirements for lots subject to waterfront regulations. The property is part of Stuyvesant Cove Park, is managed by the City’s Department of Small Business Services (SBS), and is mapped as a “Marginal Street, Wharf, or Place.”

SYSTEM OPERATION AND MAINTENANCE

An operations and maintenance manual will be developed for the proposed system to identify the procedures for deploying, inspecting, testing, and maintaining each element of the proposed flood protection system to ensure that the floodwalls and closure structures remain in proper working order and are ready to perform in advance of a design storm event.

Operation and maintenance of the proposed parallel conveyance and interceptor gates would require periodic inspection and maintenance of the piping and mechanical equipment. These inspections would be in accordance with standard operation and maintenance procedures for the City’s sewer infrastructure and a pre-approved operations and maintenance protocol developed for the proposed project.

As discussed below in Section D, “Operations and Maintenance Program,” upon completion of construction of the proposed project, the City would submit engineering plans, design modifications during construction, supporting materials (i.e., design criteria, geotechnical data, hydraulic modeling, etc.), a final operations and maintenance plan, and relevant construction data to FEMA to demonstrate compliance with requirements listed in Chapter 44 of the Federal Code of Regulations, Section 65.10 for FEMA accreditation.

CONSTRUCTION

The flood protection system and raised East River Park proposed under this alternative would be constructed in 3.5 years and completed in 2023. The foundations for the shared-use flyover bridge would also be completed in 2023. Subsequently, a prefabricated bridge span would be installed and completed in 2025. East River Park is anticipated to be closed for the entire 3.5-year construction duration but access to the Corlears Hook ferry landing would be maintained. Construction of the Preferred Alternative is expected to occur over a 3.5-year duration as compared to the 5-year duration for Alternatives 2, 3, and 5. This shorter construction duration for the Preferred Alternative is primarily due to less disruption to the FDR Drive since flood protection in East River Park would be primarily along the East River rather than along the FDR Drive. Construction activities would require the use of barges and trucks for material deliveries. Approximately 775,000 cubic yards of fill is estimated to be required for the construction under

the Preferred Alternative, and an average of 3 barge trips per day are anticipated throughout the 3.5-year construction period. The sources of clean soils or fill materials to be used anywhere on the project site would be determined by the construction contractors with review and approval by DEP and/or DEC and are dictated by a number of factors, including composition, certification of suitability of intended use, quality, availability, cost, and the proximity of the soil/clean fill provider's loading site to the project area.

CAPITAL COSTS

The estimated capital cost for the Preferred Alternative is approximately \$1.45 billion.

OTHER ALTERNATIVE (ALTERNATIVE 2): FLOOD PROTECTION SYSTEM ON THE WEST SIDE OF EAST RIVER PARK – BASELINE

Alternative 2 would provide flood protection in Project Areas One and Two using a combination of floodwalls, levees, and closure structures (i.e., deployable gates) from Montgomery Street to East 25th Street. **Figure 2.0-11** shows the proposed alignment of Alternative 2. Scaled conceptual designs of Alternative 2 for each of the project reaches are provided in **Appendix C2**.

