3.0 CONCEPT AND ALTERNATIVE DEVELOPMENT

National Environmental Policy Act (NEPA) documents must evaluate all reasonable alternatives (40 CFR 1502.14). The alternatives to be considered in any NEPA document are driven by the purpose and need for the action. The purpose and need for the Project is to reduce the potential for and magnitude of flooding impacts arising from both coastal storm surge and rainfall events (see Section 2.0, Purpose and Need). In order to identify the alternatives to evaluate in this Final Environmental Impact Statement (FEIS), five project concepts were first developed and then comparatively screened using a matrix. This led to the elimination of two of the concepts from further study and refinement of the remaining three into the Build Alternatives to be analyzed in the EIS. This section describes the process of development and screening of the five concepts, leading to the selection of the three alternatives. The analysis of those alternatives and selection of the Preferred Alternative is described in Section 6. The success of constructing a reliable and permanent comprehensive flood risk reduction system relies upon designing project approaches that consider existing infrastructure and environmental constraints, while also designing a flood risk reduction system in accordance with the regulatory standards (such as Federal Emergency Management Agency [FEMA] flood elevation standards, the New Jersey Department of Environmental Protection [NJDEP] Flood Hazard Area Control Act, and local floodplain ordinances).

Baseline conditions within the Study Area were determined through data collection, public engagement, and inter-agency coordination. Concurrently, the Project screening criteria and metrics were established through consideration of regulatory requirements and public feedback, which defined performance measures for different elements of the Project.

During concept development, the project team used a toolkit of location and section areas to define the elements of the Project (including Resist, Delay, Store and Discharge components); conducted a suitability assessment; and organized the Project elements by theme. The project team then applied concept development principles to group these elements into five comprehensive concepts. In December 2015, the five concepts were presented to the public for feedback. They were then qualitatively screened using the established concept screening criteria, further evaluated for engineering feasibility, and reviewed by the Executive Steering Committee (ESC), Citizen Advisory Group (CAG), and the general public (see **Table 3.1**). As a result, the five concepts were modified and three refined concepts were advanced as alternatives for analysis in the DEIS and FEIS. The variation among alternatives in this FEIS is based primarily on Resist alignments. Potential locations for the Resist alignments were identified in the Notice of Intent (NOI) as: (1) in the water; (2) along the waterfront; and (3) upland. All concepts and alternatives include a proposal for Delay, Store and Discharge (DSD) infrastructure. The process for


View Looking West , Cove Park Proposed Amenities

Table 3.1 Public and Agency Coordination Groups

COMMITTEE	ROLE
Citizen Advisory Group (CAG)	Comprised of representatives from each of the three cities to provide an open forum for discussion about the Project as it progresses.
Executive Steering Committee (ESC)	Comprised of NJDEP stakeholders, mayors, and municipal staff to serve as an advisory board to collaborate, exchange information, and provide a forum for committee members.
Federal Review and Permitting (FRP)	Comprised of federal agencies with jurisdiction over the Study Area to provide guidance on environmental concerns.
Technical Coordination Team (TCT)	Comprised of both federal and state agencies with jurisdiction and subject-matter expertise to provide guidance on environmental concerns.

Source: Dewberry, 2015-2017

Figure 3.1 Rebuild By Design competition idea board

developing concepts and alternatives is discussed in the following sections. Section 6 discusses the alternative screening process, results, and the identification of the Preferred Alternative.

3.1 Concept Development

3.1.1 Data Collection

In order to gain an understanding of existing conditions in the Study Area, data collection was undertaken as a first step in the concept development process. Information gathering and analysis included compiling existing data and conducting field work to gather detailed information on topography, geotechnical characteristics, and conditions of existing waterfront structures.

Existing sources of data pertaining to the location of wetlands, hazardous waste sites, floodplains, cultural resources, groundwater, and other environmental parameters were analyzed to identify potential constraints on the location of Project infrastructure, as well as the magnitude of potential environmental impacts. The location of existing infrastructure such as parks, roads, stormwater systems, subsurface utilities, and foundation structures establish the available footprint for constructing the various Project elements. The size and availability of the footprint area dictates the type of potential Project elements that could be constructed, such as earthen berms, floodwalls, or deployable flood systems.

An integrated coastal and inland flood model was developed to identify the locations of flooding and evaluate the effectiveness of various flood risk reduction concepts to reduce potential future flooding impacts.

3.1.2 Toolkit Development and Analysis

As a next step in the concept development process, a toolkit consisting of possible approaches to meet the purpose and need for both coastal storm surge and rainfall flooding risk reduction was developed. These components were built off of the initial ideas generated during the Rebuild by Design (RBD) competition in 2013 and 2014 (see **Figure 3.1**). The RBD competition's conceptual framework provided potential locations and types of structures that would subsequently be incorporated into some of the toolkit components. The toolkit's coastal storm surge risk reduction components included interventions such as floodwalls, in-water gates, revetments, raised bulkheads, terraced berms, deployable gates, and earthen levees (see **Figure 3.2**). These components were arranged geographically to address flood risk reduction for each part of the Study Area including Weehawken Cove, the northern waterfront, the southern waterfront, rail yard/terminal, and rail underpass. The various Resist components from the toolkit could be configured in a variety of combinations. (see **Figure 3.3**).

Resist structure heights (also known as the "Design Flood Elevation" or "DFE") were developed for all

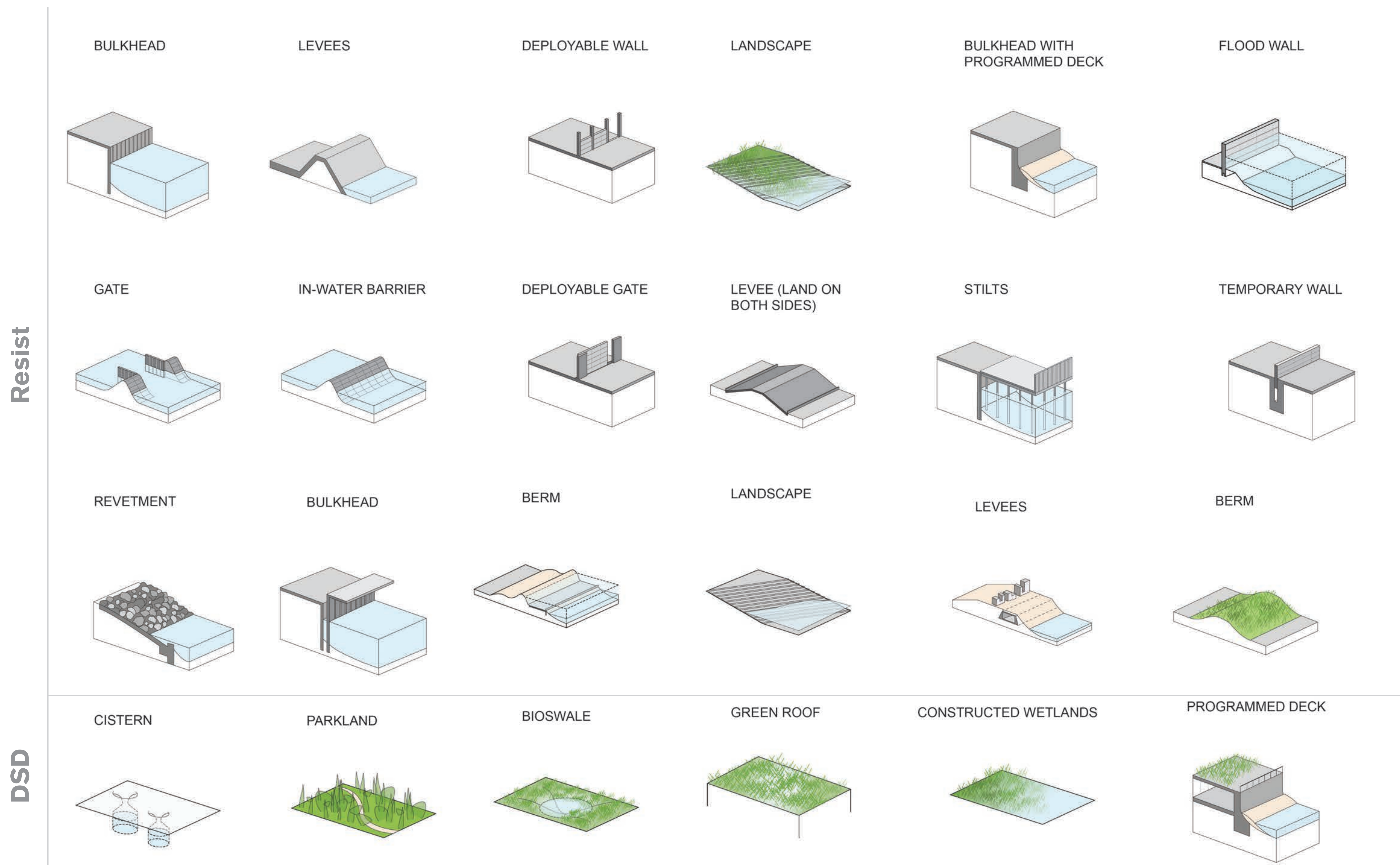


Figure 3.2 Toolkit Components - Types of Resist and DSD Features

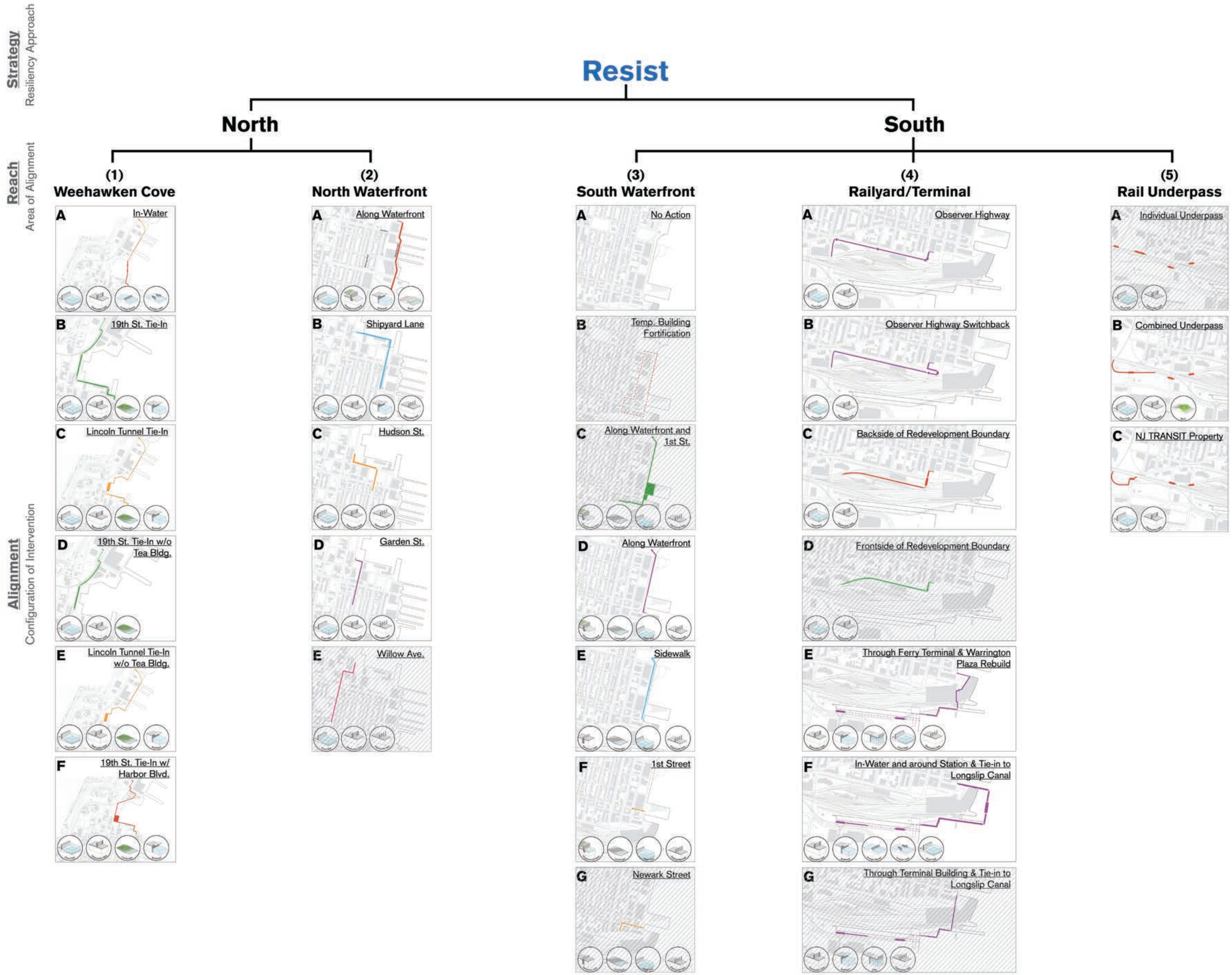


Figure 3.3 Toolkit Components - Resist

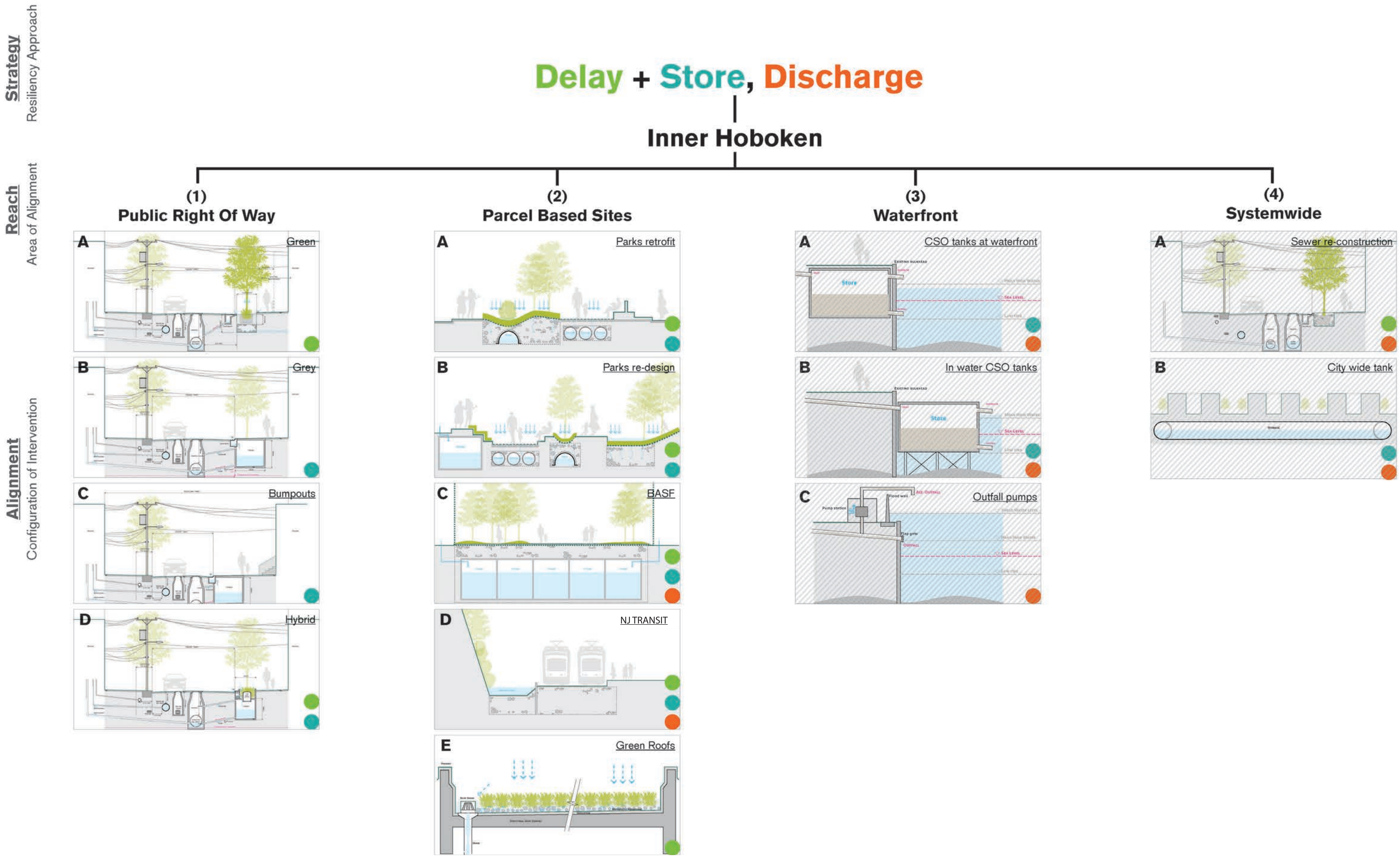


Figure 3.4 Toolkit Components - DSD

segments of the Resist infrastructure. The DFE's were developed using the criteria stated in 44 CFR 65.10 requirements and by incorporating sea level rise. The DFE's were based on the FEMA Base Flood Elevation (BFE) for the one percent annual chance flood (100-year flood) plus an additional 2.34 feet in elevation to account for possible sea level rise by 2075, based on NOAA's intermediate-high projections, as well as one foot of freeboard. Depending upon the location (i.e., waterfront or inland), the DFE values are different. For locations along or near the waterfront where wave action would be expected during a coastal surge event (such as along Weehawken Cove and Lincoln Harbor), the criteria stated in 44 CFR 65.10 required use of additional structure height to accommodate for wave run-up to prevent potential overtopping of the structure by wave action. These additional heights were not necessary for inland areas, such as along Garden Street, where wave action would be minimal.

In addition to the Resist elements, the DSD components were developed within the toolkit. These components included a full range of approaches intended to maximize temporary storage of rainfall and/or delay the rainfall volume from entering the combined sewer system. These components ranged from large tanks under piers and construction of underground caverns to smaller storage tanks and combination rain garden and rain water storage tanks (see **Figure 3.4**).

In order to organize the toolkit components, ten themes were developed. Each component of the toolkit was placed in one or more of the following themes: Minimum Flood Risk Reduction, Maximum Flood Risk Reduction, Maximum Green Infrastructure, Maximum Grey Infrastructure, Maximum Deployable with Resist, Maximum Permanent Resist Portion, Activated Waterfront, Minimum Impact to Study Area Infrastructure, Minimum Impact on Natural Environment, and Maintain Views and Access to Waterfront (see **Figure 3.5**).

