



**US Army Corps  
of Engineers®**  
New York District

## **Cost Engineering Appendix**

**DRAFT**

### **New York – New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study**

**Appendix C**

**September 2022**

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## LIST OF ACRONYMS

<b>Term/Acronym</b>	<b>Expanded</b>
AK	Arthur Kill
AMF	Access Material Factor
CSI	Construction Specifications Institution
CWWBS	Civil Works Work Breakdown Structure
E&D	Engineering & Design
EL.	Elevation
EM	Engineering Manual
ER	Engineer Regulation

<b>Term/Acronym</b>	<b>Expanded</b>
FC	Flushing Creek
GC	Gowanus Canal
GIS	Geographic Information System
NYNJHAT	New York–New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study
HFFPF	High Frequency Flood Protection Feature
HOOH	Home Office Overhead
HR	Hackensack River
HRL	Hackensack Perimeter Lower Area – Polygon
IFF	Induced Flooding-Mitigation Features
JB	Jamaica Bay
JOOH	Job Office Overhead
KV	Kill Van Kull
LOP	Line of Protection
MCASES	Micro-Computer Aided Cost Estimating System
MCLEM	Marine Crew Labor and Equipment
MII	MCASES Second Generation
NAVD88	North American Vertical Datum of 1988
NAVD88	North American Vertical Datum of 1988
NC	Newton Creek
NJ	New Jersey
NY	New York
NYC	New York City
OMRRR	Operation Maintenance Repair Replacement Rehabilitation
PED	Planning, Engineering, & Design
PDT	Project Delivery Team
RRF	Risk Reduction Features
SBM	Shore-Based Measures
SH	Sandy Hook
SIOH	Supervision, Inspection, and Overhead
SoW	Scope of Work
SSB	Storm Surge Barriers
TN	Throg’s Neck
TPCS	Total Project Cost Summary
TSP	Tentatively Selected Plan
USACE	United States Army Corps of Engineers
USACE ER	USACE Engineering Regulation
USACE-NAN	USACE New York District
VN	Verrazano Narrows
WBS	Work Breakdown Structure

# 1 Introduction

This appendix presents the cost estimates and construction durations developed for the NYNJHAT study, including both the in-water (e.g., storm-surge barriers) and land-based features (e.g., levees, floodwalls, etc.), to achieve a Class 4 (Class 5 for some cases) cost estimate per Engineer Regulation (ER) 1110-2-1302 for the purpose of assisting with distinguishing the current five project alternatives described in the main feasibility report for the selection of a tentatively selected plan (TSP).

## 1.1 Study Alternatives Overview

The six alternatives for the NYNJHAT Study (no action, and five project alternatives) are presented in the body of the main feasibility report. An overview of each study alternative is presented in Table 1.

**Table 1: NYNJHAT Study Alternatives – Structural Measure Overview**

Alt.	Areas that see flood risk reduction as a result of the Alternative	Feature	Location Description of Features and Measures
1	None.		No Action Alternative.
2	Most of the NYNJHAT Study area.	SSBs:	Outer Harbor (OH) and Throgs Neck (TN)
		SBMs:	Tie-ins to TN SSB and tie-ins to OH SSB
		IFFs:	Along shorelines at the western end of the Long Island Sound. IFFs include additional SSB structures.
		RRFs:	Within the newly created basin between the OH and TN SSB.
3A	A large portion of the NYNJHAT Study area.	SSBs:	Arthur Kill (AK), Verrazzano Narrows (VN), Throgs Neck (TN), Jamaica Bay (JB), Sheepshead Bay (SB), Gerritsen Creek (GRC).
		SBMs:	Tie-ins to the JB SSB, tie-ins to VN SSB, tie-ins to AK SSB and tie-ins to TN SSB.
		IFFs:	Along shorelines at the western end of the Long Island Sound, IFFs at Breezy Point and IFFs in the Lower Bay along the Staten Island and Jersey shoreline. IFFs include additional SSB structures.
		RRFs:	Within the newly created basin between the AK, VN and TN SSB and within Jamaica Bay, upstream of the JB SSB.
3B	Inland NJ areas (incl port, oil terminals and Newark airport) and west side of Staten Island as result of SSBs. In addition, areas with relative high flood risk in NYC.	SSBs:	AK, Kill van Kull (KVK), JB, Flushing Creek (FC), SB, GRC, Newtown Creek (NC), Gowanus Canal (GC).
		SBMs:	Tie-ins to the JB SSB, tie-ins to the AK SSB, tie-ins to KvK and tie-ins to the FC SSB. In addition, SBMs in the Red Hook neighborhood tied into the GC SSB and SBMs in Long Island City tied into the NC SSB. SBMs along the shorelines of Jersey City, the south side and west side of Manhattan and SBMs along the Harlem River.
		IFFs:	At Breezy Point and IFFs in the East River and Harlem River.
		RRFs:	Within the newly created basin between the AK and KVK SSB and within Jamaica Bay, upstream of the JB SSB.
4	Only the areas with higher flood risk or smaller tributary basins in NYNJHAT study area.	SSBs:	Hackensack River (HR), NC, GC, JB, FC, SB, GRC
		SBMs:	Tie-ins to the JB SSB, tie-ins to the HR SSB and tie-ins to the FC SSB. In addition, SBMs in the Red Hook neighborhood tied into the GC SSB and SBMs in Long Island City tied into the NC SSB. SBMs along the shorelines of Jersey City, the south side and west side of Manhattan and SBMs along the Harlem River
		IFFs:	At Breezy Point and IFFs in Newark Bay and the lower reaches of the Passaic and Hackensack River.
		RRFs:	Within Jamaica Bay, upstream of the JB SSB.
5	No SSBs and only SBMs for the areas with higher flood risk in NYNJHAT study area.	SSBs:	None
		SBMs:	SBMs along the shorelines of Jersey City, the south side and west side of Manhattan, SBMs along the Harlem River and SBMs in the Meadowlands
		IFFs:	None
		RRFs:	None

## 2 Work Breakdown Structure

The project work breakdown structure (WBS) within MII has 5 levels. The NYNJHAT MII WBS follows the following format:

1. Structure (Alphanumeric)
  - Differentiates SSB, SBM, RRF, IFF, Interior Drainage, Non-Structural, and Utility Relocation costs.
  - (e.g., JB = Jamacia Bay SSB, HR = Hackensack River SSB, HRL = Hackensack Perimeter Lower Area – Polygon, etc.)
2. Phase
3. Feature
4. Sub-feature
5. Activity

Table 2 shows the allocation of each structure type (WBS Level 1) within the CWWBS.