FLOOD PROTECTION ALIGNMENT AND DESIGN

Project Area One

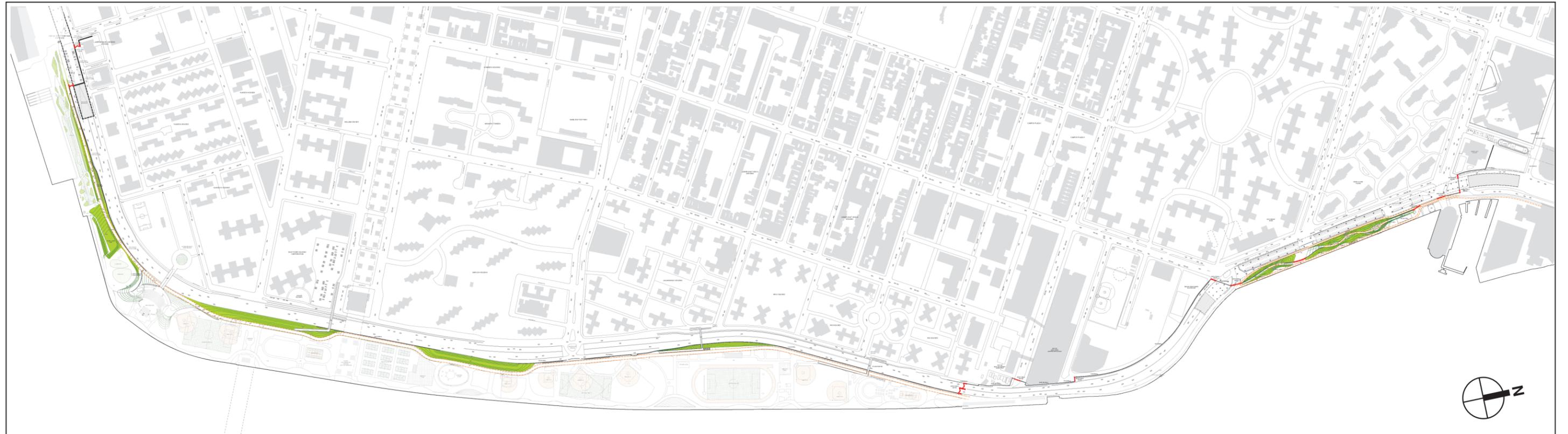
In Project Area One, the line of flood protection would generally be located on the west side of East River Park. Protection would be provided by a concrete floodwall starting at Montgomery Street within the sidewalk adjacent to the Gouverneur Gardens Cooperative Village. The floodwall would then cross under the FDR Drive with closure structures across the FDR Drive's South Street off- and on-ramps. A combination of floodwalls and levees would then run along the west side of East River Park for the length of the entire park. The park-side landings for the Delancey Street and East 10th Street Bridges would be rebuilt within East River Park to accommodate the flood protection system. As with the Preferred Alternative, a shared-use pedestrian/bicyclist flyover bridge linking East River Park and Captain Brown Walk would be built cantilevered over the northbound FDR Drive to address the narrowed pathway (pinch point) near East River Dock between East 13th Street and East 15th Street, substantially improving the City's greenway network and north-south connectivity in the project area.

Project Area Two

In Project Area Two, the flood protection alignment would be similar to that proposed under the Preferred Alternative. However, the portions of Murphy Brothers Playground and Asser Levy Playground that are affected by construction of the floodwall would be replaced in kind rather than redesigned and reconstructed.

DRAINAGE SYSTEM MODIFICATIONS

Similar to the Preferred Alternative as described above, this alternative also includes modifications of the existing sewer system, including installing gates underground near the northern and southern extents of the project area within the existing large capacity sewer pipe (interceptor) and flood-proofing manholes and regulators located on the unprotected side of the proposed project alignment to control flow into the project area from the larger combined sewer drainage area. Installation of additional sewer pipes and, in one location, enlarging existing sewer pipes, is also proposed within and adjacent to the project area to reduce the risk of street and property flooding within the protected area during a design storm event.



Project Elements

- Proposed Floodwall
- █ Proposed Levees or Raised Landscapes
- - - Proposed Deployable Systems
- ⋯ Proposed Reconstructed Shared Use Path

NOTE: Based on Preliminary Draft Design Concept. See Appendix C1 for additional design details on this alternative. Design includes flyover bridge.

SOURCES: East Side Coastal Resiliency Project, Project Area One Conceptual Design Report, November 2015. East Side Coastal Resiliency Project, Project Area Two Conceptual Design Report, November 2015.

SYSTEM OPERATION AND MAINTENANCE

Operations and maintenance of Alternative 2 would be similar to those described above under the Preferred Alternative and would involve periodic inspections, testing, and maintenance to the flood protection system elements, including floodwalls, closure structures, levees and drainage components.