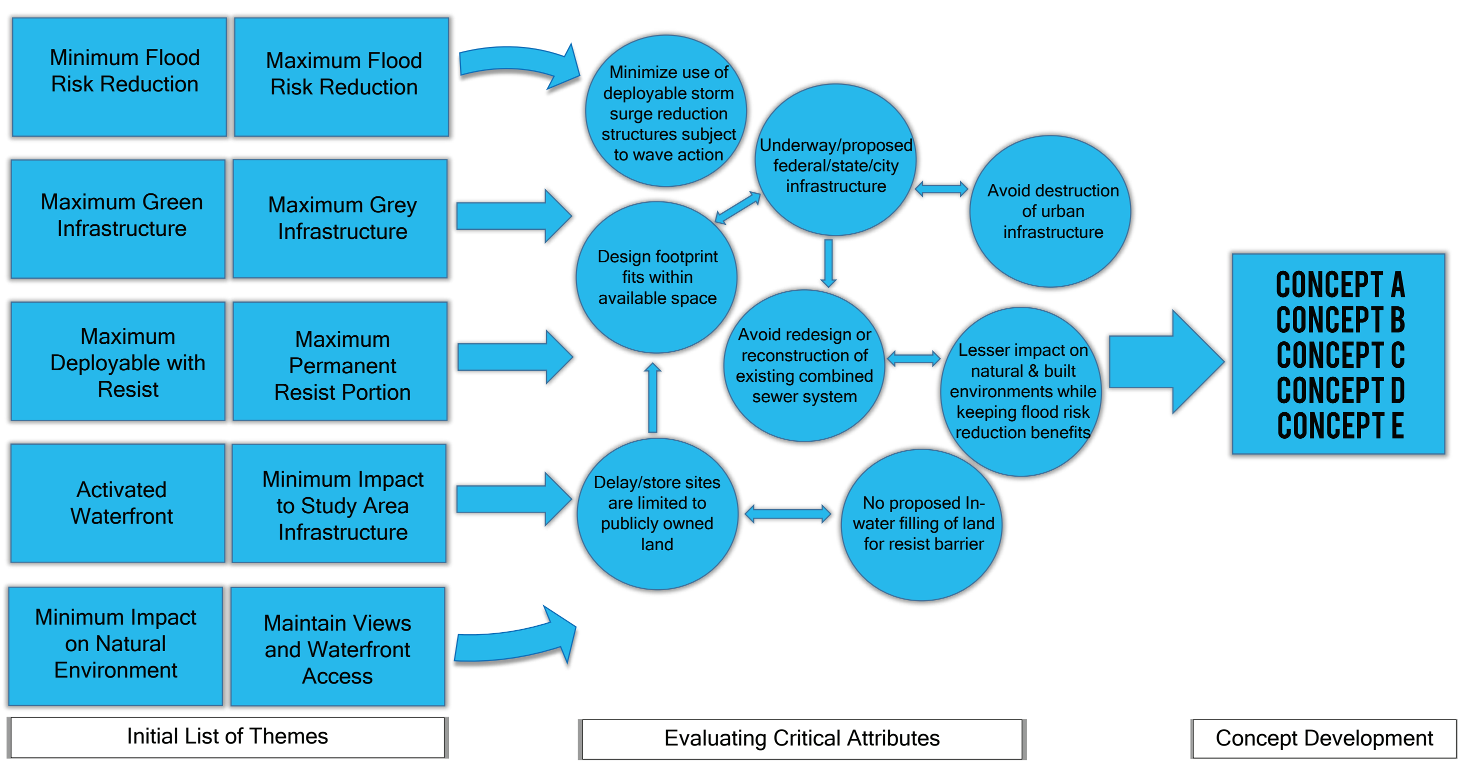


Figure 3.5 Toolkit Component Schematic

These themes provided a range of options that allowed the team to qualitatively review the level of flood risk reduction, impacts to the community, and considerations on reliability. These themes were used as a starting point to understand potential constraints and opportunities and to aid in the development of various flood risk reduction strategies while considering impacts to the built and natural environment. Each theme had its pros and cons along with a set of constraints that were reviewed by the team qualitatively to identify the five concepts that provided a range of flood risk reduction benefits.

A set of critical attributes was then developed. These critical attributes were used to evaluate whether a proposed idea was feasible, practical, or prudent. The components contained in the toolkit were then evaluated based on the critical attributes provided below:

- The use of deployable storm surge reduction structures subject to wave action is minimized
- The component considers federal/state/city infrastructure plans underway or proposed
- The Resist structure design footprint fits within available space
- In-water filling of land for Resist barriers is not proposed
- The delay/store sites are limited to publicly-owned lands
- The destruction of private urban infrastructure (i.e., buildings) is avoided
- The component represents a lesser impact on the natural and built environments compared to other components with equal flood risk reduction benefits
- The inland rainfall flood risk reduction strategies are independent of, and do not address, a full redesign or reconstruction of the existing combined sewer system

Guided by these critical attributes, certain components were determined to be not feasible and were discarded from further consideration. For example, a fully deployable system along the waterfront was rejected because of reliability concerns leading to a high probability of failure from wave action during storms. Similarly, full separation of the stormwater collection system from the existing combined storm sewer system was rejected from inclusion in the DSD because plans for the upgrade of the existing combined storm sewer system are under development by the North Hudson Sewerage Authority (NHSA). Based on this analysis, five potentially feasible themes that met the purpose and need of the Project were identified. For example, the Maximize Flood Risk Reduction theme became Concept C. The initial five concepts developed by the project team were refined through discussions and meetings with the ESC and the CAG.

3.1.3 Screening Criteria and Metrics

A total of 21 Project screening criteria were used to evaluate the effectiveness of each of the five concepts that would be developed. These 21 Project screening criteria were grouped into the following five categories.

- Flood Risk Reduction
- Built Environment/Socioeconomics
- Construction, Maintenance, and Operations
- Environmental Impacts
- Benefit Cost Analysis

Twelve screening criteria were qualitative, rating each concept as “good”, “fair”, or “poor”. Seven criteria were binary and based on presence or absence with a “yes” or “no” rating, and the remaining two criteria (e.g., Percent Population with Coastal Storm Surge Risk Reduction Benefits and Potentially Hazardous Waste Sites) were quantitative.

Following is a description of each screening criterion and associated measuring methods (metrics) used to evaluate the concepts for screening purposes.

Flood Risk Reduction

Coastal Storm Surge

This criterion quantifies the percent of the population within the Study Area 100-year floodplain that would receive a reduction in the likelihood or potential adverse consequences of a future flood event. These benefits would accrue to any people residing on the landward side of the coastal flood Resist barrier.

Potential to Adapt to Higher Coastal Flood Events (0.2-percent annual chance storm)

This criterion considers whether the north and south ends of the Resist alignment structure are tied at each end to landforms which could be used to support construction of a Resist barrier capable of addressing a storm with a 0.2-percent annual frequency (also known as a 500-year storm). It also considers whether the Resist structure foundation is capable of supporting an upgrade of the Resist barrier to handle a 0.2-percent annual chance storm.

Rainfall Flooding Events

The goal of the DSD Project component is to reduce flooding risks from rainfall runoff by reducing the volume of rainfall runoff entering into North Hudson Sewerage Authority’s combined storm sewer system. If rainfall runoff is delayed and/or prevented from entering the combined sewer system, it would inherently help in reducing flood volumes during a rainfall event. The EmNet flooding analysis report recommended a range of storage volumes between 0.1 million gallons to 4.2 million gallons to address flooding issues for various rainfall events that fell over the Study Area between May and June of 2013 (Emnet, 2013).

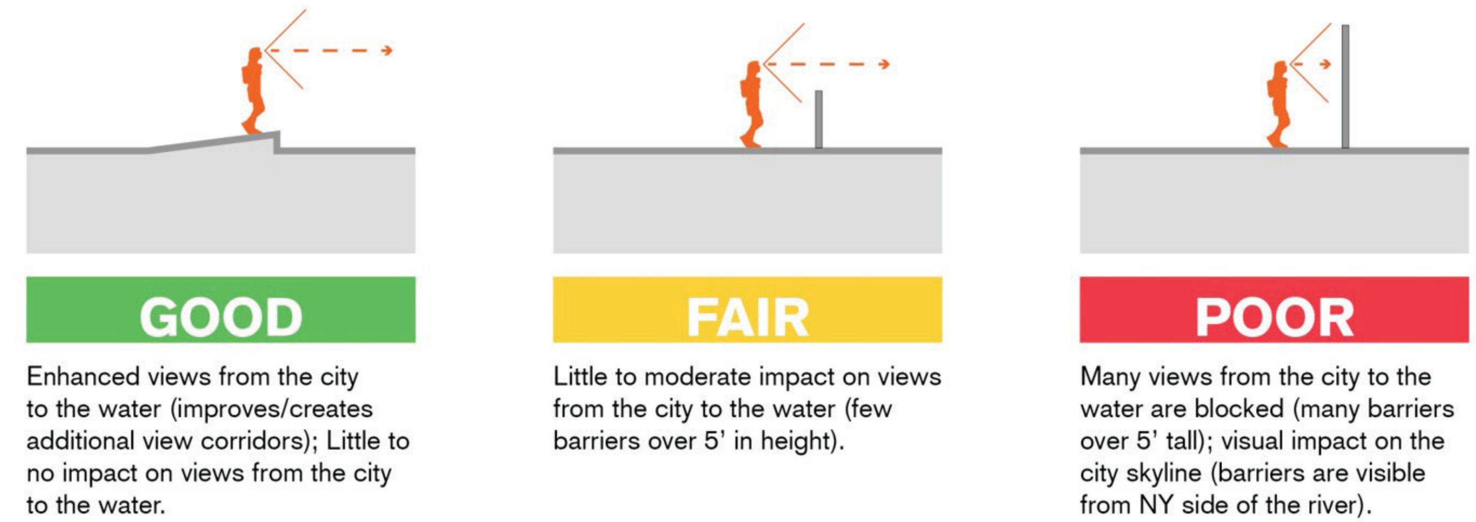


Figure 3.6 Screening Criteria Schematic

Built Environment/Socioeconomics

View Corridors

This metric evaluates the extent to which views from the Study Area to the water and New York City are obstructed by the Resist elements of the Project. The magnitude of obstruction is related to three variables. First, the length of the Resist structure is related to the total areas within the city where viewshed is obstructed. Second, the location of the Resist structure is related to the magnitude of viewshed obstruction, where the installation of the Resist structure further inland, as integrated into the built environment, would reduce the level of viewshed obstruction (see **Figure 3.6**). Third, this criterion is related to the position of the viewer. Pedestrians along the waterfront are the only population for whom views could be enhanced under any concept. In addition, as the height of the storm surge barrier is increased to provide greater storm surge risk reduction, the viewshed would have the potential to be positively impacted for pedestrians along any elevated walkway (through incorporation of new vantage points) and negatively impacted across the balance of the city. This metric considers viewshed obstruction on a relative basis.

Waterfront Access

This criterion considers the potential impact of the Resist structure on pedestrian access to the waterfront. The ability of pedestrians to access the waterfront would be related to the height of the Resist structure and the length of the Resist infrastructure, which would change the nature of the current at-grade access to the waterfront. Each of the concepts will be evaluated relative to one another.

Connectivity/Circulation

This metric evaluates how the Project would impact the street system and parking infrastructure in the Study Area. The most significant variables in this metric are impacts on the number of parking spaces effected and the extent to which Project components may involve disruptions to the street system or changes in roadway configuration. Each of the concepts will be evaluated in a relative fashion against these variables.

Potential Community Benefits

This criterion is intended to capture potential opportunities associated with the Resist structures, where new Resist structures may provide locations for amenities for existing businesses (such as incorporating outdoor seating areas). This criterion also includes potential to incorporate many new and/or improved amenities to support existing recreational, commercial, and cultural activities. These community advantages are related to benefits that will be considered in the benefit cost ratio.

Environmental Justice Populations

The breakdown of potential minority and low-income populations in the Study Area has been identified at a census tract level. The low-income and minority communities within the Study Area are concentrated in the interior, low-elevation areas of the City of Hoboken. For this reason, these populations are at greatest risk during rainfall flood events. There is a single minority and low-income population near the Hudson River. Since the DSD proposal is the same for all concepts, the impacts to minority and low-income populations only varies with respect to whether the single low-income/minority census tract near the Hudson River would receive flood risk reduction benefits based on the location of the Resist barrier.

Construction, Maintenance, and Operations

Constructability

This criterion considers different factors related to simplicity of construction. These factors include: (1) the amount of infrastructure (roads, sidewalks, utilities-both underground and overhead, etc.) that must be relocated to enable construction of the Project; (2) the extent to which businesses or public access, both pedestrian and vehicular, would be disrupted during construction activities; (3) availability of staging areas; (4) the extent to which any structures or infrastructure are located on privately-owned property; and (5) the potential construction impacts (noise and air) on nearby residences, businesses, and institutions.

Construction Duration

The October 16, 2014 Federal Register notice awarding the Project funds states that funding must be obligated by September 30, 2017 and expended within two years of obligation (79 FR 62182). United States Department of Housing and Urban Development (HUD) has granted NJDEP an extension until 2022 for this project. Funds not expended by that date are at risk of re-programming and could be re-directed to other projects. This criterion will evaluate the estimated length of time to complete construction. Completion of construction is anticipated to be most heavily impacted by complex permitting processes and/or by complex construction procedures that require highly specialized equipment or personnel, or which may have seasonal timing restrictions. Construction duration may be correlated to constructability.

Maintenance and Operation

Evaluation factors for this criterion include anticipated ease of routine maintenance or the need for expensive or labor intensive maintenance. While ease of maintenance can be more accurately characterized after the Project has been further designed, some maintenance issues are valid for consideration at this stage. This evaluation will consider the number of deployable Resist structures and/or fixed gates that need to be deployed to provide effective storm surge risk reduction. This criterion will also consider the extent to which Resist structures are located in the water, which would require specialized equipment for access and skilled personnel for maintenance. Resist barriers located along the waterfront (bulkhead) would also result in maintenance challenges not faced for Resist barriers which are inland, as waterfront Resist barriers would require a combination of land-based and in-water maintenance activities. This factor also considers maintenance life cycle costs.

Environmental Impacts

Within the environmental impact grouping, there are seven different criteria: wetlands (freshwater wetlands only, as there are no tidal wetlands in the Study Area); essential fish habitat; threatened and endangered species; U.S. Army Corps of Engineers (USACE) permits; historic properties; archaeological resources; and hazardous waste. For the first five of these criteria, there is a simple yes or no test, where presence of a resource may result in impacts that would need to be addressed. For example, if wetlands or essential fish habitat are present within the Project footprint, then impacts would be anticipated and need to be characterized and potentially mitigated. The hazardous waste criterion is based on the number of hazardous waste sites that could be impacted by a particular concept (for Resist components only). Similarly, for archaeological resources, the rating of this criterion is relative based on the number of known archaeological resources within known surveyed areas. No new field data were collected for any of these determinations.

Benefit Cost Analysis

Benefit

This criterion considers potential monetary benefits of a particular concept (arising from reduced damage to buildings and contents, as well as displacement costs) and is directly tied to the number of persons anticipated to receive flood risk reduction benefits.

Cost

This criterion considers the potential cost of the concept based on the proposed scope of infrastructure to be constructed.

Benefit Cost Ratio (BCR)

This criterion considers the potential for the benefit-cost ratio to exceed 1.0. In order to calculate the BCR for concept screening, the concept's estimated benefits were divided by the anticipated costs. Since detailed engineering, flood modeling, and cost

Figure 3.7 All Concepts "Subway" Map

estimation had not been conducted at the concept screening stage of the Project, the rating for this criterion considered relative costs and benefits among concepts.

3.2 Description of Concepts

The five concepts were presented to the community at a public meeting on December 10, 2015 (see **Figure 3.7**). All five concepts included the same approach for the DSD component and varied related to the locations for the Resist alignment. The DSD components that were advanced for all concepts include all elements from the toolkit that were determined to be feasible, practical, and prudent. The DSD concepts are described once below as part of Concept A, and are to be applied in the same manner to all proposed Resist concepts (A through E) described in the following sections. Please refer to Section 3.2.1 through 3.2.5 for more details on each concept.

3.2.1 Concept A

Concept A begins as a Resist structure near the Lincoln Harbor Light Rail Station in Weehawken (see **Figure 3.8**). The structure travels south along the Hudson Bergen Light Rail (HBLR) to Park Avenue, where it parallels the waterfront down to Cove Park to work in conjunction with the proposed boathouse (see **Figure 3.9**). The Resist alignment ties into Cove Park and then continues south to Garden Street before tapering off at approximately 13th Street. In the south, Concept A includes two options for Resist

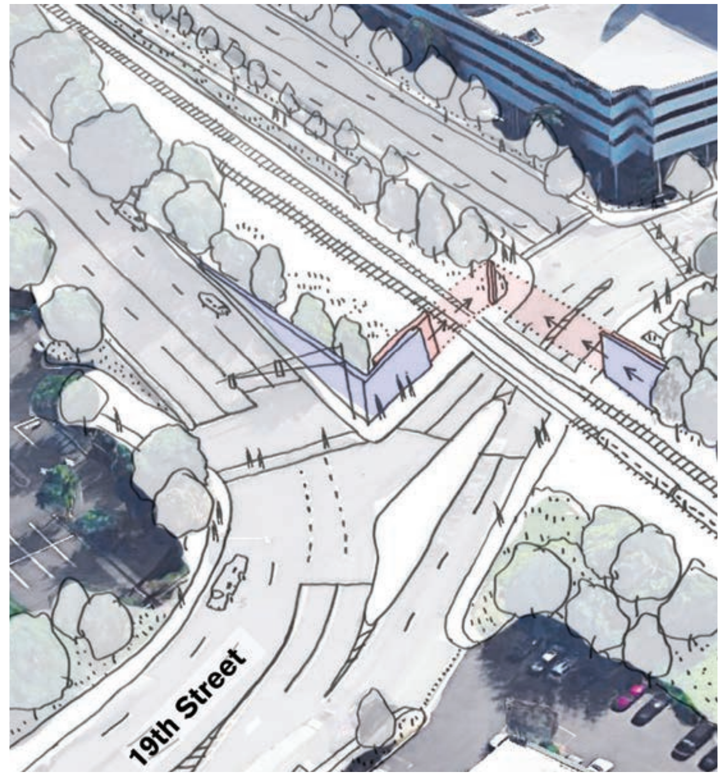


Figure 3.8 Concept A - Resist Structure Lincoln Harbor Light Rail Station

alignments: Option 1, which closely hugs the Hoboken rail lines inside the terminal, **Figure 3.10** and Option 2 along Observer Highway, **Figure 3.11**. An additional Resist component with a berm is proposed for the southwestern corner of Hoboken where the Morristown Line, Gladstone Line, Montclair-Boonton Line, and the North Jersey Coast Line cross over the HBLR. Swinging and/or sliding gates are included as part of this concept where practical (see **Figure 3.11**). This concept involves between 8,100 to 8,400 linear feet of structure and 21 movable gates. This concept provides flood risk reduction benefits to approximately 86 percent of people residing in the Study Area 100-year floodplain.