**Table 2: WBS Classification by Cost Items**

<b>NYNJHAT Cost Item</b>	<b>CWWBS</b>
Real Estate/Lands and Damages	01 – Lands and Damages
Utility Relocation	02 – Relocations
Environmental Mitigation	06 – Fish and Wildlife Facilities
SSB	10 – Breakwaters and Seawalls
IFF & RRF Navigable Gates	10 – Breakwaters and Seawalls
SBM	11 – Levees and Floodwalls
RRF	11 – Levees and Floodwalls
IFF	11 – Levees and Floodwalls
Interior Drainage	11 – Levees and Floodwalls
Cultural Resource Mitigation	18 – Cultural Resource Mitigation
Non-Structural	19 – Buildings, Grounds, and Utilities
Planning, Engineering and Design	30 – Planning, Engineering, and Design
Construction Management	31 – Construction Management

## 3 Cost Estimating Methodology

### 3.1 Scope of Work Summary

This section presents a narrative on the development of the construction cost estimate for the following elements:

- SSB
- SBM
- RRF
- IFF
- Interior Drainage Features
- Individual Structure Risk Management (Non-structural and Ring-walls)

- Relocation

## 3.2 SSB and Other Navigation Gates

The methodology adopted for the NYNJHAT study for estimating the construction cost of the SSBs included the following methodology:

- Develop a Class 4 cost estimate for VN, JB, and HR.
- Develop a hybrid/parametric Class 4 cost estimate for the remaining SSBs using scalable equivalent features from the VN, JB, and HR SSBs.
- Develop a hybrid/parametric Class 4 cost estimate for SSB alternative alignments (i.e. VN, AK, and KVKK) using scalable equivalent features from the original VN, JB, and HR SSB alignments.

### 3.2.1 VN, JB, & HR SSBs – Class 4 Cost Estimate

Project quantities were developed primarily using Microsoft Excel calculations for major elements following the design development described in Appendix B. The cost estimates for the VN, JB, and HR SSBs were developed in MCACES, Second Generation (MII) relying heavily on RSMeans data, engineering judgment, and historical data. Remaining SSBs – Hybrid Parametric Class 4 Cost Estimate.

The development of a Class 4 cost estimate for the remaining storm-surge barriers (SSBs) using scalable equivalent features from the VN, JB, and HR SSBs was completed in two steps.

**Step 1:** Assign the most applicable VN, JB, and HR sector gate, lift gate, or dam section (WBS Level 2 or 3) (i.e., Scalable Equivalent) to all remaining SSBs under consideration in the study using engineering judgment and the general criteria outlined in Table 3.

**Table 3: Scalable Equivalent Selection General Criteria**

Scalable Equivalent	Sector Gate Criteria	Lift Gate Criteria (NAVD88)	Dam Section Criteria
HR	gate height < ~59 ft navigable passage span < ~400 ft	lift gate height < ~54 ft, span < ~900 ft	dam height < ~28 ft
JB	gate height < ~59 ft navigable passage span > ~400 ft	lift gate height < ~54 ft, span > ~900 ft	~28 ft < dam height < ~34 ft
VN	gate height > ~59 ft navigable passage span > ~1,000 ft	lift gate height > ~54 ft (use phase 4, 5, or 6 depending on how the gate characteristics match)	dam height > ~34 ft

Step 1 includes making assumptions on the number of construction phases required to limit hydrodynamic and navigational impacts, as follows:

- For most SSBs, keep each phase under ~1,000 linear feet



- For Sandy Hook (SH) to Breezy Point SSB, keep each phase under ~1,500 linear feet

Table 4 and Table 5 present the Scalable Equivalent adopted for each of the remaining SSBs under consideration.

**Table 4: Remaining SSB (except SH) Scalable Equivalent VN, JB, & HR Sector Gate, Lift Gate, or Dam Section**

Remaining SSB under consideration	Scalable Equivalent WBS Phase 1 (generally, the Navigable Gate)	Scalable Equivalent WBS Phase 2	Scalable Equivalent WBS Phase 3	Scalable Equivalent WBS Phase 4
AK	VN01	HR03	HR03	n/a
KV	VN01	JB03	HR0303	n/a
GC	HR01	n/a	n/a	n/a
NC	HR01	n/a	n/a	n/a
FC	n/a	HR02	HR02	n/a
TN	VN01	JB03 (w/o dam section)	VN06	JB04

**Table 5: SH Scalable Equivalent VN, JB, & HR Sector Gate, Lift Gate, or Dam Section**

Phase Number	Phase Name	Scalable Equivalent WBS	Phase Number	Phase Name	Scalable Equivalent WBS
1	Primary Floating Sector Gate	VN01	3 – W	West Dam Section	VN0603
2	Sandy Hook Floating Sector Gate	VN01	4 – W	L Lifts Gates, West Intermediate Dam	VN06
3 – E	A Lift Gates, East Dam Section	VN06	5 – W	L Lifts Gates	VN05
4 – E	Rockaway Inlet Sector Gate, Vertical Axis	VN02	6 – W	L Lifts Gates	VN05
5 – E	C Lift Gates, E Intermediate Dam Section	VN06	7 – W	L Lifts Gates	VN05
6 – E	D Lifts Gates	VN05	8 – W	L Lifts Gates	VN05
7 – E	D Lifts Gates	VN05	9 – W	K Lifts Gates	VN05
8 – E	E Lifts Gates	VN05	10 – W	J Lifts Gates	VN05
9 – E	E Lifts Gates	VN05	11 – W	I Lifts Gates	VN05
10 – E	F Lifts Gates	VN05	12 – W	I Lifts Gates	VN05
11 – E	F Lifts Gates	VN05	13 – W	I Lifts Gates	VN05
12 – E	F Lifts Gates	VN05	14 – W	G Lifts Gates	VN05
13 – E	F Lifts Gates	VN05	15 – W	G Lifts Gates	VN05

Phase Number	Phase Name	Scalable Equivalent WBS	Phase Number	Phase Name	Scalable Equivalent WBS
14 – E	G Lifts Gates	VN05			
15 – E	G Lifts Gates	VN05			

**Step 2:** Develop a scaling factor to scale the quantities developed for each Scalable Equivalent.

Sector Gate Section: The Sector Gate sections are scaled by the navigable passage area (navigable passage span  $\times$  gate height). Navigable passage span is defined as the gate width + pier/island widths. Gate height is defined as the distance between the sill elevation and the top of the gate/top of structure elevation (elevation B in the engineering appendix).

Lift Gate Section: The Lift Gate sections are scaled by the auxiliary area (span  $\times$  gate height). Total span is defined as the distance between the outside of the outermost piers in the lift gate sections. Gate height is defined as the distance between the average sill elevation and the top of structure elevation (elevation B in the engineering appendix).