CONSTRUCTION

The flood protection alignment proposed in Alternative 2 would require that the majority of flood protection construction be performed during night-time single-lane closures of the FDR Drive and in close proximity to sensitive Con Edison transmission lines. Given the related construction complexities and logistical considerations, the flood protection system and associated components under this alternative are assumed to be constructed in five years and completed in 2025.

CAPITAL COSTS

The estimated cost of construction for Alternative 2 is approximately \$445 million.

OTHER ALTERNATIVE (ALTERNATIVE 3): FLOOD PROTECTION SYSTEM ON THE WEST SIDE OF EAST RIVER PARK – ENHANCED PARK AND ACCESS

FLOOD PROTECTION ALIGNMENT AND DESIGN

Alternative 3 provides flood protection using a combination of floodwalls, levees, and closures structures in Project Areas One and Two. **Figure 2.0-12** shows the proposed alignment of Alternative 3. Scaled conceptual designs of Alternative 3 for each of the project reaches are provided in **Appendix C3**.

As with Alternative 2, the line of protection in Project Area One would be generally located on the western side of East River Park. However, compared to Alternative 2, there would be more extensive use of berms and other earthwork in association with the flood protection along the FDR Drive to provide for more integrated access, soften the visual effect of the floodwall on park users, and introduce new types of park experience. The landscape would generally gradually slope down from high points along the FDR Drive towards the existing at-grade esplanade at the water's edge. Due to the extent of the construction of the flood protection system, compared to Alternative 2, this alternative would include a more extensive reconfiguration and reconstruction of the bulk of East River Park and its programming, including landscapes, recreational fields, playgrounds, and amenities. Specifically, the following park facilities would be raised above the current grade by approximately 2 to 3 feet:

- Multi-Purpose Turf Field south of the Williamsburg Bridge;
- Basketball Courts south of the Williamsburg Bridge;
- Ball Fields Nos. 3, 4, 5, 6, and 7 north of the Williamsburg Bridge; and
- 10th Street Playground near the base of East 10th Street Bridge landing.

In addition, the existing pedestrian bridges and bridge landings at Delancey and East 10th Streets would be completely reconstructed to provide universal access, and a new raised and landscaped park-side plaza landing would be created at the entrance to the park from the East Houston Street overpass. As with the Preferred Alternative, a shared-use pedestrian/bicyclist flyover bridge linking East River Park and Captain Brown Walk would be built cantilevered over the northbound FDR Drive to address the narrowed pathway (pinch point) near the East River Dock between East



Project Elements

- Proposed Floodwall
- Redesigned Open Spaces

NOTE: Based on Preliminary Draft Design Concept. See Appendix C2 for additional design details on this alternative. Design includes flyover bridge.

13th Street and East 15th Street, substantially improving the City's greenway network and north-south connectivity in the project area.

Project Area Two

In Project Area Two, the flood protection alignment would be similar to that proposed in the Preferred Alternative.

DRAINAGE SYSTEM MODIFICATIONS

Similar to the Preferred Alternative described above, this alternative also includes modifications of the existing sewer system, including installing gates underground near the northern and southern extents of the project area within the existing large capacity sewer pipe (interceptor) and flood-proofing manholes and regulators located on the unprotected side of the proposed project alignment to control flow into the project area from the larger combined sewer drainage area. Installation of additional sewer pipes and, in one location, enlarging existing sewer pipes, is also proposed within and adjacent to the project area to reduce the risk of street and property flooding within the protected area during a design storm event.

SYSTEM OPERATION AND MAINTENANCE

Operations and maintenance of Alternative 2 would be similar to those described above under the Preferred Alternative and would involve periodic inspections, testing, and maintenance to the flood protection system elements, including floodwalls, closure structures, levees and drainage components.

CONSTRUCTION

Alternative 3 would involve construction of the flood protection system alignment along the FDR Drive and in close proximity to sensitive Con Edison transmission lines. Given the associated complexities and logistical considerations involved when working in and around these facilities, a 5-year construction duration is assumed, with the proposed project estimated to be completed in 2025.