The DSD elements of the Concept A include 61 small

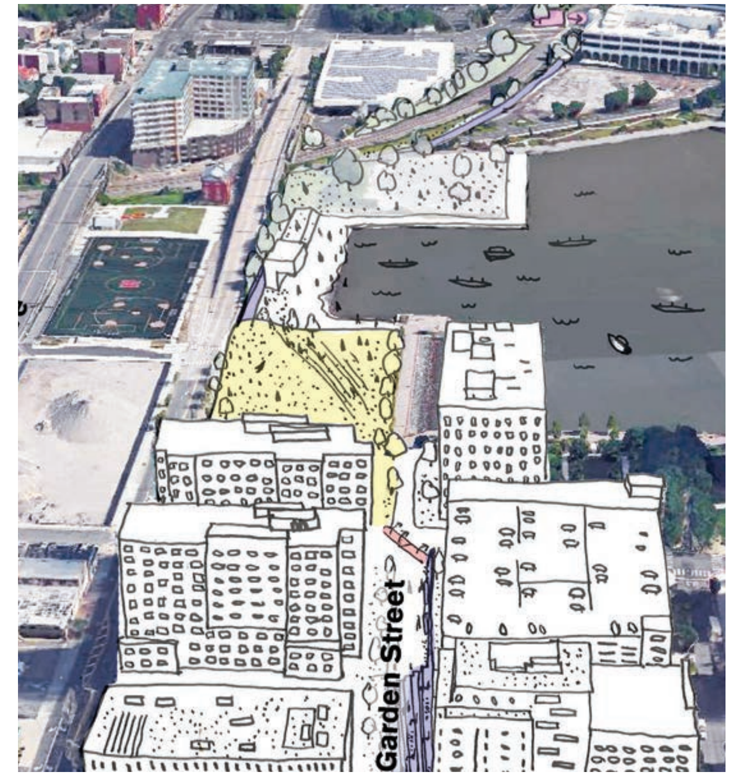


Figure 3.9 Concept A - South to Garden Street

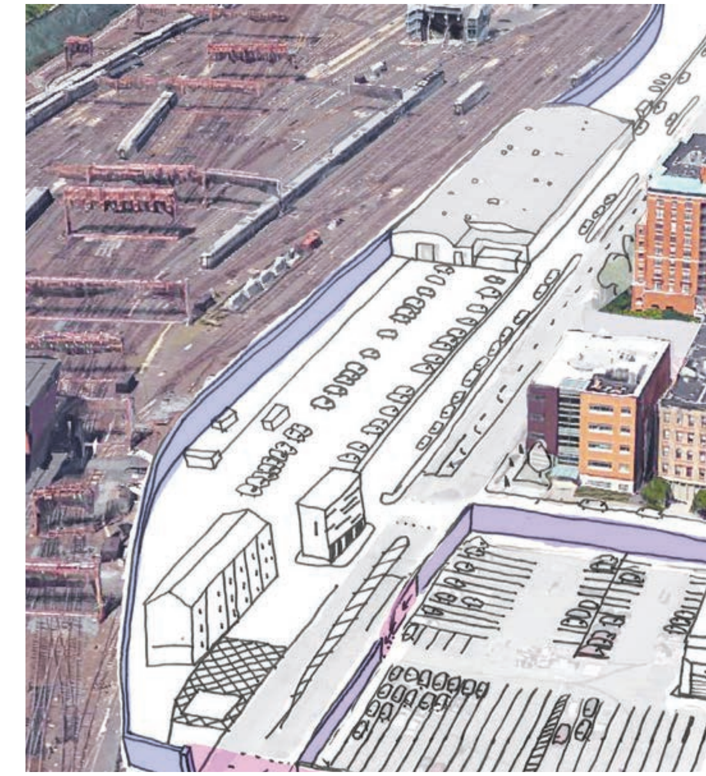


Figure 3.10 Concept A - Option 1 along Observer Highway, within Rail Yard

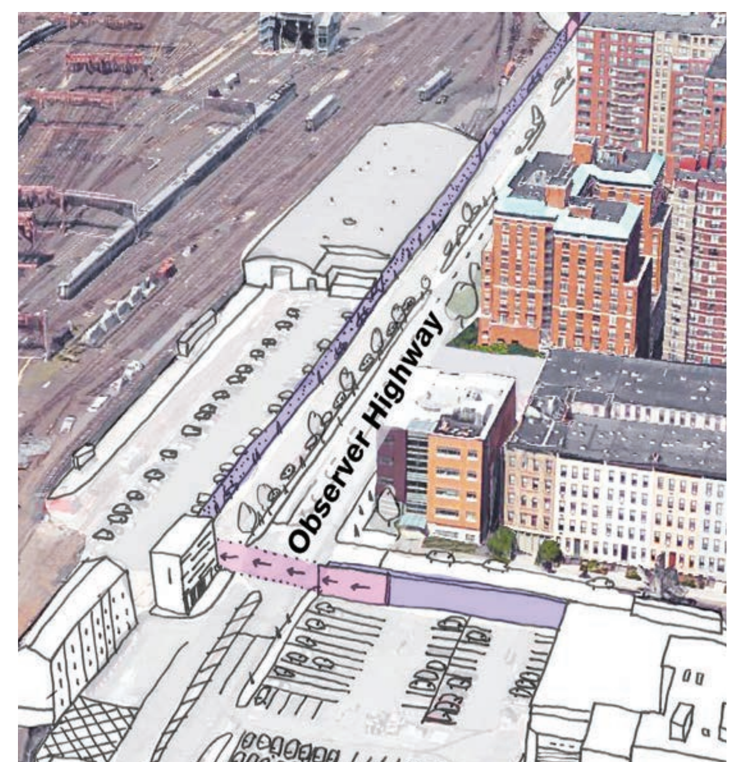


Figure 3.11 Concept A - Option 2 along Observer Highway

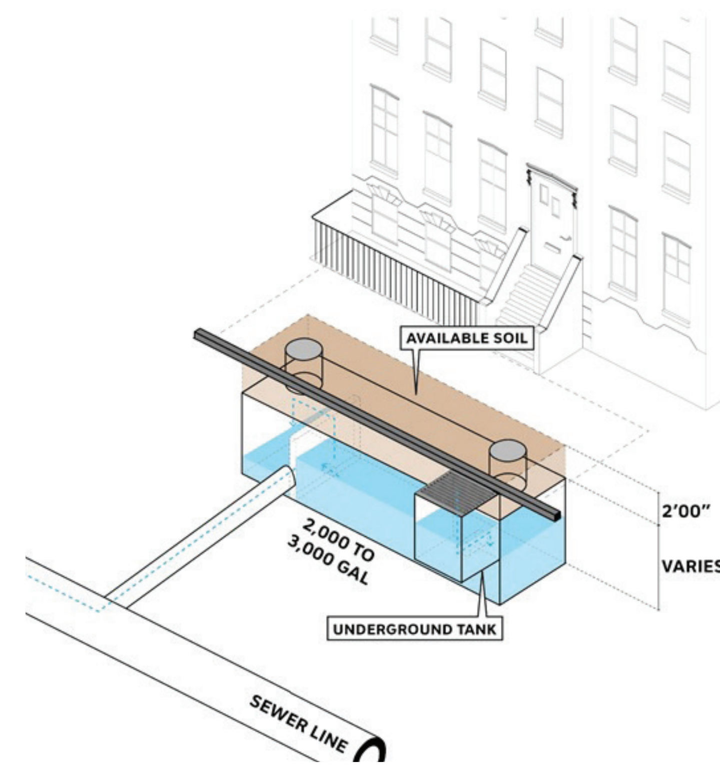


Figure 3.12 DSD - Small ROW Tank

Alignment Options	Option 1	Option 2
Flood Risk Reduction		
Percent of Population with Coastal Storm Surge Risk Reduction Benefits	86	86
Potential to Adapt to Higher Coastal Flood Event [>500yr and Sea Level Rise]	Red	Red
Rainfall	Green	Green
Built Environment		
View Corridors	Yellow	Yellow
Waterfront Access	Green	Green
Potential Community Benefits	Red	Red
Connectivity/ Circulation	Red	Yellow
Environmental Justice Populations	Yellow	Yellow
Construction/Maintenance & Operation		
Constructability	Green	Yellow
Construction Duration	Green	Yellow
Maintenance and Operation for Overall System	Green	Green
Environmental Impacts		
Potential Hazardous Waste Sites (Resist Only)	32	28
Wetlands	Yes	Yes
Essential Fish Habitat	No	No
Threatened and Endangered Species	No	No
Army Corps Permits	No	No
Historic Properties	Yes	Yes
Archaeological Resources	Yellow	Yellow
Benefit/Cost Analysis		
Benefits	High	High
Costs	Low	Low
Benefit/Cost Ratio	Green	Green

Figure 3.13 Concept A

"Right of Way" (ROW) sites in the inland portion of Hoboken that would include new and/or improved stormwater management techniques designed to complement other efforts by the City of Hoboken as part of the Green Infrastructure Strategic Plan. Most of these stormwater storage sites would have a capacity of storing up to several thousand gallons of water in curbside treatments, vegetated swales, rain gardens, and stormwater infiltration planters (see **Figure 3.12**).

Where feasible, larger underground water storage tanks are proposed in flooding "Hot Spots," such as at the 17-acre Hoboken Housing Authority. Delay/Store techniques are also proposed to be incorporated into current and future planned green spaces and parks in Hoboken such as the 4.3-acre BASF property and the Block 10 site. Potential stormwater retrofit options that would allow to capture and store rainfall runoff within the existing parks, such as Columbus Park and active recreational fields, such as Mama Johnson field and JFK stadium were also included.

The Discharge component includes two pumps to be located in the northwestern corner of Hoboken; one near the NHSA and one near the proposed Northwest Park (BASF property). Both pumps would assist in the drainage of the large northwestern catchment area. A third pump (lift station) is proposed for the southwestern corner near the Hoboken Housing Authority (HHA) and HBLR property at approximately 4th Street to encourage the water to flow north out of this low-lying area. Two new outfall pipes in northern Weehawken Cove are also proposed. One outfall would be located in the northern part of the cove near Lincoln Harbor and would drain the flow of the proposed swale/ditch running along the western side of the HBLR line. The second outfall is proposed to be located north of Cove Park near 1600 Park Street to drain the BASF catchment area connected via underground discharge pipe. Concept A, including Resist and DSD components, is shown on **Figure 3.13.**

3.2.2 Concept B

Concept B consists of a Resist structure in the form of a berm beginning in Weehawken and traveling down the waterfront along Weehawken Cove to tie in at the Cove Park. The Resist alignment then continues along the waterfront, at varying elevations, in front of the Hudson Tea Building (see **Figure 3.14**) and along the east side of Frank Sinatra Drive, tying into the Castle Point area near the Hoboken Cove Boathouse (see **Figure 3.15**). A deployable wall is proposed along 1st Street between Sinatra Drive and River Street (see **Figure 3.16**). In the south, Concept B also includes two options for Resist alignments: Option 1 and Option 2 along Observer Highway (see **Figure 3.17**). One additional Resist component with a berm is proposed for the southwestern corner of Hoboken where the Morristown Line, Gladstone Line, Montclair-Boonton Line, and the North Jersey Coast Line cross over the HBLR. This concept involves 13,430 linear feet of Resist structure and 21 gates. This concept is estimated to provide flood risk reduction benefits to approximately 98 percent of people residing in the Study Area 100-year floodplain.

Figure 3.14 Concept B - Seawall along waterfront in front of Hudson Tea Building

Figure 3.15 Concept B - Sinatra Drive North

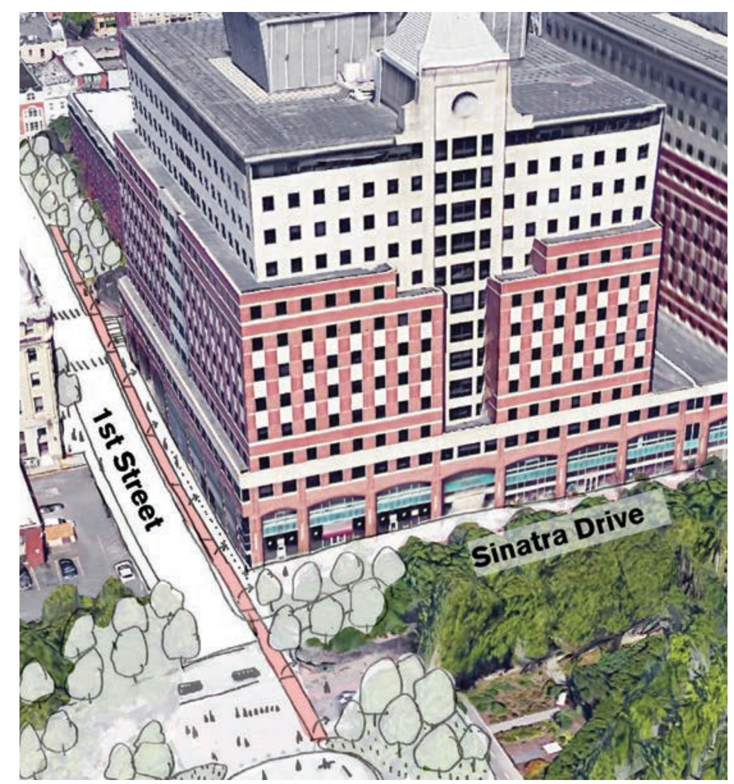


Figure 3.16 Concept B - Deployable wall along 1st Street

Figure 3.17 Concept B - Alignment along Observer Highway

Alignment Options	Option 1	Option 2
Flood Risk Reduction		
Percent of Population with Coastal Storm Surge Risk Reduction Benefits	98	98
Potential to Adapt to Higher Coastal Flood Event [>500yr and Sea Level Rise]	● (yellow)	● (yellow)
Rainfall	● (green)	● (green)
Built Environment		
View Corridors	● (yellow)	● (yellow)
Waterfront Access	● (yellow)	● (yellow)
Potential Community Benefits	● (yellow)	● (yellow)
Connectivity/ Circulation	● (yellow)	● (yellow)
Environmental Justice Populations	● (green)	● (green)
Construction/Maintenance & Operation		
Constructability	● (yellow)	● (yellow)
Construction Duration	● (yellow)	● (yellow)
Maintenance and Operation for Overall System	● (yellow)	● (yellow)
Environmental Impacts		
Potential Hazardous Waste Sites (Resist Only)	31	28
Wetlands	Yes	Yes
Essential Fish Habitat	Yes	Yes
Threatened and Endangered Species	Yes	Yes
Army Corps Permits	Yes	Yes
Historic Properties	Yes	Yes
Archaeological Resources	● (red)	● (red)
Benefit/Cost Analysis		
Benefits	High	High
Costs	High	High
Benefit/Cost Ratio	● (red)	● (red)

Figure 3.18 Concept B

Concept B also includes concepts for DSD, which were evaluated to address inland stormwater issues to alleviate flooding from rainfall events. (See above description under Concept A). Concept B, including Resist and DSD components is shown on **Figure 3.18**.

3.2.3 Concept C

Concept C begins in Weehawken near the Lincoln Tunnel with a berm. The Resist alignment then travels south along the waterfront and crosses through Weehawken Cove as an in-water revetment with gates for small boat access to the cove (see **Figure 3.19**). The revetment would tie into a berm at the Monarch property before continuing down the waterfront along Sinatra Drive, concluding at Castle Point near the Hoboken Cove Boathouse (see **Figure 3.20**). The Resist structure begins again as a berm at Stevens Park and travels south along Sinatra Drive behind Pier A Park as a raised path (see **Figure 3.21**). A seawall is proposed to be built around the Hoboken Terminal (see **Figure 3.22**), with a gate opening for ferries to access the terminal. The seawall continues down to the Long Slip Canal, where it becomes a terrestrial Resist structure following the length of the canal on its south side. Additional gates and walls were proposed at other locations along the rail lines and Marin Blvd, in addition to the berm proposed for the southwestern corner of Hoboken where the Morristown Line, Gladstone Line, Montclair-Boonton Line, and the North Jersey Coast Line cross over the HBLR.