Dam Section: The dam sections are scaled by the dam area (length  $\times$  dam height). Dam span is defined as the total length of the dam section between the outermost lift gate pier and the shore-based measures. Dam height is defined as the distance between the average dam mudline elevation and the top of the dam structure/top of structure elevation (elevation B in the engineering appendix).

Combined Lift Gate and Dam Section: The VN, JB, and HR Phases (WBS Level 2) generally include a combined lift gate and dam section. As such, a combined lift gate and dam section scaling factor was developed using a weighted equation based off the interim study SSB construction cost equation (USACE, 2019b).

### 3.2.2 SSB Alternative Alignments and RRF and IFF Navigation Gates – Hybrid Parametric Class 4 Cost Estimate

The project construction costs for the SSB Alternative Alignments and RRF and IFF Navigation Gates were developed with the same process as the remaining SSBs outlined in Section 3.2.2.

### 3.3 SBM, RRF, and IFF

Project quantities were developed for typical measure cross-sections primarily using Microsoft Excel calculations for major elements following the design development described in Appendix B. Linear foot costs for typical SBM, RRF, and IFF measures were developed in MII as assemblies, relying heavily on cost book data and supplemented with quotes for major equipment (i.e., flip-up barriers and operable floodgates). Within MII, the quantity measure assemblies are multiplied by the length of each measure attributed to the specific site.

The typical SBM and IFF features developed in MII include:

- XL Floodwall
- Large Floodwall
- Medium Floodwall
- Medium Levee
- Large Levee
- Elevated Promenade

- Reinforced Dune
- Seawall
- Floodwall w/ Park Integration
- Levee with Road Ramp
- Flip-up Barrier
- Deployable Floodgate
- Tide Gates

The typical RRF features developed in MII include:

- High Floodwall
- Standard Floodwall
- Low Floodwall
- High Berm
- Medium Berm
- Low Berm
- Hybrid Berm
- Revetment with Floodwall
- Deep Bulkhead
- Shallow Bulkhead
- Tide Gates
- Deployable Floodgate
- Road Ramp
- Road Raising

Site specific modifiers, such as population density, site access, and staging conditions, were applied as productivity, marine crew labor and equipment (MCLEM), and access material factor (AMF) markups within MII to account for construction cost variability at each site.

### 3.4 Interior Drainage Features

Cost estimates for interior drainage features associates with SSBs, SBMs, and RRFs were developed as follows:

- **SSB Interior Drainage Features** - Pump station costs have been estimated using a cost curve developed from prior projects.
- **SBM & RRF Interior Drainage Features** – Cost estimates for interior drainage facilities behind fixed lines of protection were developed from historical costs of such facilities for previously constructed or currently proposed projects of a similar nature in the New York/New Jersey area. The costs were applied as a linear foot cost and based off storage/access constrains.

### 3.5 Individual Structure Risk Management (Non-structural and Ring-walls)

Cost estimates for individual structure risk management were developed as follows:

- **Wet Floodproofing, Dry Floodproofing, & Elevation** - The analysis referenced non-structural costs developed for other projects and assigned costs based on structure type (i.e., slab on grade, basement – subgrade, basement – walkout, raised/crawlspace, bilevel / raised ranch, split level), flood depth / elevation height, and building footprint.
- **Structural Ring-walls and Ring-levees** - The reference cost for ring-walls was taken from the cost estimate for a stand-alone floodwall of height 6.5 feet above grade, derived as part of the structural plan development.

The individual structure risk management costs were incorporated into the MII cost estimate as a direct cost allowance within an individual CSI task. Reference Engineering Sub-Appendix B.5 for

additional information on the individual structure risk management costs. Individual structure risk management costs are input into MII at the effective price level.

### **3.6 SBM, RRF, and IFF Relocation**

Relocation costs include removing, relocating, or reconstructing property of others, such as roads, railroads, cemeteries, utilities, buildings, and other structures, and includes real estate planning and acquisition expenses. For the NYNJHAT study, relocations costs for each project were developed at a Class 5 level without site-specific investigations or surveys. A parametric formula for relocation costs was developed from recent similar projects in the Northeast using a best-fit exponential equation relating site-specific characteristics of the project area to the cost per foot for relocations. Cost data were gathered from the following sources:

- East Harlem Resiliency Study – Costing Memo, October 23, 2018;
- South Shore of Staten Island, NY Coastal Storm Risk Management; Interim Feasibility Study for Fort Wadsworth to Oakwood Beach – USACE Cost Engineering Appendix, September 2016; and
- Rahway River Basin, New Jersey Coastal Storm Risk Management Feasibility Study – USACE Cost Engineering Appendix.

### **3.7 Lands and Damages**

Studies were conducted by the USACE New York District Real Estate Division to determine the estimates value of land and easements needed for each alternative. The estimates for Alternatives 2 and 5 were completed at a higher level than Alternatives 3A, 3B, and 4.

### **3.8 Planning, Engineering, & Design**

The cost was developed for all activities associated with the planning, engineering, and design effort. The cost for this account includes the preparation of Design Documentation Reports, plans, specifications, and engineering support during construction through project completion. It includes all the in-house labor based upon work-hour requirements, material and facility costs, travel, and overhead.

### **3.9 Construction Management**

The cost was developed for all construction management activities from pre-award requirements through final contract closeout. This cost includes the in-house labor based upon work-hour requirements, materials, facility costs, support contracts, travel and overhead. The cost was developed based on the input from the construction division in accordance with the CWBS and include but not limited to anticipated items such as salaries of the resident engineer and staff, survey men, inspectors, draftsmen, clerical, and custodial personnel; operation, maintenance and fixed charges for transportation and for other field equipment; field supplies; construction management, general construction supervision; project office administration, distributive cost of area office and general overhead charged to the project. The work items and activities would

include, but not be limited to: the salaries of all supervisory, engineering, office and safety field personnel; all on site expenses.

## 4 Schedule Methodology

This section provides background on how the construction durations were developed for each project and each NYNJHAT study alternative.

### 4.1 Environmental Restriction Windows

Environmental restriction windows are a major impact on the duration of marine construction projects. The initial environmental restriction windows assumptions adopted for the study were developed based on previous projects and are presented in Table 6 and Table 7. The construction schedule durations for the NYNJHAT study are based on these environmental windows.