CAPITAL COSTS

The estimated capital cost for Alternative 3 is approximately \$1.2 billion.

OTHER ALTERNATIVE (ALTERNATIVE 5): FLOOD PROTECTION SYSTEM EAST OF FDR DRIVE

FLOOD PROTECTION ALIGNMENT AND DESIGN

Alternative 5 proposes a flood protection alignment similar to the Preferred Alternative, except for the approach in Project Area Two between East 13th Street and Avenue C. This alternative would raise the northbound lanes of the FDR Drive in this area by approximately six feet to meet the design flood elevation then connect to closure structures at the south end of Stuyvesant Cove Park. Maintaining the flood protection alignment along the east side of the FDR Drive would eliminate the need for gates crossing the FDR Drive near East 13th Street as well as the need to install floodwalls adjacent to NYCHA Jacob Riis Houses, the Con Edison Complex and Murphy Brothers Playground.

As with the Preferred Alternative, this alternative would also include the construction of the shared-use flyover bridge to address the Con Edison pinch point.

RAISED FDR DRIVE PLATFORM WITH FLOODWALL PROTECTION

The floodwall system constructed along the elevated FDR Drive platform would connect to the proposed floodwall in East River Park to the south and to the closure structures at the entrance to Stuyvesant Cove Park to the north. To create the platform, drilled shafts would be installed in the middle lane of the FDR Drive northbound lanes extending to bedrock at intervals of approximately 125 feet (with one shaft potentially needed between Con Edison's intake tunnels that run under the FDR) from approximately East 14th Street to East 17th Street in Reaches K through M (see **Figure 2.0-13** for approximate location of shafts). It is estimated that approximately 12 shafts would be necessary along this design segment. A precast, pre-stressed box structure/raised platform would then rest on the piers supported by the shafts, and a new paved roadway for the northbound FDR Drive would then be supported by the box/platform structure. Along the river side of the raised platform, a floodwall would be installed below the elevated FDR Drive to the necessary flood protection design height.

Under this alternative, the elevated FDR Drive structure would remain completely independent of the Con Edison Complex and infrastructure located west of the FDR Drive. Further, the raised platform and floodwall would provide flood protection on the east edge of the FDR Drive, minimizing the number of closure structures needed for this reach, protecting and improving emergency access along the FDR Drive during a design storm event, and would avoid the disruptions associated with the testing and maintenance of closures structures in this segment.

In the design segment north of the proposed raised platform between approximately East 17th and 18th Streets along the waterfront in Captain Patrick J. Brown Walk within Reach M, a floodwall would be affixed to the existing FDR Drive abutment along the northbound service road to the Avenue C Viaduct. This floodwall would then connect to the closure structure proposed at the existing FDR Drive off-ramp at the south end of Stuyvesant Cove Park within Reach N. The flood protection system at and north of Stuyvesant Cove Park would be identical to that for Alternatives 2, 3, and 4.