This concept involves 14,730 linear feet of on-land

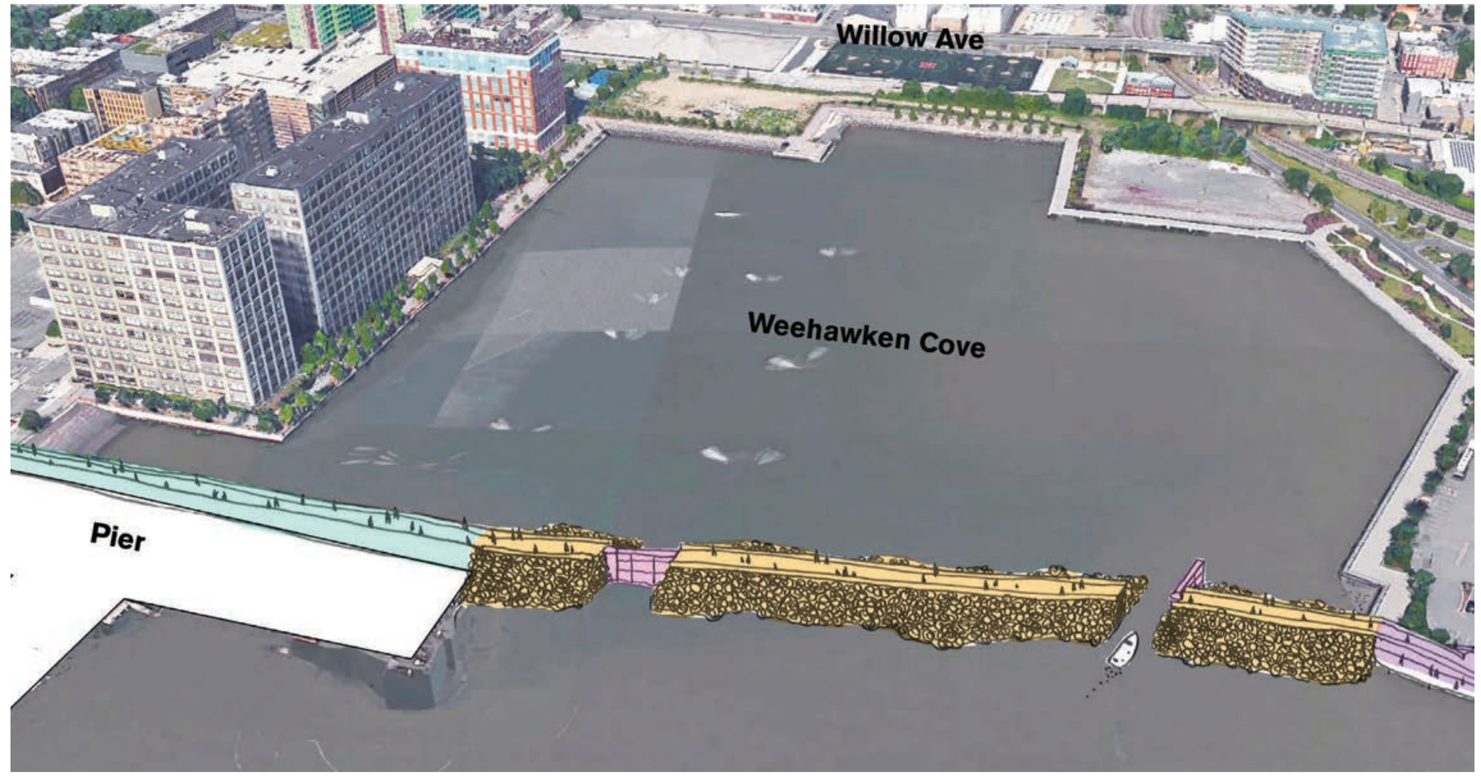


Figure 3.19 Concept C - In-water revetment

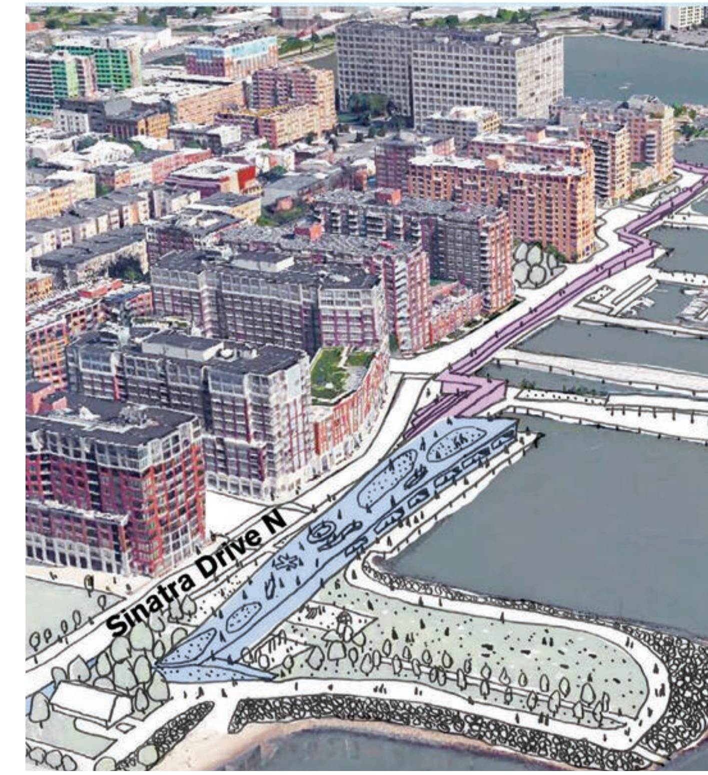


Figure 3.20 Concept C - Sinatra Drive North

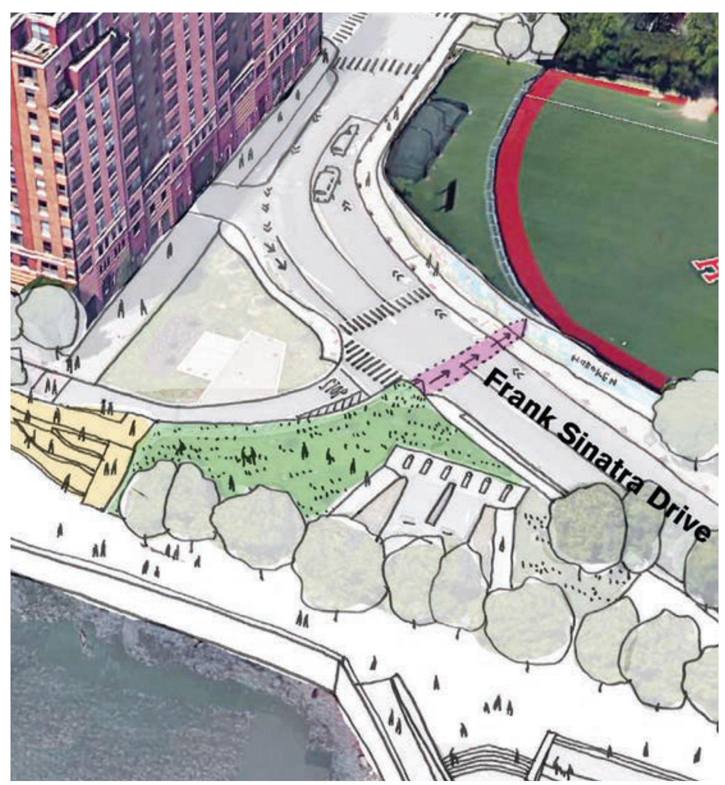


Figure 3.21 Concept C - Frank Sinatra Drive

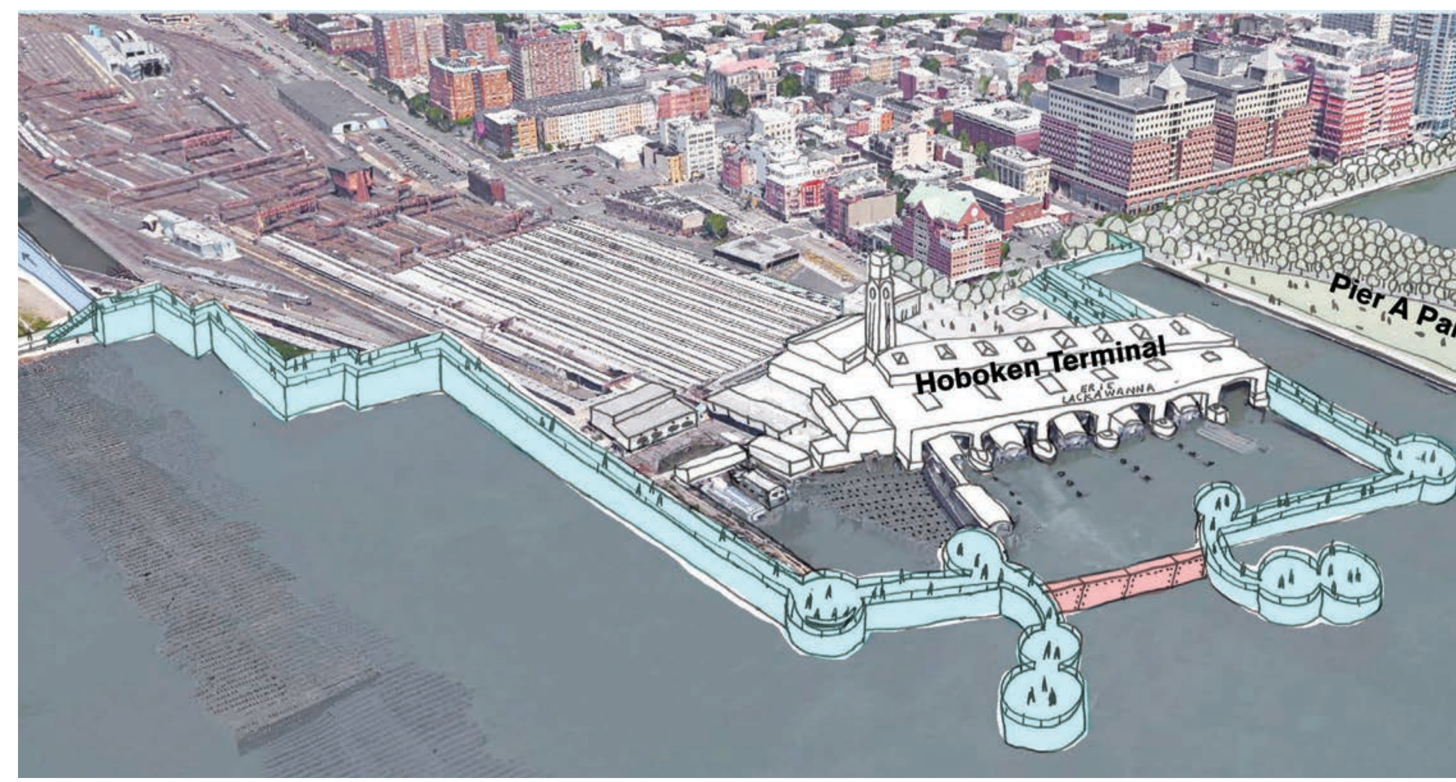


Figure 3.22 Concept C - Hoboken Terminal

Flood Risk Reduction	
Percent of Population with Coastal Storm Surge Risk Reduction Benefits	99
Potential to Adapt to Higher Coastal Flood Event [>500yr and Sea Level Rise]	Green
Rainfall	Green
Built Environment	
View Corridors	Red
Waterfront Access	Red
Potential Community Benefits	Yellow
Connectivity/ Circulation	Green
Environmental Justice Populations	Green
Construction/Maintenance & Operation	
Constructability	Red
Construction Duration	Red
Maintenance and Operation for Overall System	Red
Environmental Impacts	
Potential Hazardous Waste Sites (Resist Only)	18
Wetlands	Yes
Essential Fish Habitat	Yes
Threatened and Endangered Species	Yes
Army Corps Permits	Yes
Historic Properties	Yes
Archaeological Resources	Red
Benefit/Cost Analysis	
Benefits	Highest
Costs	Highest
Benefit/Cost Ratio	Red

Figure 3.23 Concept C

Figure 3.24 Concept D - Harbor Blvd.

structures with 16 gates and 2,700 linear feet of in-water Resist barriers with five gates. This concept is estimated to provide flood risk reduction benefits to approximately 99 percent of people residing in the Study Area 100-year floodplain.

Concept C also includes concepts for DSD that were evaluated to address inland stormwater issues to alleviate flooding from rainfall events. (See above description under Concept A). Concept C, including Resist and DSD components is shown on **Figure 3.23**.

3.2.4 Concept D

Concept D begins as a berm at the Lincoln Tunnel and travels south as a Resist structure along the waterfront, tying in at Cove Park (see **Figure 3.24**).

The Resist structure travels along the waterfront and down Sinatra Drive ending at Castle Point/Hoboken Cove Boathouse (see **Figure 3.25**). The Resist structure resumes its course as a raised path down Sinatra Drive at Stevens Park hugging the waterfront behind Pier A Park (see **Figure 3.26**) and traveling south through the Hoboken Terminal building, continuing as a seawall south of the terminal to meet Long Slip Canal, and then traveling westward as a Resist structure along the southern length of the canal (see **Figure 3.27**). Additional gates and walls were proposed at other locations along the rail lines and Marin Blvd, in addition to the berm proposed for the southwestern corner of Hoboken where the Morristown Line, Gladstone Line, Montclair-Boonton Line, and the North Jersey Coast Line cross over

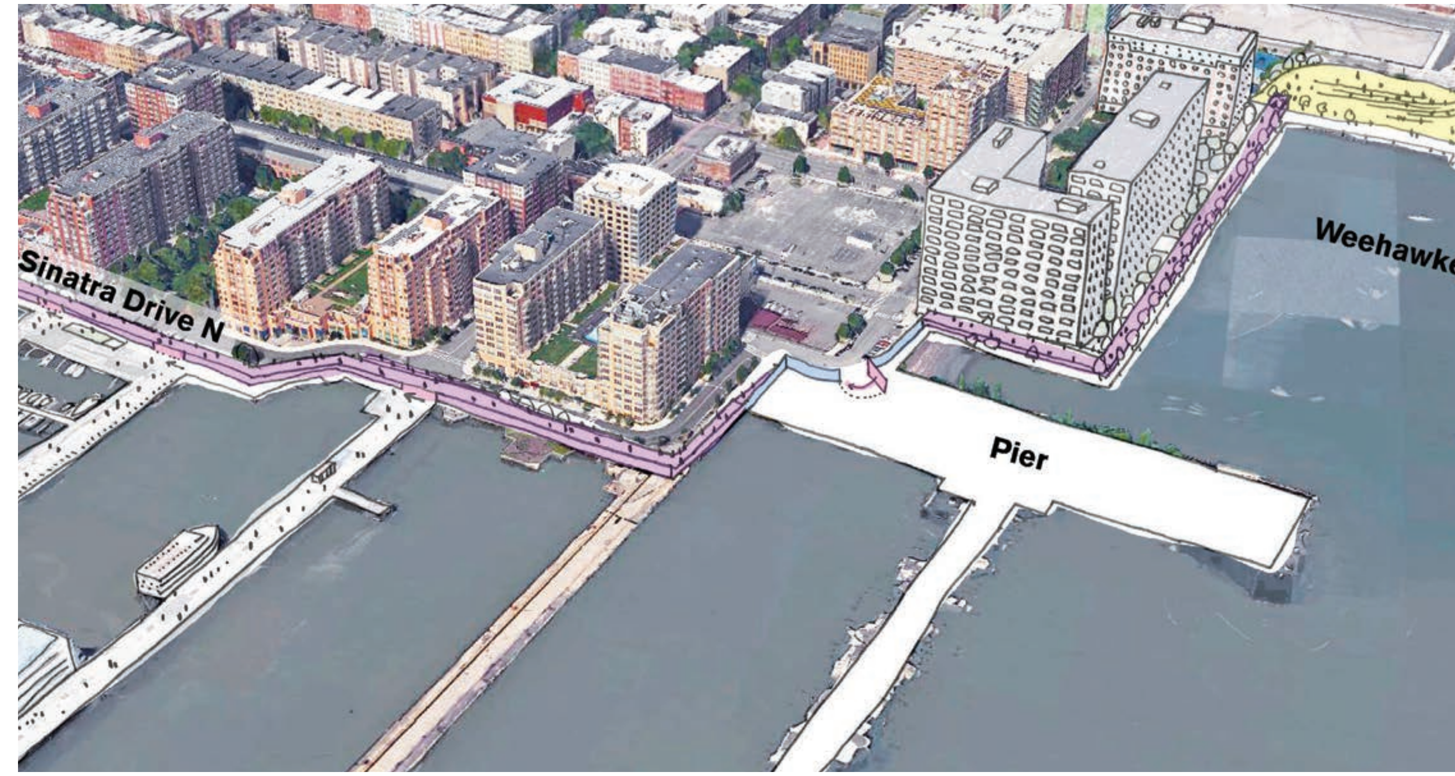


Figure 3.25 Concept D - Sinatra Drive North

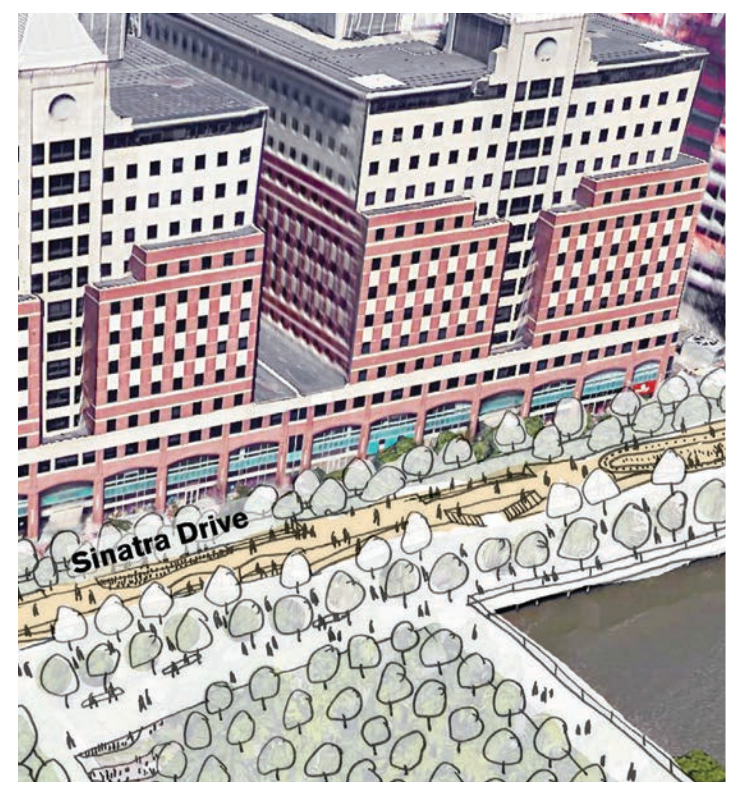


Figure 3.26 Concept D - Sinatra Drive South

Figure 3.27 Concept D - South of Hoboken Terminal

Flood Risk Reduction	
Percent of Population with Coastal Storm Surge Risk Reduction Benefits	99
Potential to Adapt to Higher Coastal Flood Event [>500yr and Sea Level Rise]	Green
Rainfall	Green
Built Environment	
View Corridors	Red
Waterfront Access	Red
Potential Community Benefits	Green
Connectivity/ Circulation	Yellow
Environmental Justice Populations	Green
Construction/Maintenance & Operation	
Constructability	Red
Construction Duration	Red
Maintenance and Operation for Overall System	Red
Environmental Impacts	
Potential Hazardous Waste Sites (Resist Only)	20
Wetlands	Yes
Essential Fish Habitat	Yes
Threatened and Endangered Species	Yes
Army Corps Permits	Yes
Historic Properties	Yes
Archaeological Resources	Red
Benefit/Cost Analysis	
Benefits	Highest
Costs	Highest
Benefit/Cost Ratio	Red

Figure 3.28 Concept D

the HBLR. This concept includes 16,230 linear feet of Resist structure and 20 gates and is estimated to provide flood risk reduction benefits to approximately 99 percent of residents in the Study Area 100-year floodplain.

Concept D also includes concepts for DSD, which were evaluated to address inland stormwater issues to alleviate flooding from rainfall events. (See above description under Concept A). Concept D, including Resist and DSD components, is shown on **Figure 3.28**.

3.2.5 Concept E

Concept E begins as a Resist structure near the Lincoln Harbor Light Rail Station in Weehawken (see **Figure 3.29**). The structure travels south along the HBLR to Park Avenue, where it continues down to Cove Park. Concept E then travels east along the waterfront and turns to proceed south along two different options: Option 1 along Hudson Street (see **Figure 3.30**) and Option 2 along Shipyard Lane (see **Figure 3.31**). Both options' Resist structures would end at 12th Street. The Resist structure would begin again as a berm near Stevens Park and continue south to Pier A Park as a raised path. A deployable wall is proposed for a portion of 1st Street between Sinatra Drive and Hudson Street. An extension of the Resist structure would begin at the southern end of Washington Street where it meets Observer Highway and would continue to run along the rail line westward, terminating at Marin Boulevard (see **Figure 3.32**).

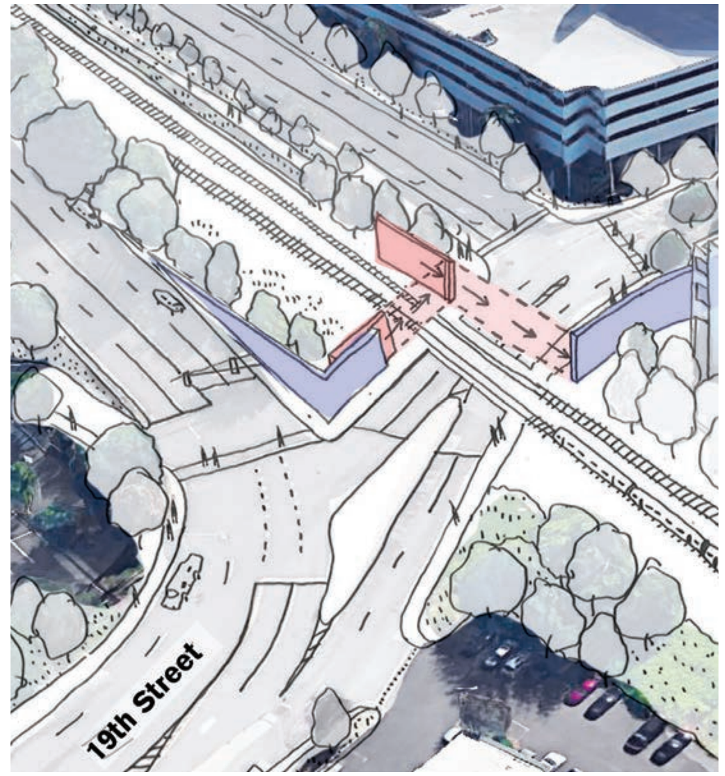


Figure 3.29 Concept E - Resist Structure Lincoln Harbor Light Rail Station

Figure 3.30 Concept E - Option 1 along Hudson Street

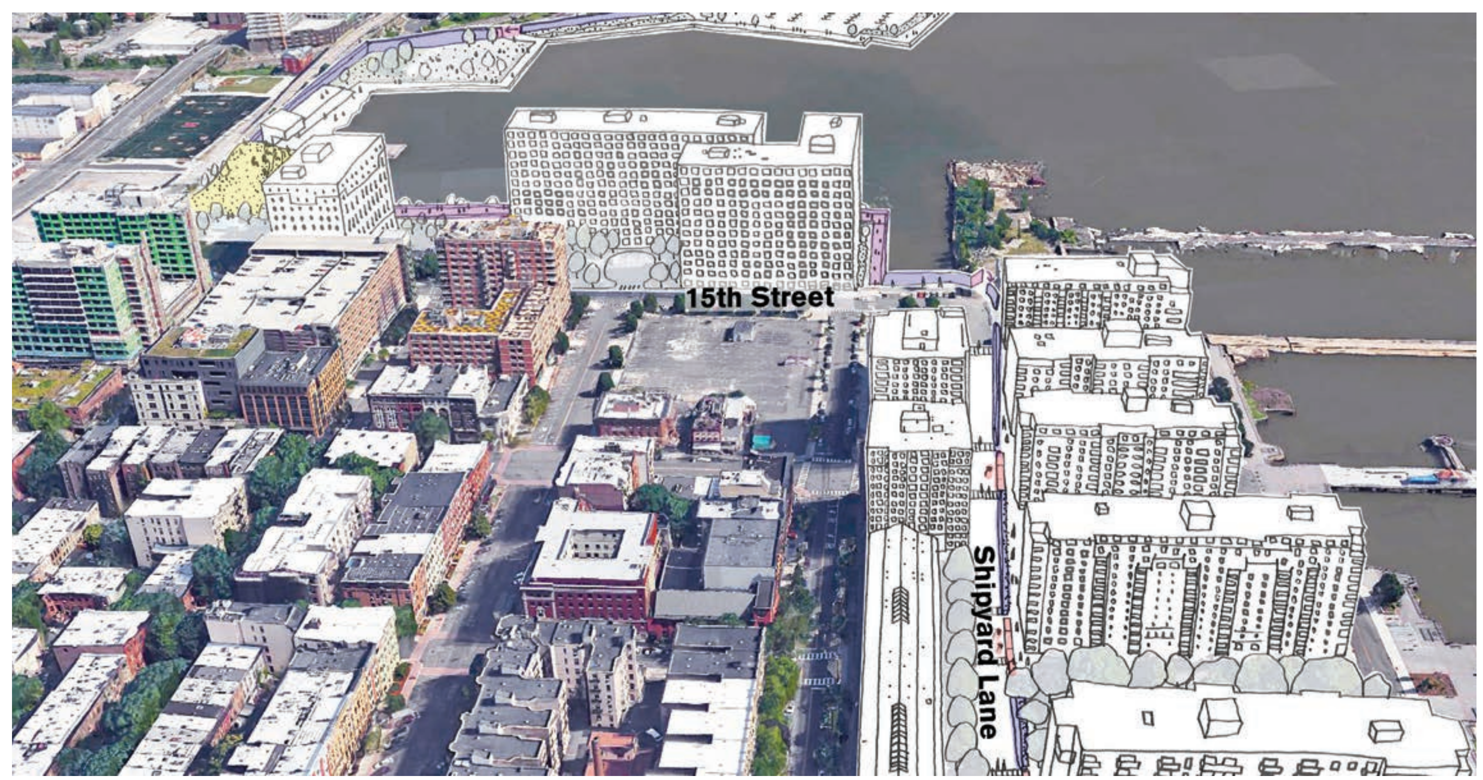


Figure 3.31 Concept E - Option 2 along Shipyard Lane

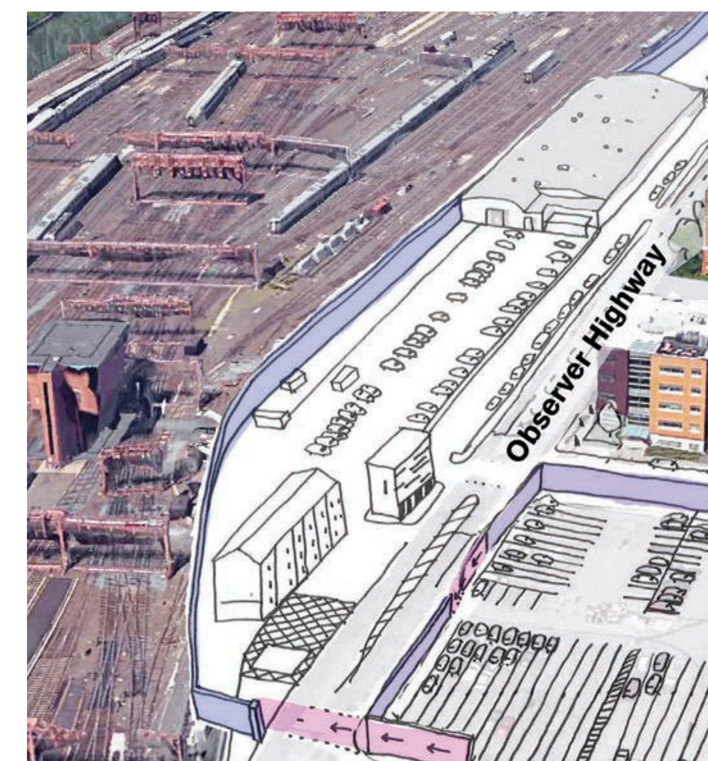


Figure 3.32 Concept E - Observer Highway and Washington Street

Alignment Options	Option 1	Option 2
Flood Risk Reduction		
Percent of Population with Coastal Storm Surge Risk Reduction Benefits	90	90
Potential to Adapt to Higher Coastal Flood Event [>500yr and Sea Level Rise]	Red	Red
Rainfall	Green	Green
Built Environment		
View Corridors	Yellow	Red
Waterfront Access	Green	Green
Potential Community Benefits	Yellow	Yellow
Connectivity/ Circulation	Red	Yellow
Environmental Justice Populations	Green	Green
Construction/Maintenance & Operation		
Constructability	Green	Yellow
Construction Duration	Green	Green
Maintenance and Operation for Overall System	Yellow	Yellow
Environmental Impacts		
Potential Hazardous Waste Sites (Resist Only)	30	30
Wetlands	Yes	Yes
Essential Fish Habitat	Yes	Yes
Threatened and Endangered Species	Yes	Yes
Army Corps Permits	Yes	Yes
Historic Properties	Yes	Yes
Archaeological Resources	Red	Red
Benefit/Cost Analysis		
Benefits	High	High
Costs	High	High
Benefit/Cost Ratio	Yellow	Yellow

Figure 3.33 Concept E

An additional Resist structure with a gate is proposed for the southwest corner of Hoboken where the Morristown Line, Gladstone Line, Montclair-Boonton Line, and the North Jersey Coast Line cross over the HBLR. This concept requires 12,010 linear feet of Resist structure and 16 gates and is estimated to provide flood risk reduction benefits to approximately 90 percent of people residing in the Study Area 100-year floodplain.