**Table 6: SSB Environmental Restriction Windows**

<b>SSB</b>	<b>Environmental Restriction Window</b>	<b>% of Year</b>
SH	Jan 1 – May 31	41%
HR	Mar 1 – Jun 30	33%
AK, KV	Mar 1 – May 31	25%
VN	Nov 15 – Apr 15	42%
JB	Apr 1 – Sep 15	46%
FC, NC, GC, TN	Jul 1 – Sep 30	25%

**Table 7: SBM, RRF, and IFF Environmental Restriction Windows**

<b>SBM</b>	<b>Environmental Restriction Window</b>	<b>% of Year</b>
ALL SBMs, RRFs, and IFFs	Mar 1 – Jun 30	33%

### 4.2 NYNJHAT Study Alternative - Construction Duration Methodology

The construction durations for each NYNJHAT study alternative were developed with a simplified contracting strategy consistent across each alternative for the purpose of determining the TSP. The adopted methodology used the following major assumptions:

- Four (4) of each category of perimeter measure/feature (primary SBMs, RRFs and IFFs) will be under construction at any given time.
- The number of SSBs under construction at any given time is not limited.
- If any single measure/feature (such as an SSB or a major SBM) has a construction duration larger than the previous assumption calculations, then that becomes the critical path.
- If the average amount of "schedule float" associated with the categories of construction which are not on the critical path is less than 25% of the duration of the estimated

construction duration associated with the critical path, an additional year is added to the total duration estimate.

The NYNJHAT study alternative construction durations are presented in Table 8.

**Table 8: NYNJHAT Study Alternative Construction Duration**

<b>Alternative</b>	<b>Construction Duration (years)</b>
2	32
3A	25
3B	14
4	14
5	6

## **5 Contingencies**

As stated in ER 1110-2-1302, the goal in contingency development is to identify the uncertainty associated with an item of work or task, forecast the cost/risk relationship, and assign a value to this task that would limit the cost risk to an acceptable degree of confidence. Consideration must be given to the details available at each stage of planning, design, or construction for which a cost estimate is being prepared. Contingencies may vary throughout the cost estimate and could constitute significant portion of the overall costs when the lack of investigated data or design details are available. Final contingency development and assignment that describes the potential for cost growth is included in the cost estimate. During development of the cost estimates, sufficient contingencies developed via PDT discussions during Abbreviated Risk Analysis (ARA) were applied to develop the Total Project First Cost (TPCS). The ARA for each of the alternatives is shown in Tables 9-13. Please note Table 14 for the breakdown of each CWWBS account. The contingency factors developed per ARA are summarized in Tables 9-13.

**Table 9: Alternative 2 Contingency Factors**

<b>Element</b>	<b>Features of Work</b>	<b>Contingency Factor</b>
02 Relocations	Relocations	54.23%
06 Fish & Wildlife Facilities	Environmental Mitigation	80.82%
10 Breakwater & Seawalls	SSB: Breezy Point to Sandy Hook	62.17%
10 Breakwater & Seawalls	SSB: Throgs Neck	47.49%
10 Breakwater & Seawalls	IFF SSB and RRF Navigable Barriers	85.11%
11 Levees and Floodwalls	Shoreline Based Measures	29.24%
11 Levees and Floodwalls	Induced Flooding-Mitigation Features	36.30%
11 Levees and Floodwalls	Risk Reduction Features	53.98%
11 Levees and Floodwalls	Interior Drainage Features	50.76%
11 Levees and Floodwalls	Individual Structure Protection/Non-Structural	45.25%
19 Building, Grounds, and Utilities	Individual Structure Protection/Non-Structural	45.25%
<b>Total Construction Contingency</b>		<b>59.24%</b>
01 Lands and Damages	Lands and Damages	50.00%
30 Planning, Engineering, and Design	Planning, Engineering, and Design	59.24%
31 Construction Management	Construction Management	59.24%

**Table 10: Alternative 3A Contingency Factors**

<b>Element</b>	<b>Features of Work</b>	<b>Contingency Factor</b>
02 Relocations	Relocations	54.23%
06 Fish & Wildlife Facilities	Environmental Mitigation	80.82%
10 Breakwater & Seawalls	SSB: Verrazano Narrows	79.40%
10 Breakwater & Seawalls	SSB: Arthur Kill	42.65%
10 Breakwater & Seawalls	SSB: Jamaica Bay	33.70%
10 Breakwater & Seawalls	SSB: Throgs Neck	47.49%
10 Breakwater & Seawalls	IFF SSB and RRF Navigable Barriers	85.11%
11 Levees and Floodwalls	Shoreline Based Measures	32.76%
11 Levees and Floodwalls	Induced Flooding-Mitigation Features	37.53%
11 Levees and Floodwalls	Risk Reduction Features	53.98%
11 Levees and Floodwalls	Interior Drainage Features	50.76%
11 Levees and Floodwalls	Individual Structure Protection/Non-Structural	45.25%
18 Cultural Resource Mitigation	Cultural Resource Mitigation	23.31%
19 Building, Grounds, and Utilities	Individual Structure Protection/Non-Structural	45.25%
<b>Total Construction Contingency</b>		<b>59.10%</b>
01 Lands and Damages	Lands and Damages	50.00%
30 Planning, Engineering, and Design	Planning, Engineering, and Design	59.10%
31 Construction Management	Construction Management	59.10%

**Table 11: Alternative 3B Contingency Factors**

<b>Element</b>	<b>Features of Work</b>	<b>Contingency Factor</b>
02 Relocations	Relocations	76.33%
06 Fish & Wildlife Facilities	Environmental Mitigation	56.68%
10 Breakwater & Seawalls	SSB: Arthur Kill	42.65%
10 Breakwater & Seawalls	SSB: Kill Van Kull	42.65%
10 Breakwater & Seawalls	SSB: Jamaica Bay	33.70%
10 Breakwater & Seawalls	SSB: Gowanus, Newtown, and Flushing	85.11%
10 Breakwater & Seawalls	IFF SSB and RRF Navigable Barriers	85.11%
11 Levees and Floodwalls	Shoreline Based Measures	52.47%
11 Levees and Floodwalls	Induced Flooding-Mitigation Features	37.53%
11 Levees and Floodwalls	Risk Reduction Features	53.98%
11 Levees and Floodwalls	Interior Drainage Features	65.52%
11 Levees and Floodwalls	Individual Structure Protection/Non-Structural	49.47%
18 Cultural Resource Mitigation	Cultural Resource Mitigation	61.94%
19 Building, Grounds, and Utilities	Individual Structure Protection/Non-Structural	49.47%
<b>Total Construction Contingency</b>		<b>50.71%</b>
01 Lands and Damages	Lands and Damages	30.00%
30 Planning, Engineering, and Design	Planning, Engineering, and Design	50.71%
31 Construction Management	Construction Management	50.71%