DRAINAGE SYSTEM MODIFICATIONS

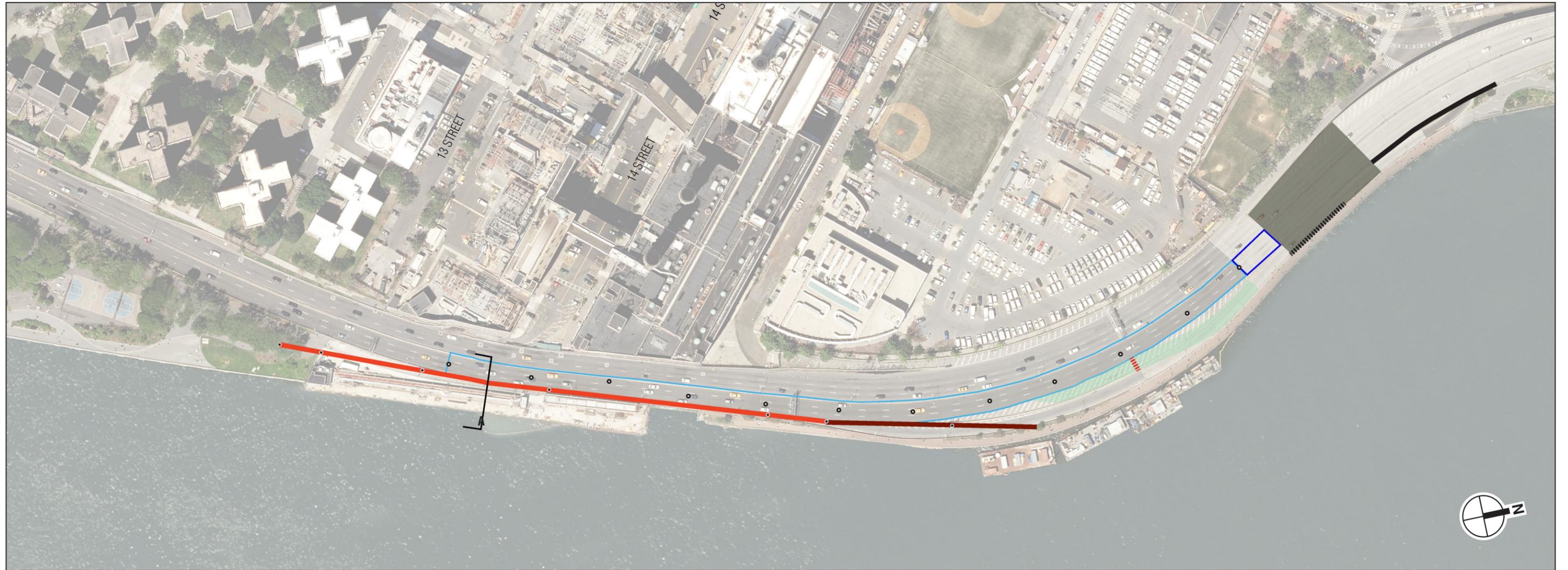
Similar to the Preferred Alternative as described above, this alternative also includes modifications of the existing sewer system, including installing gates underground near the northern and southern extents of the project area within the existing large capacity sewer pipe (interceptor) and flood-proofing manholes and regulators located on the unprotected side of the proposed project alignment to control flow into the project area from the larger combined sewer drainage area. Installation of additional sewer pipes and, in one location, enlarging existing sewer pipes, is also proposed within and adjacent to the project area to reduce the risk of street and property flooding within the protected area during a design storm event. As with the Preferred Alternative, the water and sewer infrastructure within East River Park would be reconstructed.

SYSTEM OPERATION AND MAINTENANCE

Operations and maintenance of Alternative 2 would be similar to those described above under the Preferred Alternative and would involve periodic inspections, testing, and maintenance to the flood protection system elements, including floodwalls, closure structures, levees and drainage components.

CONSTRUCTION

Alternative 5 is anticipated to be constructed in five years and completed in 2025 and this duration is driven by construction of the raised northbound lanes of the FDR Drive and the adjacent shared-



Project Elements

- ▬ Proposed Elevated FDR Drive Roadway & Floodwall
- ▭ Transition Slab with "L" Floodwall
- ▭ Proposed Realigned North Bound FDR Exit Ramp
- ▭ Existing Wall Enclosure Under FDR Drive
- ▬ Proposed Floodwall
- - - - 3' - 6' High Floodwall Attached to East Side of Bridge

- - - - Proposed Deployable Systems
- ▬ Proposed Fly-Over Bridge
- FDR Drilled Shaft with Pier Cap (125' Apart)

use flyover bridge in this same footprint. **Figures 2.0-13 and 2.0-14** show a schematic of Alternative 5 and a typical cross section of the proposed raised FDR Drive, respectively.

CAPITAL COSTS

The overall estimated cost for Alternative 5 is approximately \$1.59 billion.