Concept E also includes concepts for DSD, which were evaluated to address inland storm water issues in order to alleviate flooding from rainfall events. (See above description under Concept A). Concept E, including Resist and DSD components, is shown in **Figure 3.33**.

3.3 Concept Screening

Following the concept development phase, an evaluation of the five concepts was conducted through the use of a screening matrix (see **Table 3.2**). The concept screening matrix was preliminarily developed and evaluated by the project team. Additional input was obtained from stakeholder groups and then presented in a community workshop setting. The community workshop allowed the public to give the project team input into the criteria. Public involvement is described in greater detail in Section 7. The purpose of the concept screening was to winnow down the five concepts to three Build Alternatives to be analyzed further in the DEIS.

The evaluation of the various concepts was based upon "desktop" evaluations with limited field data or analytical calculations. The individual ratings assigned for each criterion are based on consideration of both the definitions included in the criterion, as well as the relative merit of a concept in meeting that criterion, as compared to the other concepts evaluated. This ranking is not a simple numeric exercise because all of the criterion are not of equal importance. When considering which concepts would be recommended for inclusion in the DEIS as build alternatives, the first consideration was how well the concept meets the purpose and need of the Project. The second consideration was the feasibility and practicality to undertake the Project, in terms of constructability. The third consideration was the nature of built and environmental impacts resulting from Project implementation. Note that some of the environmental impacts can be either totally or partially mitigated (e.g., by establishment of replacement wetlands). The selection of build alternatives for consideration in the DEIS was also informed by comments from the public, elected public officials, and input from agencies with jurisdiction by law or special expertise.

Table 3.2 Concept Screening Matrix

		CONCEPTS							
	Rating	A (option 1)	A (option 2)	B (option 1)	B (option 2)	C	D	E (option 1)	E (option 2)
FLOOD RISK REDUCTION	Percent Population with Coastal Storm Surge Risk Reduction Benefits	86%	86%	98%	98%	99%	99%	90%	90%
	Potential to Adapt to Higher Coastal Flood Events [>= 500yr and Sea Level Rise]	POOR	POOR	FAIR	FAIR	GOOD	GOOD	POOR	POOR
	Rainfall	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
BUILT ENVIRONMENT/SOCIOECONOMICS	View Corridors	FAIR	FAIR	FAIR	FAIR	POOR	POOR	FAIR	POOR
	Waterfront Access	GOOD	GOOD	FAIR	FAIR	POOR	POOR	GOOD	GOOD
	Potential Community Benefits	POOR	POOR	FAIR	FAIR	FAIR	GOOD	FAIR	FAIR
	Connectivity / Circulation	POOR	FAIR	FAIR	FAIR	GOOD	FAIR	POOR	FAIR
	Environmental Justice Populations *Includes only the waterfront protection level.	FAIR	FAIR	GOOD	GOOD	GOOD	GOOD	GOOD	GOOD
CONSTRUCTION / MAINTENANCE & OPERATION	Constructability	GOOD	FAIR	FAIR	FAIR	POOR	POOR	GOOD	FAIR
	Construction Duration	GOOD	FAIR	FAIR	FAIR	POOR	POOR	GOOD	GOOD
	Maintenance & Operation for Overall System	GOOD	GOOD	FAIR	FAIR	POOR	POOR	FAIR	FAIR
ENVIRONMENTAL IMPACTS (BASED ON DATA GATHERED TO DATE)	Potentially Hazardous Waste Sites. Number is for Resist only.	32	28	31	28	18	20	30	30
	Wetlands Permitting (Yes / No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Essential Fish Habitat	No	No	Yes	Yes	Yes	Yes	Yes	Yes
	Threatened & Endangered Species (Yes / No)	No	No	Yes	Yes	Yes	Yes	Yes	Yes
	USACE 404 Permits (Yes / No Hudson River Waterfront)	No	No	Yes	Yes	Yes	Yes	Yes	Yes
	Historic Properties	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Archaeological Resources	FAIR	FAIR	POOR	POOR	POOR	POOR	POOR	POOR
BENEFIT - COST ANALYSIS	Benefits	High	High	High	High	Highest	Highest	High	High
	Costs	Lowest	Lowest	High	High	Highest	Highest	High	High
	Benefit / Cost Ratio	GOOD	GOOD	POOR	POOR	POOR	POOR	FAIR	FAIR

Source: Dewberry, 2015-2017

3.4 Concept Evaluation

This section presents an evaluation of the five design concepts that were presented to the community at a public meeting on December 10, 2015 (see **Photograph 3.1**). The design concepts were developed in an effort to holistically address the purpose and need of the Project and served as an important tool for gaining public input and feedback on potential solutions. The five design concepts (A through E) each have different Resist components, but share the same DSD components. Since each of these design concepts can be successfully integrated with the DSD components, the evaluation presented here focuses on application of the screening criteria to the Resist infrastructure, as described in Section 3.2. **Table 3.2** displays the results of the concept evaluation against each of the 21 screening criteria described in Section 3.1.3.

3.4.1 Concept A

Flood Risk Reduction

Concept A would result in coastal storm surge flood risk reduction benefits to 86 percent of the people residing in the Study Area 100-year floodplain. Neither end of the Resist barrier ties in outside of the 500-year floodplain. While there is capacity along the barrier to increase the design elevation to adapt to higher coastal flood events, Concept A would result in the greatest relative cost to achieve protection from a 500-year flood.

Built Environment/Socioeconomics

With regard to view corridors, Concept A was rated as fair, as it would result in little to moderate impact on views from the Study Area to New York City. Concept A would maintain or enhance existing pedestrian access to the waterfront; however, it has limited potential to incorporate new or improved amenities to support recreational, commercial, and cultural activities. Option 1 of Concept A would result in moderate to heavy impacts on circulation within the Study Area and loss of parking spaces. Although Option 2 of Concept A would result in the loss of some parking spaces, it would result in little to no impact on connectivity of the Study Area's street system. Concept A provides flood risk reduction benefits to a moderate number of low-income and minority communities compared to other concepts.

Construction, Maintenance, and Operation

Construction of Option 1 of Concept A would not result in the need to relocate major infrastructure and would not require major disruption to business operations or public access during construction. Option 2 of Concept A would result in some level of disruption to business operations or public access during construction. There is a high probability that Option 1 would be constructed within the required project timeline and a medium probability that Option 2 would be constructed within the required project timeline. Concept A primarily includes permanent structures and incorporates fewer deployable structures relative to the other concepts. As a result, there would be lower ongoing operation and maintenance costs and reduced potential for human error relative to other concepts.

Environmental Impacts

An initial environmental review of the Study Area for Concept A indicates that Options 1 and 2 would encounter 32 and 28 potentially hazardous waste sites, respectively. Wetlands are present within the Study Area and would potentially be impacted. Concept A would not result in impacts to the Hudson River waterfront and would not require a permit from the USACE. There are historic properties/districts within the Area of Potential Effect (APE) for Concept A that would be impacted and there is a low potential for encountering archaeological resources.

Benefit Cost Analysis

While all of the concepts would result in monetary benefits, due to its lower relative costs, Concept A was determined to have the highest relative BCR among the five concepts. There is a high potential that the BCR for Concept A would be greater than 1.0.

3.4.2 Concept B

Flood Risk Reduction

Concept B would result in coastal storm surge flood risk reduction benefits to 98 percent of the people residing in the Study Area 100-year floodplain. One end of the Resist barrier ties in outside of the 500-year floodplain and there is capacity along the barrier to increase the design elevation to adapt to higher coastal flood events with additional cost to achieve protection from a 500-year flood.

Photograph 3.1 December 10, 2015 Public Meeting

Built Environment/Socioeconomics

With regard to view corridors, Concept B was rated as fair because it would result in little to moderate impact on views from the Study Area to New York City. Concept B would have minimal to moderate impacts on existing pedestrian access to the waterfront and it has the potential to incorporate new or improved amenities to support recreational, commercial, and cultural activities. Although Concept B would result in the loss of some parking spaces, it would result in little to no impact on connectivity of the Study Area's street system. This concept provides maximum coastal storm surge risk reduction benefits to low-income and minority communities.

Construction, Maintenance, and Operation

Construction of Concept B would result in some level of disruption to business operations and public access during construction. Concept B has a medium probability to be constructed within the required project timeline. Concept B includes more deployable structures than Concept A and would result in relatively moderate ongoing operations and maintenance costs and moderate potential for human error.

Environmental Impacts

Based on an initial environmental review of Concept B, Options 1 and 2 would encounter 31 and 28 potential hazardous waste sites, respectively. Wetlands, essential fish habitat, and threatened or endangered species are present within the Study Area and potentially impacted. Concept B would result in impacts to the Hudson River waterfront and would require a permit from the USACE. There are historic properties/districts within the APE for Concept B that would be impacted and there is a high potential for encountering archaeological resources.

Benefit Cost Analysis

While all of the concepts would result in monetary benefits, due to its higher relative costs, Concept B was determined to have a lower BCR than Concepts A and E.

3.4.3 Concept C

Flood Risk Reduction

Concept C would result in coastal storm surge flood risk reduction benefits to 99 percent of the people residing in the Study Area 100-year floodplain. Both ends of the Resist barrier would tie in outside of the 500-year floodplain and, if needed, capacity along the barrier is available to increase the design elevation.

Built Environment/Socioeconomics

Concept C was rated as poor with regard to impacts to view corridors - it would block many waterfront views from the Study Area to New York City. This concept would result in moderate to high impacts on existing pedestrian access to the waterfront (limiting access points, requiring stairs, ADA ramps, etc.); however, it has the potential to incorporate new or improved amenities to support recreational, commercial, and cultural activities. Concept C would not impact traffic and circulation. This concept provides maximum coastal storm surge risk reduction benefits to low-income and minority communities.

Construction, Maintenance, and Operation

Construction of Concept C would be technically challenging due to construction of in-water revetments. There is a low probability that Concept C would be constructed within the required project timeline. Concept C includes many deployable structures and would result in high ongoing operation and maintenance costs and a higher potential for human error.

Environmental Impacts

Based on an initial environmental review of the Study Area, Concept C would encounter 18 potentially hazardous waste sites. Wetlands, essential fish habitat and threatened or endangered species are present within the Study Area and potentially impacted. Concept C would result in impacts to the Hudson River waterfront and would require a permit from the USACE. There are historic properties/districts within the APE for Concept C that would be impacted and there is a high potential for encountering archaeological resources.

Benefit Cost Analysis

While all of the concepts would result in monetary benefits, due to its higher relative costs, Concept C was determined to have a lower BCR than Concepts A and E.

3.4.4 Concept D

Flood Risk Reduction

Concept D would result in coastal storm surge flood risk reduction benefits to 99 percent of people residing in the Study Area 100-year floodplain. Both ends of the Resist barrier would tie in outside of the 500-year floodplain and, if needed, capacity along the barrier is available to increase the design elevation.

Built Environment/Socioeconomics

Concept D was rated as poor with regard to impacts to view corridors, as it would block many waterfront views from the Study Area to New York City. It would result in moderate to high impacts on existing pedestrian access to the waterfront (limiting access points, requiring stairs, ADA ramps, etc.). Concept D has the potential to incorporate many new or improved amenities to support recreational, commercial, and cultural activities. Although Concept D would result in the loss of some parking spaces, it would result in little to no impact on connectivity of the Study Area's street system. This concept provides maximum coastal storm surge risk reduction benefits to low-income and minority communities.

Construction, Maintenance, and Operation

Construction of Concept D would be technically challenging to construct due to the required construction within a busy terminal situated over the Hudson River. There would be significant disruption to public transit during construction. There is a low probability that Concept D would be constructed within the required project timeline. Concept D includes many deployable structures and would result in high ongoing operation and maintenance costs and a higher potential for human error.

Environmental Impacts

Based on an initial environmental review of the Study Area, Concept D would encounter 20 potentially hazardous waste sites. Wetlands, essential fish habitat, and threatened or endangered species are present within the Study Area and potentially impacted. Concept D would result in impacts to the Hudson River waterfront and would require a permit from the USACE. There are historic properties/districts within the APE for Concept D that would be impacted (Concept D would travel through the Hoboken Terminal building, which is listed as historic) and there is a high potential for encountering archaeological resources.

Benefit Cost Analysis

While all of the concepts would result in monetary benefits, due to its higher relative costs, Concept D was determined to have a lower BCR than Concepts A and E.

3.4.5 Concept E

Flood Risk Reduction

Concept E would result in coastal storm surge flood risk reduction benefits to 90 percent of the people residing in the Study Area 100-year floodplain. Neither end of the Resist barrier ties in outside of the 500-year floodplain. While there is capacity along the barrier to increase the design elevation to adapt to higher coastal flood events, like Concept A, Concept E would result in the greatest relative cost to achieve protection from a 500-year flood.

Built Environment/Socioeconomics

With regard to impacts to view corridors, Option 1 was rated as fair because it would result in little to moderate impact on views from the Study Area to New York City. Option 2 was rated as poor because it would block many waterfront views. Concept E would maintain or enhance existing pedestrian access to the waterfront and it has the potential to incorporate new or improved amenities to support recreational, commercial, and cultural activities. Option 1 of Concept E would result in moderate to heavy impacts on connectivity of the Study Area's street system and would result in a reduction of parking spaces. Although Option 2 of Concept E would result in the loss of some parking spaces, it would result in little to no impact on connectivity of the Study Area's street system. This concept provides maximum coastal storm surge risk reduction benefits to low-income and minority communities.

Construction, Maintenance, and Operation

Construction of Option 1 of Concept E would not result in the need to relocate major infrastructure and would not require major disruption to business operations and public access during construction. Option 2 of Concept E would result in some disruption to business operations and public access during construction. There is a high probability that Concept E would be construed within the required timeline. The construction of Concept E includes more deployable structures than Concept A and would result in relatively moderate ongoing operations and maintenance costs and moderate potential for human error.

Environmental Impacts

Based on an initial environmental review of the Study Area, Concept E would encounter 30 potentially hazardous waste sites, which is similar to Concepts A and B but considerably greater than Concepts C and D. Wetlands, essential fish habitat, and threatened or endangered species are present within the Study Area and are potentially impacted. Concept E would result in impacts to the Hudson River waterfront and would require a permit from the USACE. There are historic properties/districts within the APE for Concept E that would be impacted and there is a high potential for encountering archaeological resources.

Benefit Cost Analysis

While all of the concepts would result in monetary benefits, due to its moderate relative costs, Concept E was determined to have a higher BCR than Concepts B, C, and D. There is a moderate potential that the BCR for Concept E would be greater than 1.0.

3.4.6 Concept Evaluation Summary

With regard to the overarching goal–flood risk reduction–all concepts performed well. The concepts were similar for most other criteria, but differed substantially with regard to impacts on view corridors, waterfront access, and constructability.

Flood Risk Reduction

Flood risk reduction from coastal storm surge was provided for 86 to 99 percent of Study Area residents within the 100-year floodplain, with Concepts B, C and D performing best. Resist infrastructure in Concepts C and D could also be most easily modified to provide flood risk reduction benefits during a 500-year coastal storm event.

Built Environment / Socioeconomics

There were two criteria on which the public expressed great concern and which reflected substantial differences among concepts. These criteria were view corridors and waterfront access. Concept C, Concept D, and Option 2 of Concept E would block many waterfront views from the Study Area to New York City with many barriers over five feet above ground level in height. Furthermore, Concepts C and D would also result in moderate to high impacts on existing pedestrian access to the waterfront related to the requirement for stairs or ramps to access the waterfront, as well as reduced handicapped accessibility. By comparison, Concepts A and E would maintain or enhance existing pedestrian access to the waterfront. These enhancements would result from creation of additional access opportunities or a shorter distance needed to reach the waterfront. Concept B would result in minimal to moderate impacts on existing pedestrian access to the waterfront.

Construction, Maintenance, and Operations

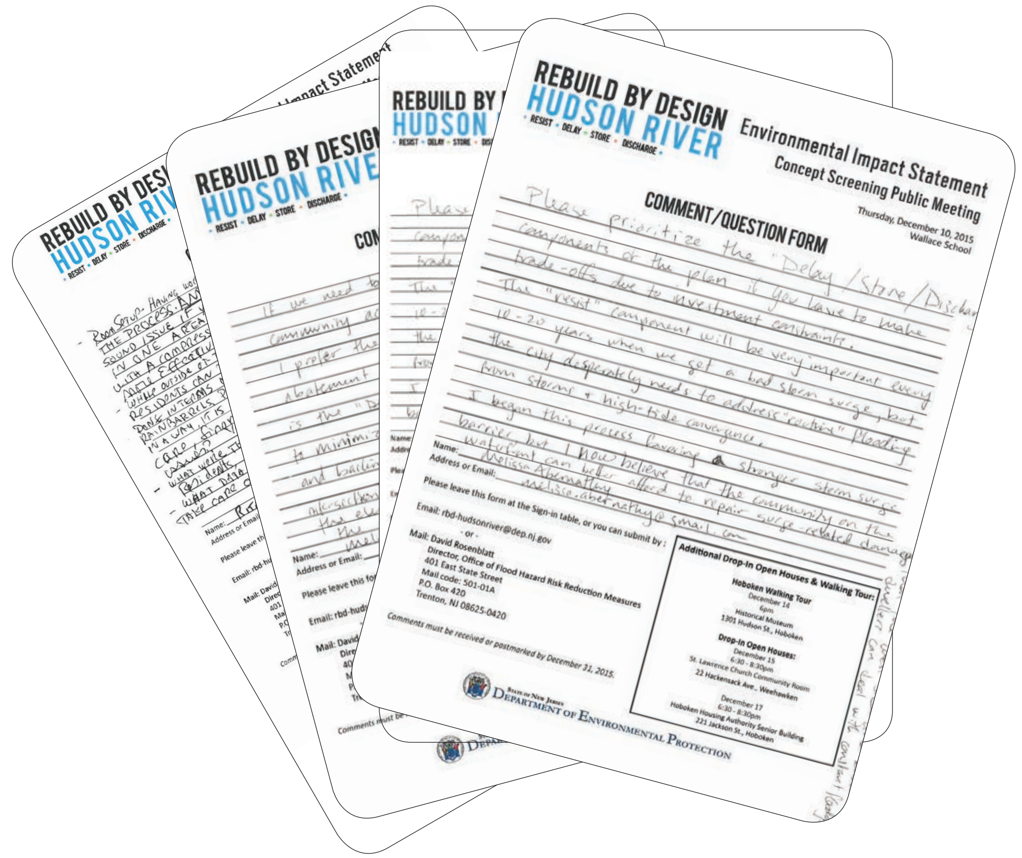
Concepts C and D would require construction methods that were deemed infeasible due to unusual technical complexity and schedule risk. Concept D would require construction of a floodwall traversing the exterior and interior of a historic structure. This would not only represent unusual complexity and risk, it would also require extensive regulatory procedures that could extend beyond the feasible time frame for project implementation and the outcome of which may also render this concept impracticable due to potential significant adverse impacts and adverse effects on cultural resources potentially requiring extensive mitigation measures.