**Table 12: Alternative 4 Contingency Factors**

<b>Element</b>	<b>Features of Work</b>	<b>Contingency Factor</b>
02 Relocations	Relocations	76.33%
06 Fish & Wildlife Facilities	Environmental Mitigation	56.68%
10 Breakwater & Seawalls	SSB: Hackensack	34.74%
10 Breakwater & Seawalls	SSB: Jamaica Bay	33.70%
10 Breakwater & Seawalls	SSB: Gowanus, Newtown, and Flushing	85.11%
10 Breakwater & Seawalls	RRF Navigation Gates	85.11%
11 Levees and Floodwalls	Shoreline Based Measures	52.47%
11 Levees and Floodwalls	Induced Flooding-Mitigation Features	47.52%
11 Levees and Floodwalls	Risk Reduction Features	53.98%
11 Levees and Floodwalls	Interior Drainage Features	65.52%
11 Levees and Floodwalls	Individual Structure Protection/Non-Structural	61.94%
18 Cultural Resource Mitigation	Cultural Resource Mitigation	23.31%
19 Building, Grounds, and Utilities	Individual Structure Protection/Non-Structural	61.94%
<b>Total Construction Contingency</b>		<b>51.75%</b>
01 Lands and Damages	Lands and Damages	50.00%
30 Planning, Engineering, and Design	Planning, Engineering, and Design	51.75%
31 Construction Management	Construction Management	51.75%



**Table 13: Alternative 5 Contingency Factors**

<b>Element</b>	<b>Features of Work</b>	<b>Contingency Factor</b>
02 Relocations	Relocations	75.10%
06 Fish & Wildlife Facilities	Environmental Mitigation	56.68%
11 Levees and Floodwalls	Shoreline Based Measures	52.47%
11 Levees and Floodwalls	Interior Drainage Features	65.52%
18 Cultural Resource Mitigation	Cultural Resource Mitigation	23.31%
19 Building, Grounds, and Utilities	Individual Structure Protection/Non-Structural	61.94%
<b>Total Construction Contingency</b>		<b>58.93%</b>
01 Lands and Damages	Lands and Damages	50.00%
30 Planning, Engineering, and Design	Planning, Engineering, and Design	58.93%
31 Construction Management	Construction Management	58.93%

**Table 14: NYNJHAT ARA Features of Work**

<b>CWWBS Account Number</b>	<b>Description of the Division of the Features of Work</b>
02 Relocations	One Feature of Work for all relocations.
06 Fish and Wildlife Facilities	One Feature of Work for all environmental mitigation.
10 Breakwaters and Seawalls	Each major SSB was evaluated as a separate Feature of Work with the exception of the smaller SSBs (GC, NC, FC) and the RRF/IFF navigation gates.
11 Levees and Floodwalls	SBMs, IFFs, RRFs, and IDFs were evaluated as separate Features of Work.
18 Cultural Resource Preservation	One Feature of Work for all cultural resource mitigation.
19 Buildings, Grounds, and Utilities	One Feature of Work for all ISRM.

## 6 OMRRR Costs

Operation, Maintenance, Repair, Replacement, and Rehabilitation (OMRRR) costs are calculated as a function of construction costs and applied at the appropriate years, after construction is complete. The OMRRR percentages were developed and described in the interim report (USACE, 2019a).

**Operations:** All features are treated as if functional/deployed at a rate of once every 2 years at the start of the 50-year period of analysis, growing to three-times every 2 years at the end of the period of analysis.

**Maintenance:** Annual maintenance costs are calculated at 0.3% of construction costs, to be applied annually once the feature is constructed. Five-year maintenance costs are calculated and applied every 5 years.

**Repair:** Repair costs are to be applied every 10 years once the feature is constructed.

**Rehabilitation:** Rehabilitation costs applied twice within the period of analysis, at the 25-year mark and at the 50-year mark.

## 7 NYNJHAT Study Alternatives First Cost Tables

The NYNJHAT study alternatives cost estimates by First Costs are presented in Table 15, Table 16, Table 17, Table 18, and Table 19.

**Table 15: Alternative 2 First Cost Table**

<b>Feat. Acct</b>	<b>Description</b>	<b>Subtotal</b>	<b>Cont. %</b>	<b>Cont. \$\$</b>	<b>Total Cost</b>
01	LANDS AND DAMAGES	\$350,830,000	50%	\$175,410,000	\$526,240,000
02	RELOCATIONS	\$985,240,000	54%	\$534,300,000	\$1,519,530,000
06	FISH AND WILDLIFE FACILITIES	\$1,340,000,000	81%	\$1,083,040,000	\$2,423,040,000
10	BREAKWATERS AND SEAWALLS	\$49,931,600,000	62%	\$30,893,380,000	\$80,824,970,000
11	LEVEES AND FLOODWALLS	\$7,238,890,000	38%	\$2,746,600,000	\$9,985,500,000
19	BUILDINGS, GROUNDS, AND UTILITIES	\$77,530,000	45%	\$35,080,000	\$112,610,000
30	PLANNING, ENGINEERING, AND DESIGN	\$8,489,190,000	59%	\$5,028,040,000	\$13,517,230,000
31	CONSTRUCTION MANAGEMENT	\$2,234,000,000	59%	\$1,323,170,000	\$3,557,170,000
	<b>Total Alt 2</b>	<b>\$70,647,270,000</b>		<b>\$41,819,030,000</b>	<b>\$112,466,300,000</b>

**Table 16: Alternative 3A First Cost Table**

<b>Feat. Acct</b>	<b>Description</b>	<b>Subtotal</b>	<b>Cont. %</b>	<b>Cont. \$\$</b>	<b>Total Cost</b>
01	LANDS AND DAMAGES	\$2,904,950,000	50%	\$1,370,170,000	\$4,275,120,000
02	RELOCATIONS	\$1,076,310,000	54%	\$583,680,000	\$1,659,990,000
06	FISH AND WILDLIFE FACILITIES	\$1,540,000,000	81%	\$1,244,690,000	\$2,784,690,000
10	BREAKWATERS AND SEAWALLS	\$27,801,500,000	64%	\$17,854,390,000	\$45,655,890,000
11	LEVEES AND FLOODWALLS	\$8,477,570,000	39%	\$3,322,460,000	\$11,800,030,000
18	CULTURAL RESOURCE PRESERVATION	\$39,000,000	23%	\$9,090,000	\$48,090,000
19	BUILDINGS, GROUNDS, AND UTILITIES	\$25,450,000	45%	\$11,520,000	\$36,970,000
30	PLANNING, ENGINEERING, AND DESIGN	\$5,551,780,000	59%	\$3,280,650,000	\$8,832,430,000
31	CONSTRUCTION MANAGEMENT	\$1,460,990,000	59%	\$863,330,000	\$2,324,320,000
	<b>Total Alt 3A</b>	<b>\$48,877,550,000</b>		<b>\$28,539,970,000</b>	<b>\$77,417,520,000</b>