D. OPERATIONS AND MAINTENANCE PROGRAM

Activation of the flood protection system under pre-storm event conditions would involve emergency preparedness planning and implementation across multiple City, State, and federal agencies responsible for managing the proposed flood protection system, street traffic, drainage management, and emergency access and services before a storm event. To that end, many City departments would be involved during the emergency operations phase, including but not limited to the New York City Police Department (NYPD), the Fire Department (FDNY), NYCDOT, DEP, NYC Parks, DSNY, New York City Office of Emergency Management (NYCEM), along with State agencies such as the MTA which operates the transit systems (buses and subways) and the nearby Midtown Tunnel (entrances at 34th Street), Con Edison, and the VA Medical Center. Activating the proposed flood protection system would involve synchronizing both the storm surge flood protection and the drainage components of the protection system to manage or prevent combined flow from the larger sewershed within the protected area. As an imminent storm approaches, street closures would be implemented for public safety, flood protection system closure structures would be activated, and personnel would seek protected locations. Pre-storm measures would also involve close monitoring of weather patterns in advance of predicted heavy winds and storm surge, to ensure pre-storm activities lead to successful flood protection operation during a storm event. Among the key requirements are activation of closure structures, closure of outfalls, and controlled and eventual closure of the interceptor gates.

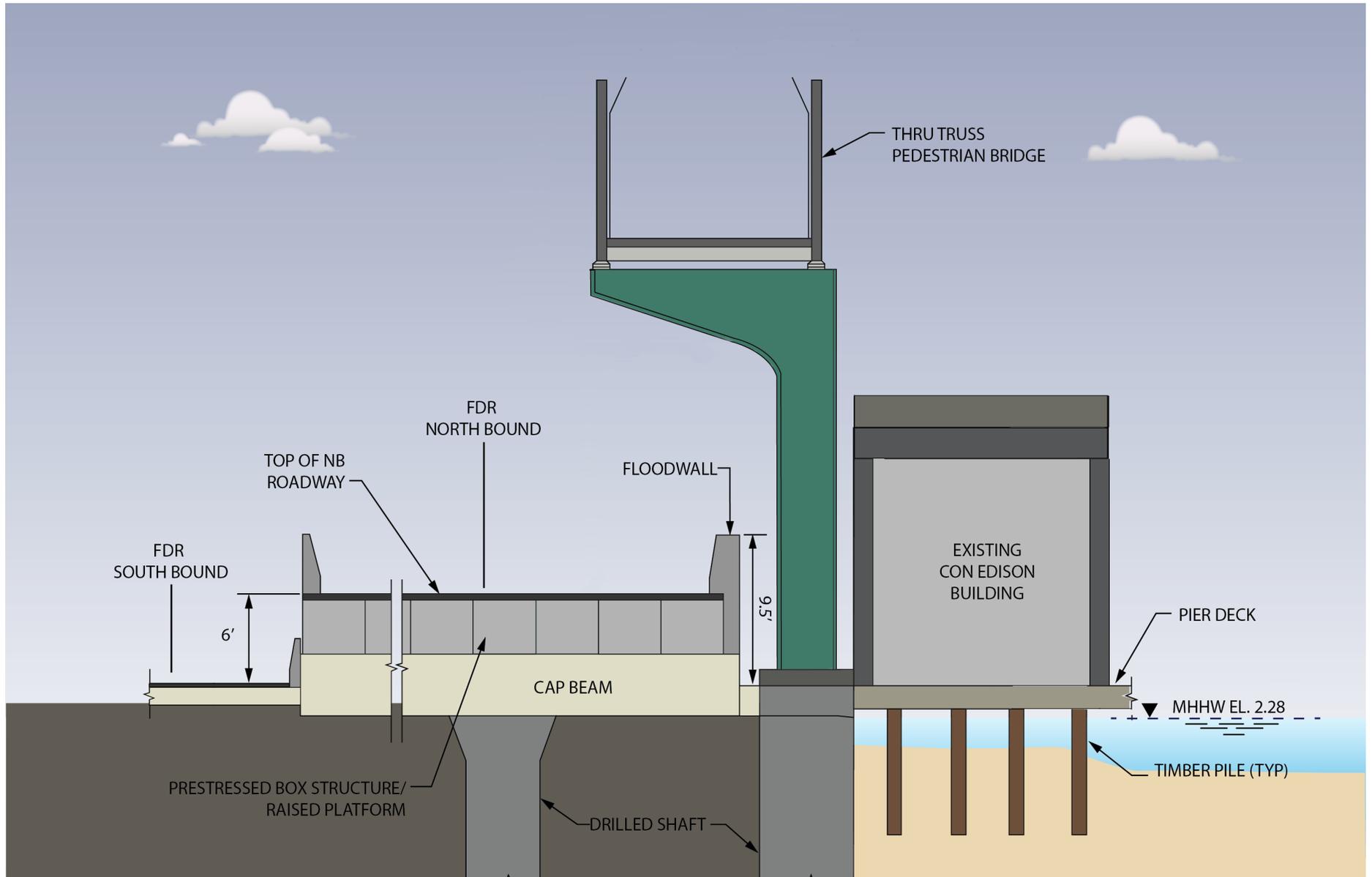
Given the number of agencies involved, the range of activities required, and the importance of their implementation during a coastal storm event, comprehensive training and emergency preparedness exercises would serve to provide a state of readiness to execute the necessary actions during the pre-storm conditions. To that end, the operations and maintenance manual that will be developed is a critical element for effective deployment of the proposed flood protection system. The manual will address each flood protection system component and the agency responsible for the components deployment during a flood event, along with a pre-storm timeline for its deployment.