Environmental Impacts

There were no significant differences among the concepts with respect to environmental impacts.

Benefit Cost Analysis

Concepts B, C, and D were all determined to have the lowest BCR. This is the result of high costs associated with very complex and unpredictable construction methods with substantial construction risk.



3.5 Concept Refinement

3.5.1 Concepts A, B, and E

The five concepts and screening criteria were presented to the public in a meeting held on December 10, 2015. This public outreach is described in detail in Section 7. Substantial public feedback was provided on these concepts through the end of the public comment period (December 31, 2015). Over 250 comments were received during the public comment period. Comments were submitted in writing at the December 10, 2015 public meeting, at the three drop-in sessions that were held over the next two weeks, or submitted to the Project's email address. About one-third of the written comments received were from residents of waterfront communities and another third of the comments originated from residents further inland (primarily on Garden Street). Many people expressed disapproval of the Resist component of the Project in Concepts B, C, and D. Specifically, those who reside in the waterfront communities of Maxwell Place and the Hudson Tea Building expressed opposition to a seawall (or any type of Resist structure) because of potential viewshed and waterfront access impacts. Residents expressed great concern over the adverse impacts that a waterfront barrier would have on their quality of life, stating that the waterfront views and waterfront parks are the most cherished aspect of Hoboken. Some of these residents also noted that they did not experience significant flooding during Superstorm Sandy.

Residents of northern Hoboken, particularly along Garden Street and Bloomfield Street, also voiced strong opposition to Concept A and were concerned that the Resist component would bisect the community and cause conflict between neighbors. They also expressed concern that implementation of Concept A would lower their property values. The public also expressed concern regarding the waterfront Resist barriers in Concept B. The primary concerns expressed were impacts on the viewshed of New York City and waterfront access.

Residents expressed great concern over the adverse impacts that a waterfront barrier would have on their quality of life, stating that the waterfront views and waterfront parks are the most cherished aspect of Hoboken.

Based on the concerns expressed during the public comment period on the five concepts and coordination with project stakeholders, including the City of Hoboken, additional variations were developed for the northern alignments of Concepts A and E. These new variations were reviewed in the field and discussed with key stakeholders and were evaluated against each other and the original Concept A and Concept E. Based on this process, it was determined that Concept A would be modified to extend from Garden Street to Washington Street through an existing privately owned alleyway that runs east to west behind the buildings fronting the north side of 14th Street, Concept E would be modified to extend from 15th Street to Washington Street. Although the alleyway alignment in modified Concept A would require an agreement for the utilization of privately owned land, the alignment provides reduced interference with residential and commercial activities in the area by locating the structure in the alleyway, which is out of the way of more heavily trafficked and highly visible streets and sidewalks. Bringing Resist structures to Washington Street potentially expands the area receiving flood risk reduction benefits, while keeping the number of deployable structures to a relatively reasonable level. In addition, the commercial nature of Washington Street provides the greatest opportunity for Resist structures to enhance the urban environment and the least impact on traffic and circulation due to the width of the street.

3.5.2 Concepts Eliminated From Further Consideration

The concept screening and public input process resulted in the elimination of two concepts from further consideration. The elimination of the two concepts was based primarily on constructability issues associated with schedule, technical feasibility, and public feedback. A summary is provided below of the general considerations that led to the elimination of these two concepts.

Concept C

Concept C involved in-water Resist structures at Weehawken Cove and in the vicinity of the Hoboken Terminal. These in-water structures were proposed for the two key locations where the Superstorm Sandy storm surge entered the Study Area. However, while these in-water structures would provide optimal siting from a flood risk reduction perspective, they also created substantial concerns regarding:

> *The concept screening and public input process resulted in the elimination of two concepts from further consideration.*

(1) Substantial exceedance of the statutory Project implementation time limits as a result of regulatory complexity associated with an Individual Section 404 permit and a Section 10 Rivers and Harbors Act permit for a structure within a navigable river

(2) The substantial annual cost arising from maintenance of in-water structures, which is not federally funded, and technical challenges associated with the maintenance of in-water structures.

All maintenance and inspection of in-water structures would have to be done from watercraft or by divers, which requires specialized equipment and personnel above that of a standard city maintenance crew. Larger-scale maintenance of in-water structures or repairs of significant damage after large storm events could possibly require working dry, which means construction of coffer dams would be required. As a comparison, maintenance and inspection of landside structures would require a lower level of skill and training would be less costly.

Based on these considerations and the substantial public concern expressed during the public comment period regarding Concept C's impacts to viewsheds and waterfront access, Concept C was eliminated from evaluation in the DEIS.

Concept D

Concept D consisted of upland and waterfront alignments with a Resist alignment proposed through the Hoboken Terminal. While it was recognized from the outset that construction in an active terminal would be challenging, the benefits of providing some level of flood risk reduction to the historically significant terminal, as well as the siting of a Resist structure in a location highly vulnerable to coastal storm surge, led to the determination that this Resist location should be considered.

The Hoboken Terminal is built on a pile-supported deck that extends outward from the train shed and boarding platforms (see **Photograph 3.2**). The train tracks are immediately west on solid ground that is retained by a porous wood crib bulkhead just west of the terminal deck. Tidal waters of the Hudson River ebb and flow daily beneath the floor of the terminal. In order to protect portions of the Hoboken Terminal from coastal storm surge, it is critical to first prevent the under-seepage from below the terminal and then place a barrier through the terminal itself to prevent overland flow of coastal storm surge water. Based on the condition of the terminal, this would represent a significant engineering challenge. In addition, through discussion with NJ TRANSIT, it was determined that construction within an active terminal would represent significant circulation impacts for passengers.

For these reasons, as well as the significant public concern expressed during the public comment period regarding Concept D's impacts to viewsheds and waterfront access, Concept D was eliminated from evaluation in the DEIS.

Photograph 3.2 Hoboken Terminal, wood-crib bulkhead

3.5.3 DSD Components Eliminated from Further Consideration

The community provided feedback that Columbus Park and the two recreational fields–JFK stadium and Mama Johnson Field–are actively used by the community and would have significant impact on their quality of life if these public amenities were not available due to construction. Additionally, qualitative assessment based on the drainage patterns and the NHSA storm sewer system around these sites showed no potential to capture an adequate amount of rainfall runoff from areas beyond the footprint of these sites. Therefore, the DSD strategy was refined by removing these three parcel based sites.

3.6 Three Build Alternatives

Three of the five design concepts progressed to the next step in the process, which was to further develop and fine tune the concepts into Build Alternatives. These three Build Alternatives underwent additional analysis (see Section 6), which was based on a modification of the original screening criteria.

All Resist structure heights described in this section are approximate. Structure heights will be finalized as part of the Project's final design process.

ALT-1 **Alternative 1**

Resist Alignment

Alternative 1 (which was developed from the earlier Concept B and components of the southern alignment of Concept E) provides coastal flood risk reduction to approximately 98 percent of the population within the Study Area 100-year floodplain. **Figures 3.34 through 3.38** are representative of Alternative 1. Alternative 1, including Resist and DSD, is shown on **Figure 3.37**.

Alternative 1 provides the greatest level of flood risk reduction by locating the Resist structures primarily along the waterfront. This alternative's Resist structure generally follows the waterfront from the Lincoln Tunnel in Weehawken south to Weehawken Cove, where it is envisioned that a boathouse would be incorporated into the structure. The Resist structure at Lincoln Harbor ranges from 7.5 to 15.5 feet above ground level (note that all references to Resist infrastructure height are in relation to height above ground level) and nine feet along the Cove. Urban placemaking amenities under consideration in this area include a new Lincoln Harbor ferry stop (see **Figure 3.34**) and an improved park space along the north of Weehawken Cove (in the area of the existing park adjacent to Harbor Boulevard). A bermed and terraced Cove Park would be incorporated into the southwest corner of Weehawken Cove (see **Figure 3.35**). This would include existing undeveloped land, as well as the currently-developed Cove Park (adjacent to Harborside Lofts at 1500 Garden Street). Amenities at this park may include playgrounds, lawn areas, game courts, and a viewing deck overlooking Weehawken Cove (see **Figure 3.36**).

The alignment continues around the waterside of the

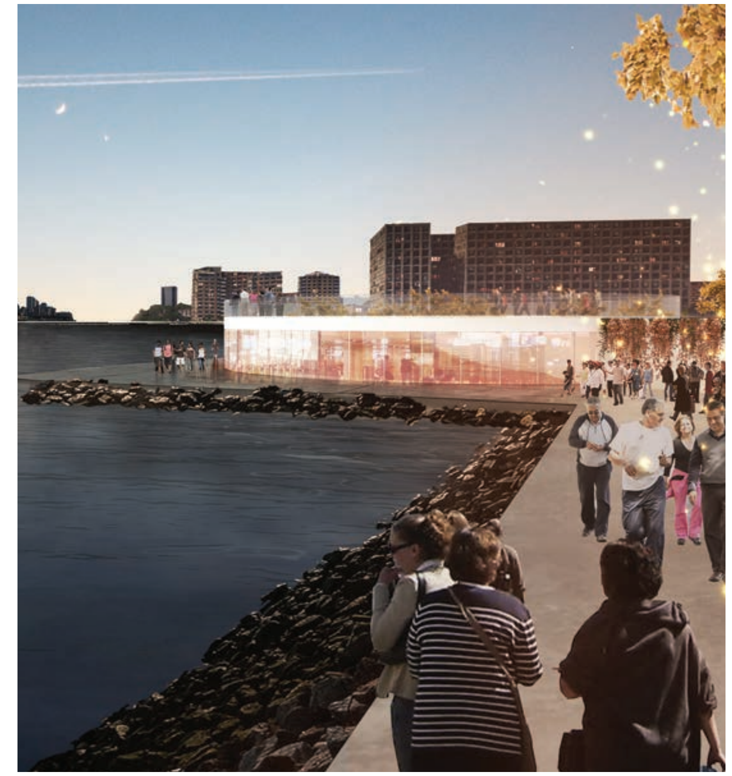


Figure 3.34 Potential Lincoln Harbor Ferry Stop

Figure 3.35 Cove Park

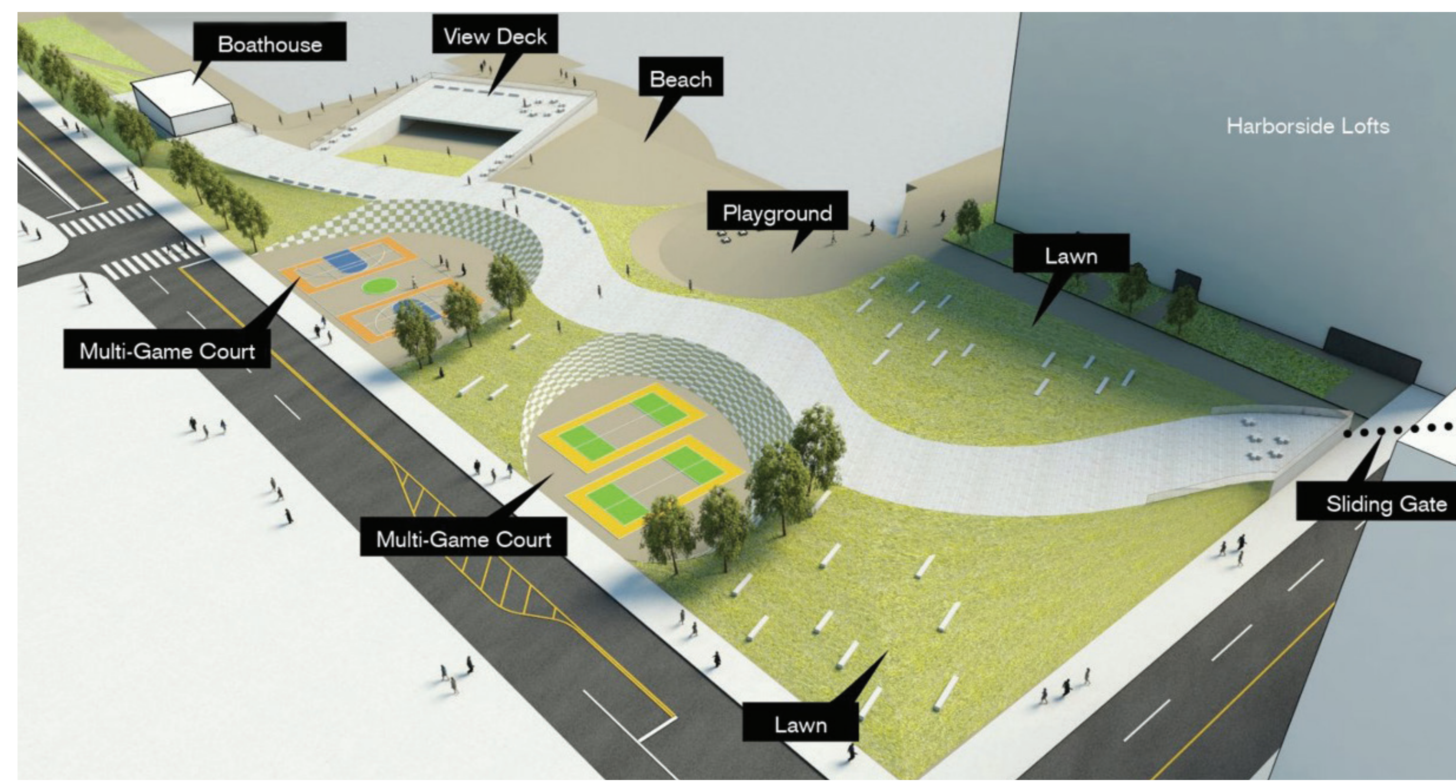


Figure 3.36 Potential Amenities at Cove Park

Figure 3.37 Alternative 1

Hudson Tea Building, at a height of between nine and 12.5 feet, and heads south in front of Maxwell Place at about nine feet in height. The Resist structure continues south along the waterfront to the intersection of Sinatra Drive North and Frank Sinatra Drive, just south of Maxwell Place Park where the ground elevation begins to rise and the wall tapers down to meet it at a height of one foot. There would be a series of gates along the waterfront to allow access onto piers and across road intersections during non-flood conditions. Possible designs for the Resist structure in this area include an elevated promenade north of the Tea Building, raised terraced parks adjacent to Shipyard Park, and bermed/terraced park areas at the location of the existing Maxwell Place Park (see **Figure 3.38**).

The Resist structure also has a component along Sinatra Drive from 4th Street to 1st Street in South Hoboken, where the design may consist of an elevated walkway and park space (up to between 2.5 feet and one foot in height along Sinatra Drive) that ties into a deployable system running east to west on 1st Street (up to 7.5 feet high). In the southern portion of the Study Area, two options will be analyzed: Option 1 features an alignment south of Observer Highway, within the rail yard (south of the proposed Hoboken Yard Redevelopment Area) at approximately five to 11 feet in height. Option 2 includes an alignment along Observer Highway from Washington Street to Marin Boulevard, on an alignment that runs behind NJ TRANSIT offices at a height of about 11 feet. The alignment includes gates for access at various

Figure 3.38 Maxwell Place Park, bermed terraced area

locations including the Marin Boulevard, Grove Street, and Newark Avenue underpasses beneath the rail lines, as well as protection where HBLR tracks pass below the NJ TRANSIT overpass in the southwest corner of the Study Area. Urban amenities in these areas include lighting, murals, seating, plantings, and wayfinding/signage (See **Figure 3.39**). Sheeting would also be installed along the NJ TRANSIT railroad embankment.

Delay, Store, Discharge

The DSD elements of the Project consist of three large stormwater detention facilities (the BASF/Northwest Resiliency Park, NJ TRANSIT and Block 10 sites) and approximately 61 small tank sites (ROW sites) (see **Figure 3.40**) that would include new and/or improved stormwater management techniques designed to

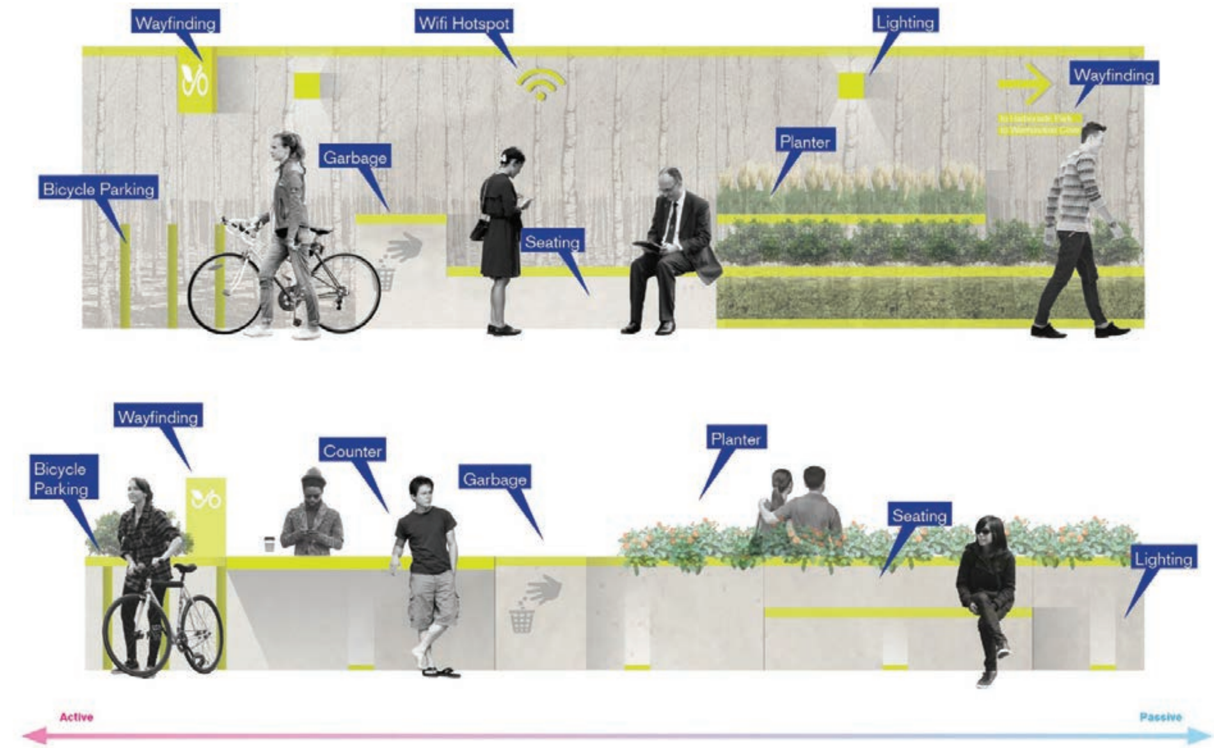


Figure 3.39 Toolkit Amenities

complement other efforts by the City of Hoboken as part of the Green Infrastructure Strategic Plan and multiple redevelopment plans (discussed further under Land Use in Section 4.8). Details on individual sites and specific plans have been developed as part of the feasibility design. The 61 small ROW sites would each hold between 1,500 and 7,000 gallons (depending on design) for a total of approximately 220,000 gallons in capacity.