**Table 17: Alternative 3B First Cost Table**

<b>Feat. Acct</b>	<b>Description</b>	<b>Subtotal</b>	<b>Cont. %</b>	<b>Cont. \$\$</b>	<b>Total Cost</b>
01	LANDS AND DAMAGES	\$4,488,850,000	30%	\$1,316,880,000	\$5,805,740,000
02	RELOCATIONS	\$1,342,640,000	76%	\$1,024,830,000	\$2,367,470,000
06	FISH AND WILDLIFE FACILITIES	\$3,220,000,000	57%	\$1,825,100,000	\$5,045,100,000
10	BREAKWATERS AND SEAWALLS	\$12,448,260,000	44%	\$5,486,220,000	\$17,934,480,000
11	LEVEES AND FLOODWALLS	\$9,200,320,000	54%	\$4,945,580,000	\$14,145,890,000
18	CULTURAL RESOURCE PRESERVATION	\$94,000,000	62%	\$58,220,000	\$152,220,000
19	BUILDINGS, GROUNDS, AND UTILITIES	\$23,040,000	49%	\$11,400,000	\$34,440,000
30	PLANNING, ENGINEERING, AND DESIGN	\$3,751,780,000	51%	\$1,902,300,000	\$5,654,080,000
31	CONSTRUCTION MANAGEMENT	\$987,310,000	51%	\$500,610,000	\$1,487,910,000
	<b>Total Alt 3B</b>	<b>\$35,556,190,000</b>		<b>\$17,071,130,000</b>	<b>\$52,627,320,000</b>

**Table 18: Alternative 4 First Cost Table**

<b>Feat. Acct</b>	<b>Description</b>	<b>Subtotal</b>	<b>Cont. %</b>	<b>Cont. \$\$</b>	<b>Total Cost</b>
01	LANDS AND DAMAGES	\$3,072,350,000	50%	\$1,453,890,000	\$4,526,240,000
02	RELOCATIONS	\$1,371,150,000	76%	\$1,046,600,000	\$2,417,750,000
06	FISH AND WILDLIFE FACILITIES	\$3,430,000,000	57%	\$1,943,990,000	\$5,373,990,000
10	BREAKWATERS AND SEAWALLS	\$6,010,930,000	40%	\$2,418,880,000	\$8,429,810,000
11	LEVEES AND FLOODWALLS	\$10,894,870,000	54%	\$5,847,440,000	\$16,742,310,000
18	CULTURAL RESOURCE PRESERVATION	\$85,000,000	23%	\$19,810,000	\$104,810,000
19	BUILDINGS, GROUNDS, AND UTILITIES	\$1,750,000	62%	\$1,080,000	\$2,830,000
30	PLANNING, ENGINEERING, AND DESIGN	\$3,105,600,000	52%	\$1,607,480,000	\$4,713,090,000
31	CONSTRUCTION MANAGEMENT	\$817,260,000	52%	\$423,020,000	\$1,240,290,000
	<b>Total Alt 4</b>	<b>\$28,788,910,000</b>		<b>\$14,762,210,000</b>	<b>\$43,551,130,000</b>

**Table 19: Alternative 5 First Cost Table**

<b>Feat. Acct</b>	<b>Description</b>	<b>Subtotal</b>	<b>Cont. %</b>	<b>Cont. \$\$</b>	<b>Total Cost</b>
01	LANDS AND DAMAGES	\$150,000,000	50%	\$75,000,000	\$225,000,000
02	RELOCATIONS	\$789,270,000	75%	\$592,740,000	\$1,382,010,000
06	FISH AND WILDLIFE FACILITIES	\$2,830,000,000	57%	\$1,603,940,000	\$4,433,940,000
11	LEVEES AND FLOODWALLS	\$4,762,400,000	58%	\$2,760,550,000	\$7,522,950,000
18	CULTURAL RESOURCE PRESERVATION	\$50,000,000	23%	\$11,650,000	\$61,650,000
30	PLANNING, ENGINEERING, AND DESIGN	\$1,201,510,000	59%	\$707,970,000	\$1,909,480,000
31	CONSTRUCTION MANAGEMENT	\$316,190,000	59%	\$186,310,000	\$502,500,000
	<b>Total Alt 5</b>	<b>\$10,099,370,000</b>		<b>\$5,938,170,000</b>	<b>\$16,037,540,000</b>

## 8 Annual Cost Summary

In order to compare the alternatives to the project benefits the project first costs including contingencies were adjusted to reflect the total present value of the investment at the 2044 base year. This analysis assumed that the project design would begin in year 2025 and that construction, real estate acquisition and construction management expenditures would begin in year 2030. Expenditures were assumed to be a uniform amount over the construction period. The calculation of investment costs includes interest during construction for expenditures prior to the 2044 base year and present value discounting of all expenditures after the base year to reflect economic opportunity costs. The total present value of the investment cost plus the present value of OMRRR costs were multiplied by the capital recovery factor to determine the average annual costs over the 50-year period of analysis. Table 20 provides a summary comparison of the first and annual costs of alternatives.