FEMA ACCREDITATION

Upon completion of construction of the proposed project, the City would submit engineering plans, design modifications during construction, supporting materials (i.e., design criteria, geotechnical data, hydraulic modeling, etc.), a final operations and maintenance plan, and relevant construction data to FEMA to demonstrate compliance with requirements listed in Chapter 44 of the Federal Code of Regulations, Section 65.10 for FEMA accreditation.

Prior to the completion of the construction activities and the initial step towards accreditation, the City will submit a Conditional Letter of Map Revision for FEMA review. The final submission would include as-built plans, including any major deviations from the original design and specifications and an updated operations and maintenance manual.

As part of achieving FEMA accreditation (recognition of the proposed project on Flood Insurance Rate Maps [FIRMs]), the City would submit documentation that the entire length of the flood



Note: Based on Preliminary draft design concept, NYCDOT, August 2016

protection system has been adequately designed, and that operation and maintenance systems are in place to provide reasonable assurance the system would be able to perform as designed throughout the accreditation period and identification of any known risks. The FEMA accreditation process considers all components of the flood protection system, including elements for resisting storm induced surge (storm tide) and the existing and proposed alterations to the interior drainage system for removing all interior waters (rainfall and dry weather flow) from the protected area.

POST-STORM ACTIONS

Deactivating Closure Structures

Post storm, the closure structures would be returned to their open positions and debris removal would begin as soon as possible. Initiating these activities would commence once the storm surge has receded, the floodwaters have subsided, and NYCCEM with the guidance of the National Weather Service (NWS) determines there is no threat of future flooding, tidal surge, or high wind conditions. It is expected that re-opening the gates would take approximately the same time as deployment, with contingencies for unforeseen conditions. Subsequent to the closure structures being returned to their open positions, any street obstructions and accumulated debris would be removed by DSNY and normal traffic circulation patterns would gradually be restored.

Deactivating Drainage Management

Post storm, the branch interceptor isolation gate valve and interceptor gates would be returned to their open position to the normal functioning and performance of the sewer system. As the storm surge recedes, and the outfall tide gates would open to allow the release of drainage collected in the sewer system. The Manhattan Pump Station would also be reset to normal pumping operations.

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