The text that follows describes the major components that comprise the large DSD sites. The location of the proposed facilities are based on studies of the existing flooding “hotspots” in Hoboken. Additionally, two new outfalls are proposed associated with the DSD sites.

Figure 3.40 ROW Site - typical small tank

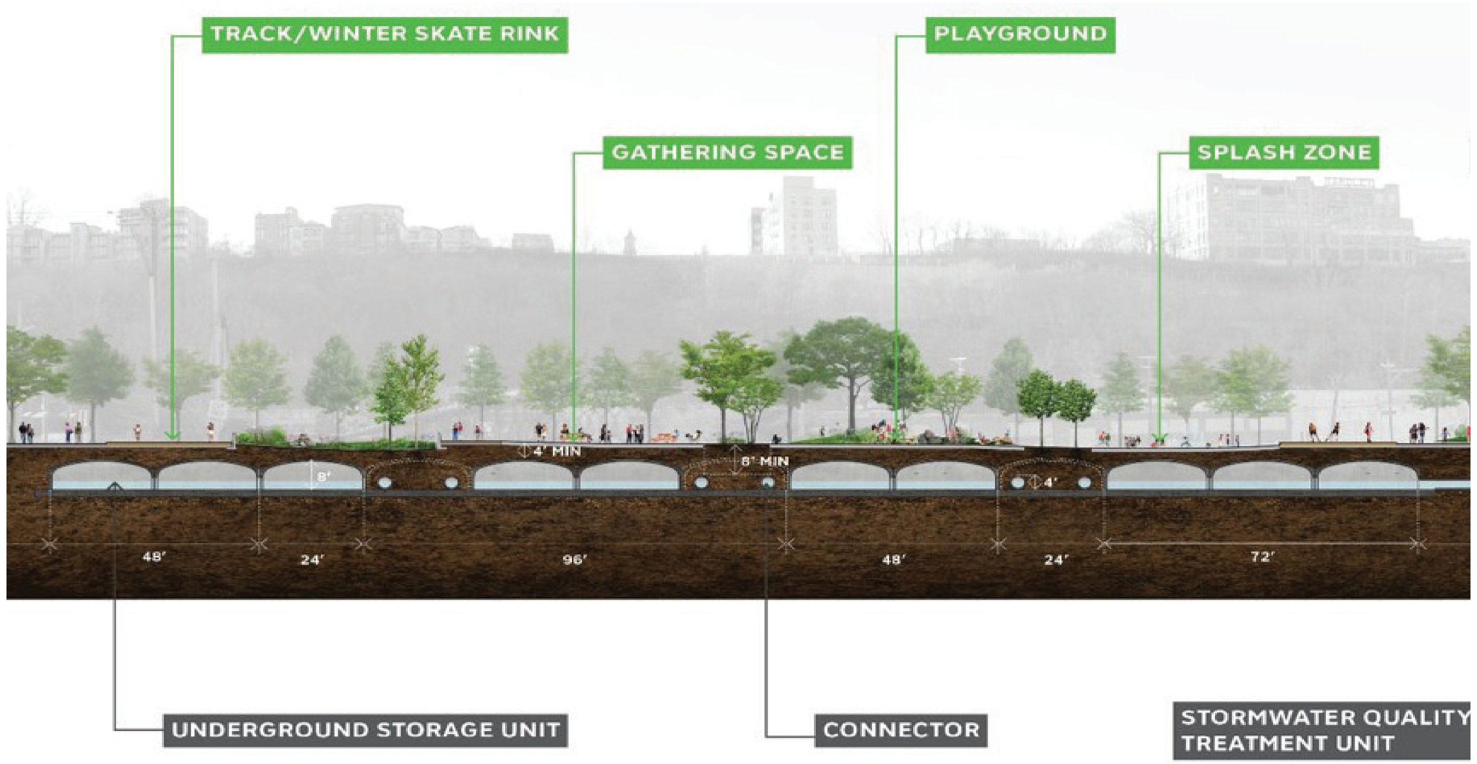


Figure 3.41 BASF - Underground Storage Tanks

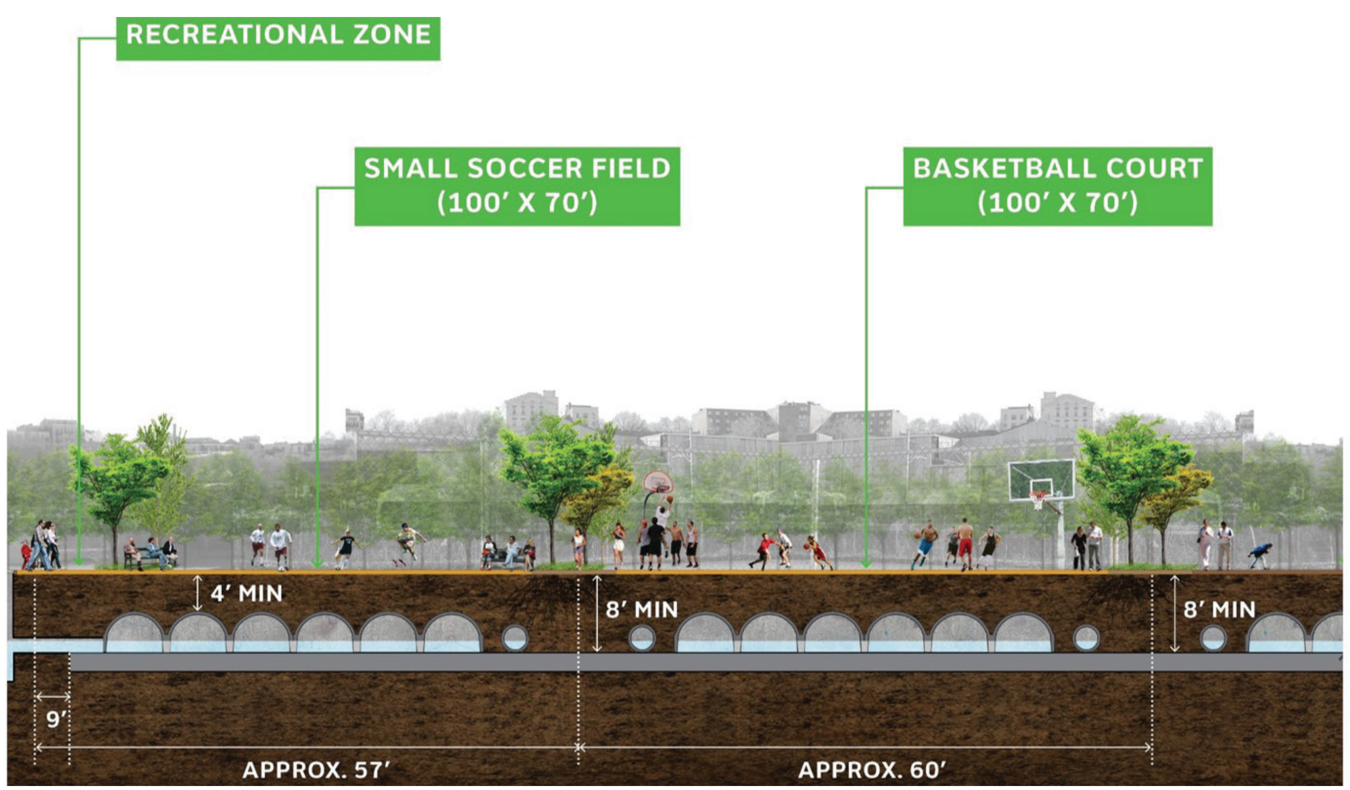


Figure 3.42 Block 10 Site - Underground Storage Tanks

BASF Site: The northwest corner of Hoboken south from the NHSA Treatment Plan is a natural topographical low point and catchment area where collection and delay/storage of stormwater can be enhanced by the development of the Northwest Park (BASF Property). The BASF/Northwest Park tank site has capacity for approximately 5.8 million gallons of stormwater. The 4.3-acre property is currently being acquired by the City of Hoboken and includes the property at Block 107, Lot 1. Block 107, Lot 1 was assessed for the stormwater retention facility and proposed urban amenities in this EIS. The City conducted an Environmental Assessment for the acquisition of this property (see Attachment #9), which also included Block 103, Lot 7. The site, which is currently paved and impermeable, is planned for conversion to green park space with an underground stormwater storage/holding tank. A new pump and outfall would be linked to this facility to provide a discharge from the overall catchment area. Amenities under consideration for this park follow three themes: destination, recreational, and ecological. A destination park provides trails and urban landscape features, a recreational park provides developed recreational uses such as ball fields and skateboard areas, and an ecological park provides an opportunity for the public to engage with native vegetation and wildlife. For a cross-section of the tank system, see **Figure 3.41**.

NJ TRANSIT Site: The area surrounded by the HHA at Jackson and Harrison Streets from 2nd Street to 6th Street also serves as a natural low-lying catchment area. A high level storm sewer collection system would be added in this 17-acre development to support the discharge component of the site and direct the stormwater overflow towards the west. On the west side of this neighborhood, a stormwater tank would be incorporated along the light rail line to provide storage of the water drained from the HHA area. The tank for the NJ TRANSIT site would have a capacity of approximately 1.4 million gallons of stormwater. A pump station would be incorporated to discharge overflows from the stormwater tank into the existing ditch located at the west side of the NJ TRANSIT Light Rail. NJ TRANSIT ditch currently conveys runoff from the Light Rail property and the Palisades Hill slope to an existing discharge at the Hudson River. Urban amenities under consideration include active and passive recreational options such as playgrounds, green space, and planted areas.

Block 10 Site: The site is located in the southwestern corner of Hoboken adjacent to Academy Bus facility and south of Paterson Avenue. Portions of this currently-paved parcel would be converted to a permeable park space allowing water to infiltrate into the ground. The tank for the Block 10 site would have a capacity of approximately 0.6 million gallons of stormwater. A high level storm sewer collection system would be added to this eight-acre watershed and stormwater runoff would be conveyed to a proposed underground detention facility, where peak flows would be controlled and delayed before discharging into the existing NHSA combined sewer. Urban amenities under consideration include active and passive recreational options such as playgrounds,

Table 3.3 Alternative 1 Construction Costs

	ESTIMATED COST (MILLIONS)
Estimated Resist Cost	$433.1 to $485.5
Estimated Resist Contingency Cost	$98.4 to $111.6
Estimated Total Resist Cost	$531.5 to $597.1
Estimated DSD Cost	$126.4 and $148

Source: Dewberry, 2015-2017

green space, and game courts. The City of Hoboken is looking to acquire the property. For a cross section of the tank system, see **Figure 3.42**.

Pump Stations: Three pump stations would be required as part of the discharge component. One pump station is proposed to discharge the overflow from the proposed NJ TRANSIT site detention facility. A force main from the pump station would cross under the HBLR and discharge to the existing ditch located at the west side of the HBLR tracks. A second pump station is required to discharge overflows from the BASF site detention tank. A 2,700-foot-long force main would convey the runoff to a new discharge proposed at Weehawken Cove. A third pump station is proposed to the north of Clinton Street (north end of the existing NJ TRANSIT ditch) in the vicinity of the NHSA treatment plant. The purpose of the Clinton Street pump station is to release flows from the ditch to compensate the additional flow discharged from the NJ TRANSIT site and to prevent surcharge of the existing ditch during backflow conditions. A 720-foot-long force main would convey the runoff to a new discharge proposed at Weehawken Cove.

Two new outfall pipes in northern Weehawken Cove are proposed as the discharge component of DSD. One outfall would drain the flow of the existing ditch running along the western side of the HBLR line. This outfall is proposed to be located in the northern part of the Cove near Lincoln Harbor. The second outfall is proposed to be located north of Cove Park to drain the BASF site's catchment area via force main discharge.

Construction and Implementation

Construction for Resist infrastructure of this alternative would last approximately 44 months and need to be completed by September 2022. The construction would occur concurrently for the northern and southern Resist features. Equipment required for this project includes: dump trucks, back hoes, pile drivers, concrete trucks, and other assorted delivery trucks. Some street closures would be required, in particular for gate construction. A total of 8,000-9,000 crew days would be required to complete this construction.

Recognizing funding limitations, the DSD portion under Alternative 1 is anticipated to be constructed over the next 15 to 20 years. DSD represents the framework for a future stormwater strategy that would need to be implemented by the City of Hoboken and other partners and can be integrated into the city's existing plans. During this period, adaptive management techniques would be used to provide effective implementation and allow for improvements and/or modifications based on lessons learned while implementing the DSD components.

Due to the Project being in the early stages of planning and design, there are many unknown variables. Modifications to design may arise from obtaining more accurate existing information or other unforeseen deviations from the feasibility study brought by outside sources, such as more accurate information regarding location of utilities. As a result, the contingency is approximately 25 percent of the construction and engineering cost.

The construction and final design costs of Resist and DSD are estimated in **Table 3.3**

These amounts are estimates of the cost to construct Resist and DSD, as well as estimated cost factors for construction, engineering project contingencies.

ALT-2 **Alternative 2**

Resist Alignment

Alternative 2 was developed from the earlier Concept E with two modifications. First, the northern Hoboken portion of the alignment along the Tea Building waterfront walkway was moved to 15th Street (south of the Tea Building) to maintain a distinction from Alternative 1. Second, because of the length and height of the structures required along Hudson Street or Shipyard Lane, as well as the significant number

Figure 3.43 Resist Structure along 15th Street and Washington Street

Figure 3.44 Cove Park, southwest corner of Weehawken Cove

Figure 3.45 Alternative 2

of gates required for each, the alignment was moved to Washington Street. Washington Street was chosen due to the width of the street to accommodate the necessary structure and potential to blend structural amenities into the commercial nature of the area. This alternative provides coastal flood risk reduction to approximately 86 percent of the population residing within the Study Area 100-year floodplain. **Figures 3.43 through 3.49** are representative of Alternative 2. Alternative 2, including Resist and DSD, is shown on **Figure 3.45**.

This alternative's Resist structure begins near the HBLR Lincoln Harbor station at Waterfront Terrace at an initial height of about 6.5 feet, traveling south towards Harbor Boulevard at a height of between 9.5 to 11.5 feet. Opportunities for urban enhancement in the northern portion of the Study Area under Alternative 2 are limited due to siting conditions and include lighting, murals, and seating. The Resist features then run south along Weehawken Cove at nine feet, where it is envisioned that a boathouse would be incorporated into the structure. In addition, a bermed and terraced Cove Park would be incorporated into the southwest corner of Weehawken Cove. This would include existing undeveloped land, as well as the currently-developed Cove Park (adjacent to Harborside Lofts at 1500 Garden Street). Potential amenities at this park may include playgrounds, lawn areas, game courts, and a viewing deck overlooking Weehawken Cove (see **Figures 3.43 and 3.44**).

The structure continues to 15th Street and travels east along 15th Street from the northern end of Garden to Washington Streets, where it would be about seven to eight feet high. Urban amenities in this area may include a bermed park along 15th Street in front of the Tea Building. The Resist feature then continues south along Washington Street, tapering to grade level at 13th Street. Street crossings would feature gates to allow for access during non-flood conditions. Consideration would be given to adapting the use of structures in a way that provides urban amenities and landscape enhancements including elevated walkways and pocket parks, plantings, and/or seating areas along Washington Street (see **Figure 3.46**).

There are two options in the south along the Hoboken Terminal rail yard: Option 1 would feature an alignment south of Observer Highway, within the rail yard (south of the proposed Hoboken Yard Redevelopment Area) at approximately five to 11 feet in height (see **Figure 3.47**). Option 2 would include an alignment along Observer Highway from Washington Street directly to Marin Boulevard. The alignment includes gates for access at various locations including the Marin Boulevard, Grove Street, and Newark Avenue underpasses beneath the rail lines, as well as protection where HBLR tracks pass below the NJ TRANSIT overpass in the southwest corner of the Study Area. Urban amenities in these areas include lighting, murals, seating, plantings, and wayfinding/signage (see **Figures 3.48 and 3.49**). Steel Sheeting would also be installed along the NJ TRANSIT railroad embankment.

Figure 3.46 Potential amenities along Washington Street

Figure 3.47 Options 1 & 2 along Hoboken Terminal Yard

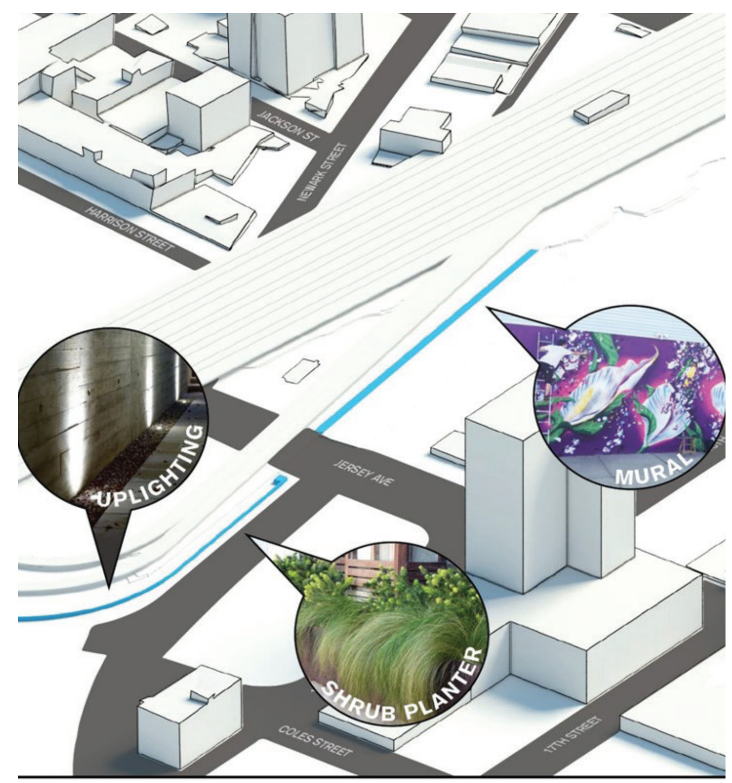


Figure 3.48 Alternative 2 - urban amenities along NJ TRANSIT railroad embankment.