**Table 20: Alternative Costs Summary**

Civil Works Feature & Sub-Feature Description	Alternative 2	Alternative 3A	Alternative 3B	Alternative 4	Alternative 5
02 - RELOCATIONS	\$ 985,239,409	\$ 1,076,309,448	\$ 1,342,637,223	\$ 1,371,153,126	\$ 789,270,692
06 - FISH & WILDLIFE FACILITIES	\$ 1,340,000,000	\$ 1,540,000,000	\$ 3,220,000,000	\$ 3,430,000,000	\$ 2,830,000,000
10 - BREAKWATER & SEAWALLS	\$ 49,931,595,963	\$ 27,801,495,009	\$ 12,448,259,897	\$ 9,335,488,309	\$ -
11 - LEVEES & FLOODWALLS	\$ 7,238,894,674	\$ 8,477,569,861	\$ 9,200,316,220	\$ 7,570,305,765	\$ 4,762,402,283
18 - CULTURAL RESOURCE PRESERVATION	\$ -	\$ 39,000,000	\$ 94,000,000	\$ 85,000,000	\$ 50,000,000
19 - BUILDINGS, GROUNDS & UTILITIES	\$ 77,528,856	\$ 25,453,929	\$ 23,039,081	\$ 1,748,257	\$ -
01 - LANDS AND DAMAGES	\$ 350,828,924	\$ 2,904,949,139	\$ 4,488,854,765	\$ 3,072,350,717	\$ 150,000,000
30 - PLANNING, ENGINEERING & DESIGN	\$ 8,489,189,393	\$ 5,551,775,525	\$ 3,751,775,970	\$ 3,105,601,603	\$ 1,201,513,399
31 - CONSTRUCTION MANAGEMENT	\$ 2,233,997,209	\$ 1,460,993,559	\$ 987,309,466	\$ 817,263,580	\$ 316,187,737
<b>PROJECT COST</b>	<b>\$ 70,647,274,427</b>	<b>\$ 48,877,546,471</b>	<b>\$ 35,556,192,622</b>	<b>\$ 28,788,911,356</b>	<b>\$ 10,099,374,110</b>
Construction Contingency (%)	59.24%	59.10%	50.71%	51.75%	58.93%
Account 01 Contingency (%)	50.00%	50.00%	30.00%	50.00%	50.00%
CONTINGENCY:	\$ 41,819,028,778	\$ 28,539,974,693	\$ 17,071,131,456	\$ 14,762,214,290	\$ 5,938,166,163
<b>TOTAL:</b>	<b>\$ 112,466,303,205</b>	<b>\$ 77,417,521,164</b>	<b>\$ 52,627,324,078</b>	<b>\$ 43,551,125,646</b>	<b>\$ 16,037,540,273</b>
OMRRR COSTS: (Present Value)	\$ 31,325,614,852	\$ 9,604,654,164	\$ 10,345,508,365	\$ 8,561,068,683	\$ 3,704,745,959
INTEREST DURING CONSTRUCTION:	\$ 6,503,054,914	\$ 9,145,800,054	\$ 13,154,506,010	\$ 10,885,557,816	\$ 6,075,902,202
<b>TOTAL CURRENT INVESTMENT COSTS:</b>	<b>\$ 150,294,972,971</b>	<b>\$ 96,167,975,381</b>	<b>\$ 76,127,338,453</b>	<b>\$ 62,997,752,145</b>	<b>\$ 25,818,188,435</b>
ANNUALIZED COSTS (50 YRS, 2.25% discount Rate):	\$ 5,037,640,836	\$ 3,223,392,708	\$ 2,551,663,448	\$ 2,111,581,262	\$ 865,383,305

## 9 Cost Summary

The Total Fully Funded Project Cost for the Tentatively Selected Plan (Alternative 3B) considers future inflation to midpoint of construction. The Total Fully Funded Project Cost for the TSP is estimated at \$77,346,381,000 as presented in Table 21.



**Table 21: Total Project Cost Summary for the Tentatively Selected Plan**

PROJECT: New York – New Jersey Harbor and Tributaries Coastal Storm Risk Management Feasibility Study

DISTRICT: New York District

PREPARED: 9/18/2022

PROJECT NO: P2 404586

POC: CHIEF, COST ENGINEERING, Jeffrey Gross

LOCATION: New York & New Jersey

This Estimate reflects the scope and schedule in report;

0

**Project First Cost (Constant Dollar Basis)**

Program Year (Budget EC): 2022

Effective Price Level Date: 1 Oct 2021

Civil Works Work Breakdown Structure		Estimated Cost				Total Project Cost (Fully Funded)									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST (\$K)	CNTG (\$K)	CNTG (%)	TOTAL (\$K)	ESC (%)	COST (\$K)	CNTG (\$K)	TOTAL (\$K)	Spent Thru: 1-Oct-21 (\$K)	TOTAL FIRST COST (\$K)	INFLATED (%)	COST (\$K)	CNTG (\$K)	FULL (\$K)
A	B	C	D	E	F	G	H	I	J		K	L	M	N	O
02	RELOCATIONS	\$1,342,637	\$1,024,835	76.3%	\$2,367,472	0.0%	\$1,342,637	\$1,024,835	\$2,367,472	\$0	\$2,367,472	48.5%	\$1,994,003	\$1,522,023	\$3,516,026
06	FISH & WILDLIFE FACILITIES	\$3,220,000	\$1,825,096	56.7%	\$5,045,096	0.0%	\$3,220,000	\$1,825,096	\$5,045,096	\$0	\$5,045,096	48.5%	\$4,782,149	\$2,710,522	\$7,492,671
10	BREAKWATER & SEAWALLS	\$12,448,261	\$5,486,216	44.1%	\$17,934,477	0.0%	\$12,448,261	\$5,486,216	\$17,934,477	\$0	\$17,934,477	48.5%	\$18,487,404	\$8,147,796	\$26,635,201
11	LEVEES & FLOODWALLS	\$9,200,316	\$4,945,575	53.8%	\$14,145,891	0.0%	\$9,200,316	\$4,945,575	\$14,145,891	\$0	\$14,145,891	48.5%	\$13,663,753	\$7,344,869	\$21,008,622
18	CULTURAL RESOURCE PRESERVATION	\$94,000	\$58,224	61.9%	\$152,224	0.0%	\$94,000	\$58,224	\$152,224	\$0	\$152,224	48.5%	\$139,603	\$86,470	\$226,073
19	BUILDINGS, GROUNDS & UTILITIES	\$23,039	\$11,397	49.5%	\$34,436	0.0%	\$23,039	\$11,397	\$34,436	\$0	\$34,436	48.5%	\$34,216	\$16,927	\$51,143
<b>CONSTRUCTION ESTIMATE TOTALS:</b>		\$26,328,253	\$13,351,343		\$39,679,596	0.0%	\$26,328,253	\$13,351,343	\$39,679,596	\$0	\$39,679,596	48.5%	\$39,101,129	\$19,828,607	\$58,929,736
01	LANDS AND DAMAGES	\$4,488,855	\$1,316,884	29.3%	\$5,805,739	0.0%	\$4,488,855	\$1,316,884	\$5,805,739	\$0	\$5,805,739	48.5%	\$6,666,576	\$1,955,756	\$8,622,332
30	PLANNING, ENGINEERING & DESIGN	\$3,751,776	\$1,902,299	50.7%	\$5,654,075	0.0%	\$3,751,776	\$1,902,299	\$5,654,075	\$0	\$5,654,075	34.5%	\$5,047,688	\$2,559,378	\$7,607,066
31	CONSTRUCTION MANAGEMENT	\$987,309	\$500,605	50.7%	\$1,487,915	0.0%	\$987,309	\$500,605	\$1,487,915	\$0	\$1,487,915	47.0%	\$1,451,352	\$735,893	\$2,187,245
<b>PROJECT COST TOTALS:</b>		\$35,556,194	\$17,071,132	48.0%	\$52,627,325		\$35,556,194	\$17,071,132	<b>\$52,627,325</b>	\$0	<b>\$52,627,325</b>	47.0%	\$52,266,745	\$25,079,635	\$77,346,381