Figure 3.49 Alternative 2 - alignment along HBLR tracks

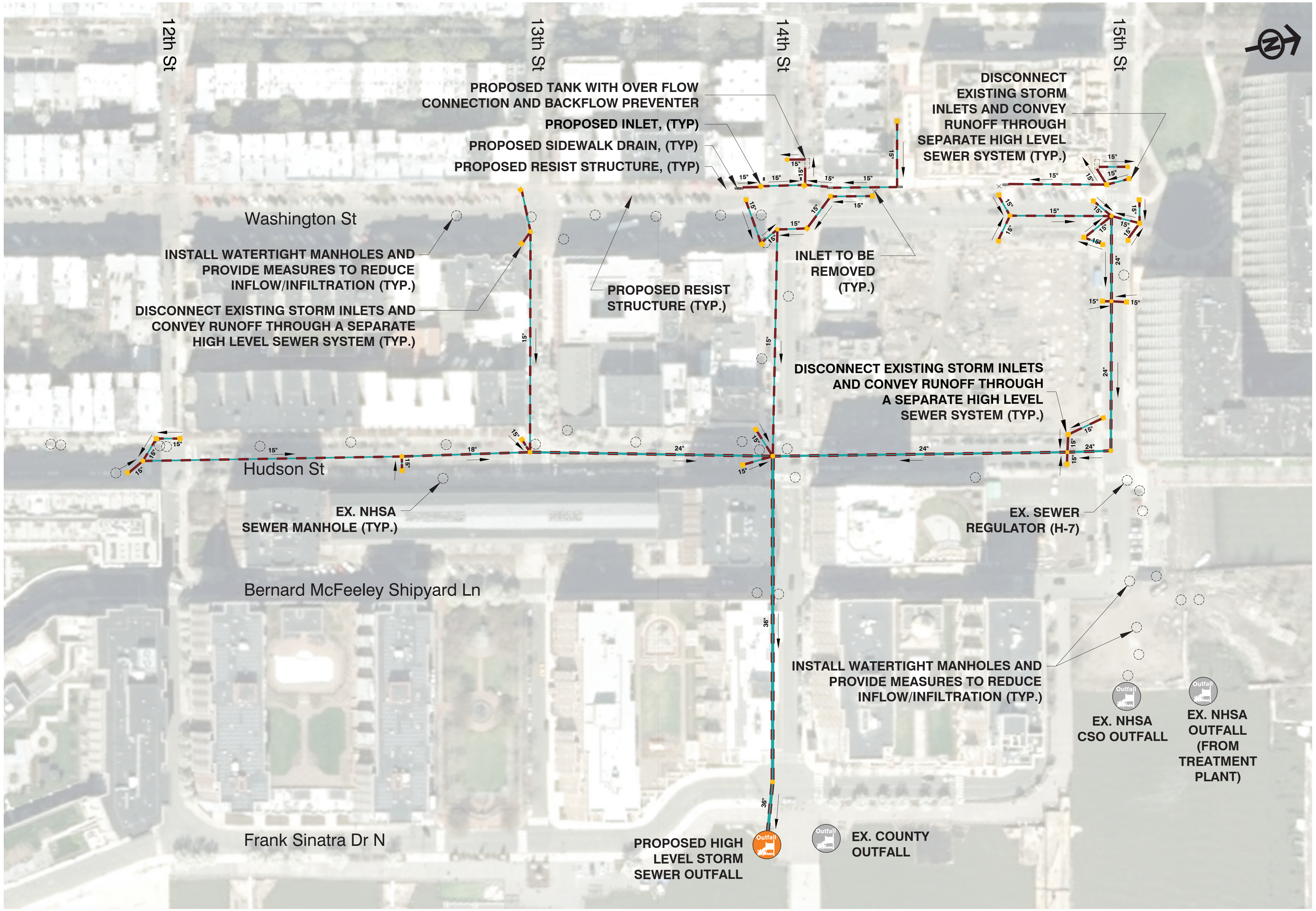


Figure 3.50 High Level Storm Sewer System, northern portion

During a coastal storm surge event, water from the Hudson River is expected to inundate unprotected areas of the Hoboken waterfront. If the river water overtops the waterfront bulkhead during a storm event, water can enter into the storm sewer system through existing inlets and unsealed manhole covers. While Alternative 1 would prevent a storm surge from entering the city streets, Alternative 2 leaves portions of the city streets and sewer system unprotected. To prevent water intrusion into the existing sewers under Alternative 2, a separation of the sanitary/storm water collection system is proposed by the construction of a high level storm sewer collection system. In addition to the installation of this new storm sewer system, the existing NHSA combined sewer inlets and manholes would be sealed and lined. This proposed drainage would be designed to prevent additional sewer backflow that could cause major flooding issues within the Alternative 2 protected areas during a storm surge event. Stormwater collected in this high level storm sewer system would gravity flow into the Hudson River (see **Figures 3.50 and 3.51**).

Delay, Store, Discharge

See above description under Alternative 1.

Construction and Implementation

Construction for Resist infrastructure under this alternative would last approximately 44 months and need to be completed by September 2022. The construction would occur concurrently for the northern and southern Resist features. Equipment required for this project includes dump trucks, back hoes, pile

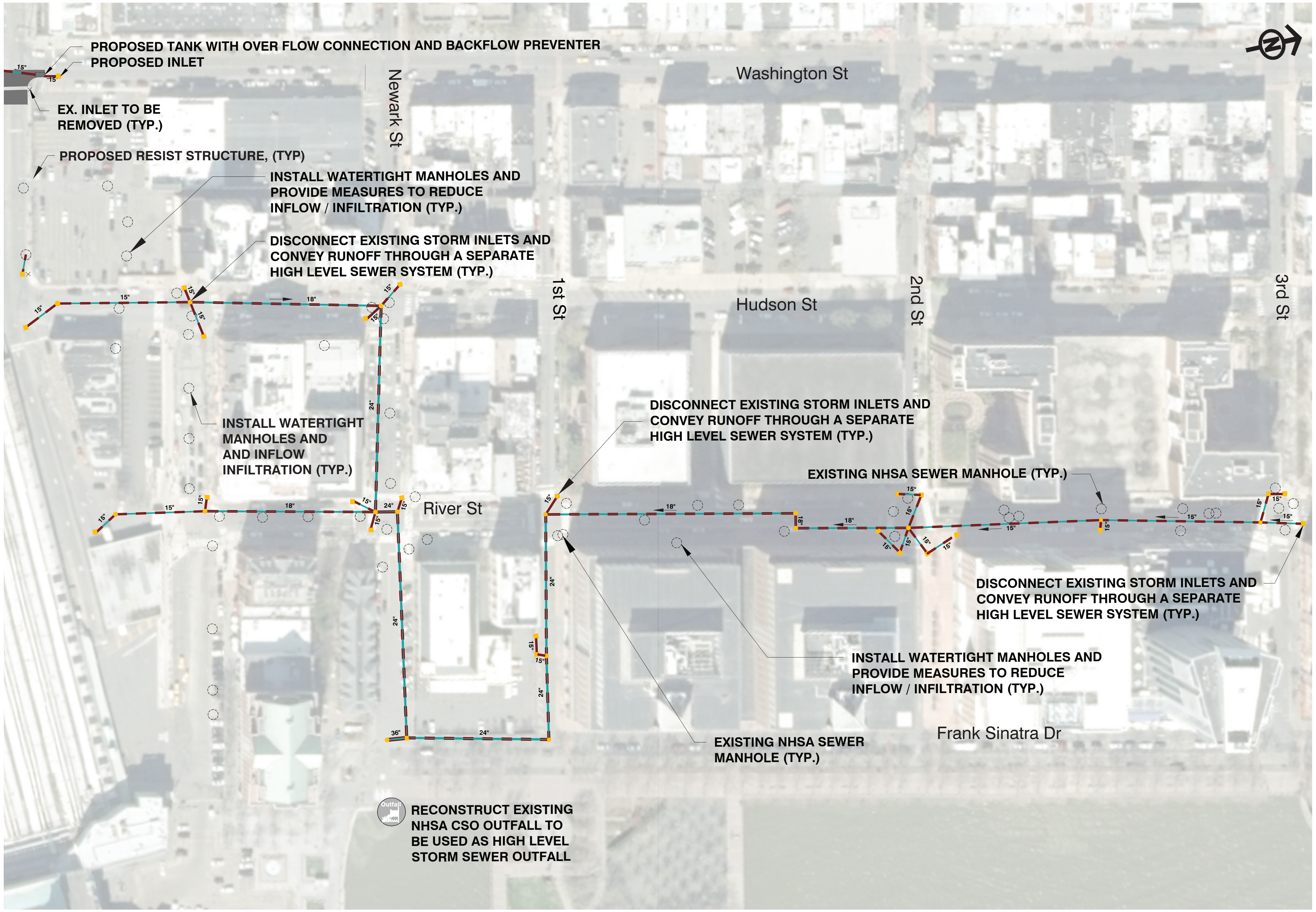


Figure 3.51 High Level Storm Sewer System, southern portion

drivers, concrete trucks, and other assorted delivery trucks. Some street closures would be required, particularly for gate construction. A total of 6,000-7,000 crew days would be required to complete this construction.

Recognizing funding limitations, the DSD portion under Alternative 2 is anticipated to be constructed over the next 15 to 20 years. DSD represents the framework for a future stormwater strategy that would need to be implemented by the City of Hoboken and other partners and can be integrated into the city's existing plans. During this period, adaptive management techniques would be used to provide for effective implementation and allow for improvements and/or modifications based on lessons learned while implementing the DSD components.

Due to the Project being in the early stages of planning and design, there are many unknown variables. Modifications to the design may arise from obtaining more accurate existing information or other unforeseen deviations from the feasibility study by outside sources (such as more accurate information regarding location of utilities). As a result, the contingency is approximately 25 percent of the construction and engineering cost.

The construction and final design costs of Resist and DSD are estimated in **Table 3.4.**

These amounts are estimates of the cost to construct Resist and DSD, as well as estimated cost factors for construction and engineering project contingencies.

Table 3.4 Alternative 2 Construction Costs

	ESTIMATED COST (MILLIONS)
Estimated Resist Cost	$193.8 to $224.7
Estimated Resist Contingency Cost	$44.4 to $52.2
Estimated Total Resist Cost	$238.2 and $276.9
Estimated DSD Cost	$126.4 and $148

Source: Dewberry, 2015-2017

ALT-3 **Alternative 3**

Resist Alignment

Alternative 3 was developed from the earlier Concept A, which was revised to relocate portions of the Resist alignment to areas that would minimize impacts on the community. The alternative utilizes a private alleyway that parallels 14th Street to extend to Washington Street to meet the same flood resist goals. Washington Street was again chosen due to the width of the street to accommodate the necessary structure and potential to blend structural amenities into the commercial nature of the area. This alternative provides coastal flood risk reduction to approximately 85 percent of the population residing within the Study Area 100-year floodplain. **Figures 3.52 through 3.56** are representative of Alternative 3.

This alternative's Resist structure begins at 6.5 feet in height near the HBLR Lincoln Harbor station at Waterfront Terrace, traveling south along HBLR rising to about 11 feet in height and then continuing south along Weehawken Cove (nine feet high) towards Garden Street at nine feet in height. Opportunities for urban enhancement in the northern portion of the Study Area under Alternative 3 are limited due to siting conditions and include lighting, murals, and seating. It is envisioned that a boathouse would be incorporated into the structure. In addition, a bermed and terraced Cove Park would be incorporated into the southwest corner of the Weehawken Cove. This would include existing undeveloped land, as well as the currently-developed Cove Park (adjacent to Harborside Lofts at 1500 Garden Street). Potential amenities at this park may include playgrounds, lawn areas, game courts, and a viewing deck overlooking Weehawken Cove.

A structure would travel down the east side of Garden Street adjacent to the west of the Hudson Tea Parking Garage, starting at eight feet in height and tapering down to five feet in height. The structure along Garden Street may consist of an elevated planter with seating. The structure would then continue down the alleyway midway between 15th and 14th Streets from Garden to Washington Streets at four feet in height (see **Figure 3.52**). Urban amenities within the alleyway could include planters (see **Figure 3.53** and **3.54**). The structure would then travel south along Washington Street at 3.5 feet in height, tapering down to grade level at 13th Street. Street crossings would

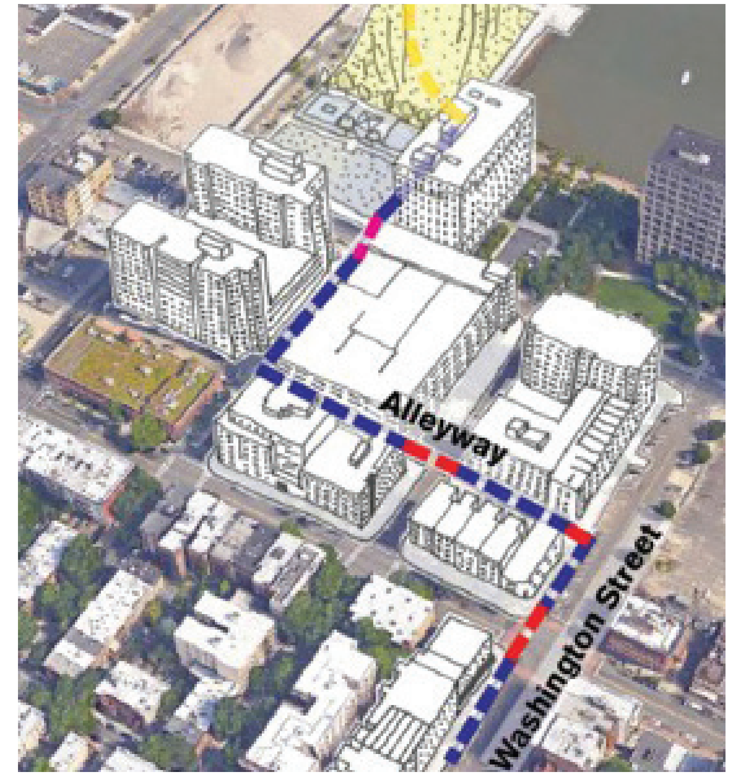


Figure 3.52 Alternative 3 along the alleyway to Washington Street

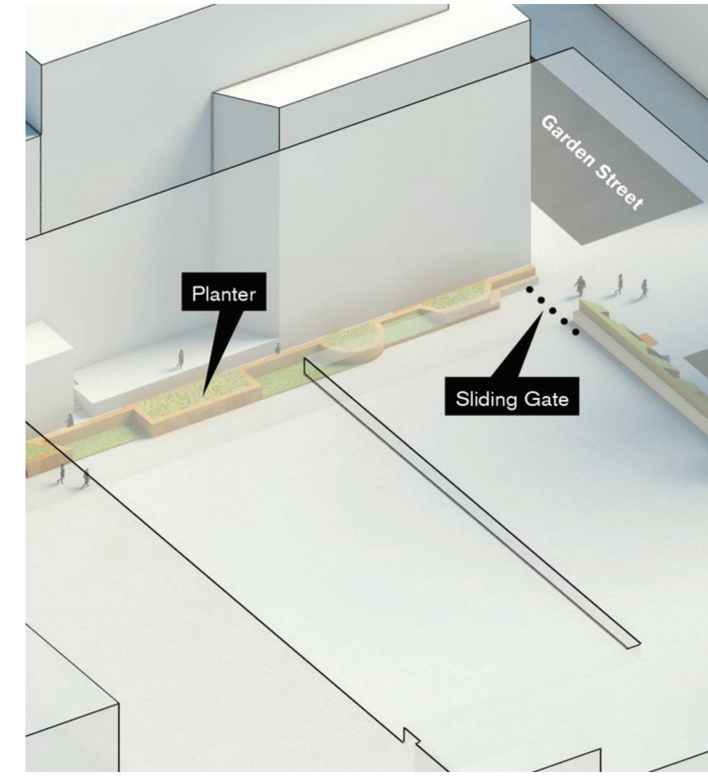


Figure 3.53 Urban amenities within the alleyway

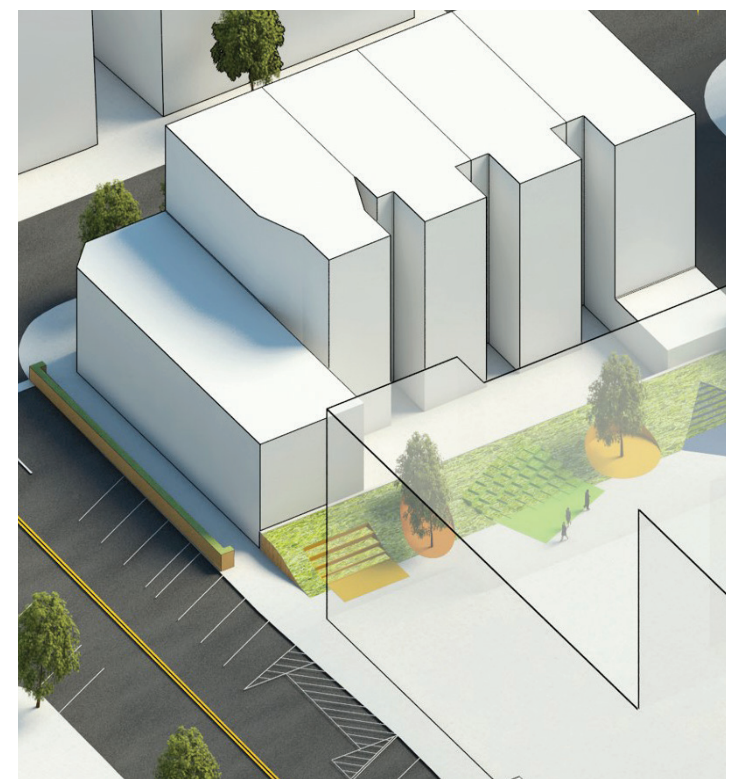


Figure 3.54 Urban amenities within the alleyway

Figure 3.55 Alternative 3 urban amenities

Figure 3.56 Alternative 3

Table 3.5 Alternative 3 Construction Costs

	ESTIMATED COST (MILLIONS)
Estimated Resist Cost	$185.4 to $220.6
Estimated Resist Contingency Cost	$39.1 to $47.9
Estimated Total Resist Cost	$224.5 and $268.5
Estimated DSD Cost	$126.4 and $148

Source: Dewberry, 2015-2017

feature gates to allow for access during non-flood conditions. Consideration would be given to adapting the use of structures to provide urban amenities such as seating and landscape enhancements (see **Figure 3.55**).

There are two options: Option 1 would include an alignment south of Observer Highway in the rail yard (south of the proposed Hoboken Yard Redevelopment Area) at approximately five to 11 feet in height. Option 2 would feature an alignment along Observer Highway from Washington Street directly to Marin Boulevard. The alignment includes gates for access at various locations including at the Marin Boulevard, Grove Street, and Newark Avenue underpasses beneath the rail lines, as well as protection where HBLR tracks pass below the NJ TRANSIT overpass in the southwest corner of the Study Area. Urban amenities in these areas include lighting, murals, seating, plantings, and wayfinding/signage. Sheeting would also be installed along the NJ TRANSIT railroad embankment.

During a coastal storm surge event, water from the Hudson River is expected to inundate unprotected areas of the Hoboken waterfront. If the river water overtops the waterfront bulkhead during a storm event, water can enter into the storm sewer system through existing inlets and unsealed manhole covers. While Alternative 1 would prevent a storm surge from entering the city streets, Alternative 3 leaves portions of the city streets and sewer system unprotected. To prevent water intrusion into the existing sewers under Alternative 3, a separation of the sanitary/stormwater collection system is proposed by the construction of a high level storm sewer collection system. In addition to the installation of this new storm sewer system, the existing NHSA combined sewer inlets and manholes would be sealed and lined. This proposed drainage would be designed to prevent additional sewer backflow that could cause major flooding issues within the Alternative 3 protected areas during a storm surge event. Stormwater collected in this high level storm sewer system would gravity flow into the Hudson River (see **Figure 3.50 and 3.51**).

Delay, Store, Discharge

See above description under Alternative 1.

Construction and Implementation

Construction for Resist infrastructure in Alternative 3 would last approximately 44 months and need to be completed by September 2022. The construction would occur concurrently for the northern and southern Resist features. Equipment required for this project includes dump trucks, back hoes, pile drivers, concrete trucks, and other assorted delivery trucks. Some street closures would be required, particularly for gate construction. A total of 6,000 crew days would be required to complete this construction.

Recognizing funding limitations, the DSD portion under Alternative 3 is anticipated to be constructed over the next 15 to 20 years. DSD represent the framework for a future stormwater strategy that would need to be implemented by the City of Hoboken and other partners and can be integrated into the city's existing plans. During this period, adaptive management techniques would be used to provide for effective implementation and allow for improvements and/or modifications based on lessons learned while implementing the DSD components.

Due to the Project being in the early stages of planning and design, there are many unknown variables. Modifications to the design may arise from obtaining more accurate existing information or other unforeseen deviations from the feasibility study brought by outside sources (such as more accurate information regarding location of utilities). As a result, the contingency is approximately 25 percent of the construction and engineering cost.

The construction and final design costs of Resist and DSD for Alternative 3 are estimated in **Table 3.5**. These amounts are estimates of the cost to construct Resist and DSD, as well as estimated cost factors for construction and engineering project contingencies. Alternative 3, including Resist and DSD is shown in **Figure 3.56**.

3.7 No Action Alternative

The No Action Alternative provides a baseline condition that allows a comparison between proposed actions and the act of doing nothing. Under this alternative, no Resist structure would be constructed. While the City of Hoboken may continue with plans to develop the BASF and Block 10 sites, a comprehensive DSD system would not be built. The No Action Alternative also includes other ongoing or planned projects in the Study Area that are proposed to be completed by 2022. This included the following projects:

1. Long Slip Fill and Rail Enhancement Project (NJ TRANSIT)
2. Property Development between Long Slip Canal and 14th Street, Jersey City (Newport Associates)
3. H1 and H5 Wet Weather Pump Stations (NHSA)
4. Southwest Resiliency Park (City of Hoboken)
5. City Hall Green Infrastructure Improvements (City of Hoboken)
6. Washington Street Rain Gardens (City of Hoboken)