CHIEF, COST ENGINEERING, Jeffrey Gross

**ESTIMATED TOTAL PROJECT COST: \$77,346,381**

PROJECT MANAGER, Bryce Wisemiller

CHIEF, REAL ESTATE, Allen Roos

CHIEF, PLANNING, Cliff Jones

CHIEF, ENGINEERING, Encer Shaffer

CHIEF, OPERATIONS, Thomas Creamer

CHIEF, CONSTRUCTION, Richard English

CHIEF, ENGINEERING, Encer Shaffer

CHIEF, PM-PB, xxxx

CHIEF, DPM, Joseph Seebode

## 10 Annex C.1 – Abbreviated Risk Assessment (ARA) – Risk Registers

Risk Level					
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3
	Negligible	Marginal	Moderate	Significant	Critical

**Table 22: Alternative 2 Risk Register**

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
<b>Project Scope Growth</b>					<b>Maximum Project Growth</b>		<b>40%</b>
Yes	PS-1	Lands and Damages					FALSE
Yes	PS-2	Relocations	Potential for scope growth, added features, and quantities. No field investigations, utility surveys, or desktop reviews of public records completed.	Scope growth - Cost based off linear feet of feature and site specific modifiers. No design completed. Scope growth - Unsure if temporary displacements were accounted for. Scope growth - Major pieces of infrastructure (i.e. pipe lines) not accounted for.	Significant	Likely	4
Yes	PS-3	Environmental Mitigation	Sufficient mitigation opportunities exist? Potential for scope growth, added features Limited field investigations to support assumptions.	Indirect effects of barriers. Can the estuary still function as an estuary? Highest risk. Scope Growth - Changes in Endangered Species Monitoring Requirements, environmental windows.	Significant	Very LIKELY	5
Yes	PS-4	SSB: Breezy Point to Sandy Hook	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Navigation gate width could increase. Crest elevation changes. Design/construction techniques could be impacted by environmental review / visual impacts Mutual acceptability by NPS.	In-the wet construction / alternative construction methodology could lead to a decrease in cost. Opportunity for repetition. Visual Impacts - Mutual acceptability by NPS. Crest elevation - potential to lower crest elevation with more research into overtopping.	Moderate	Possible	2

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-5	SSB: Throgs Neck	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Navigation gate width could increase. Crest elevation changes. Design/construction techniques could be impacted by environmental review / visual impacts	Navigation gate width could increase - Not likely too change. Low amount of engineering completed / site data collected.	Marginal	Possible	1
Yes	PS-6	IFF SSB and RRF Navigable Barriers	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Uncertainty on location/alignment. Uncertainty on navigation and flow requirements.	Scope Growth - Gowanus and Newtown Creek contamination concerns.	Significant	Very LIKELY	5
Yes	PS-7	Shoreline Based Measures	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	SH Tie-in extends through a National Park - Potential for scope growth. Priced as a buried sea wall. Conservative cost. Scope growth - aesthetics, beach nourishment	Marginal	Possible	1
Yes	PS-8	Induced Flooding Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Scope Growth - IFF placement is limited to areas where water elevations increase 0.5 ft. Decreased Scope Growth - IFFs may not be required. Scope Growth - Potential for alignment changes, transition features not defined, beach access	Moderate	Likely	3
Yes	PS-9	Residual Risk Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Crest elevation changes - less of a concern. Scope growth - small alignment changes, tie-ins, nature based features, all JB features may not be accounted for Scope growth - close proximity to NPS property. Scope growth - contaminated sediment	Significant	Likely	4

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-10	Interior Drainage Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions.	Parametric design and cost. Limit engineering completed. Future conditions may not be adequately accounted for. Pump station not required.	Moderate	Likely	3
Yes	PS-11	Cultural Resource Mitigation	Additional impacts from design changes. NPS Properties and Landmark Properties Limited field investigations to support assumptions.	Additional mitigation may be required that is not accounted for following review by the Resource Agencies.	Marginal	Very LIKELY	3
Yes	PS-12	Individual Structure Protection / Non-Structural	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions.	Scope growth - not a significant concern.	Moderate	Unlikely	1
Yes	PS-13	Planning, Engineering, & Design	Potential for scope growth and added features	Project Scope Growth - PED Contingency should be directly correlated to the overall weighted construction contingency. Field Investigations, Numerical, and Physical Modeling, Adaptive Management and Monitoring	Significant	Likely	4
Yes	PS-14	Construction Management	Potential for scope growth and added features	Project Scope Growth - CM Contingency should be directly correlated to the overall weighted construction contingency.	Significant	Likely	4
<b>Acquisition Strategy</b>					<b>Maximum Project Growth</b>		<b>30%</b>
Yes	AS-2	Relocations	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.		Marginal	Likely	2
Yes	AS-3	Environmental Mitigation	Contracting plan is not developed. Many small contracts.	No expertise for mitigating behind a SSB	Marginal	Likely	2
Yes	AS-4	SSB: Breezy Point to Sandy Hook	Limited bid competition expected for the SSBs. Contracting plan is not developed.		Moderate	Likely	3
Yes	AS-5	SSB: Throgs Neck	Limited bid competition expected for the SSBs. Contracting plan is not developed.	Floating Sector Gate more similar to VN.	Marginal	Likely	2

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	AS-6	IFF SSB and RRF Navigable Barriers	Contracting plan is not developed.	Bid competition is less of a concern	Marginal	Possible	1
Yes	AS-7	Shoreline Based Measures	Contracting plan is not developed. Lack of Material Suppliers (stone)	Contractors are likely available who can perform the work.	Marginal	Unlikely	0
Yes	AS-8	Induced Flooding Features	Contracting plan is not developed. Lack of Material Suppliers (stone)	Contractors are likely available who can perform the work. Limited competition for contractors who can install deployable flood gates, etc.	Marginal	Unlikely	0
Yes	AS-9	Residual Risk Features	Contracting plan is not developed. Many small contracts.	Contractors are likely available who can perform the work. Non federal interests will be interested in constructing local projects.	Moderate	Likely	3
Yes	AS-10	Interior Drainage Features	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.	Contractors are likely available who can perform the work. Non federal interests will be interested in constructing local projects.	Moderate	Likely	3
Yes	AS-11	Cultural Resource Mitigation	no concerns		Negligible	Possible	0
Yes	AS-12	Individual Structure Protection / Non-Structural	Contracting plan is not developed. Design-build possible. Many small contracts. SB or 8a Contracting likely.		Moderate	Likely	3
Yes	AS-13	Planning, Engineering, & Design	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2
Yes	AS-14	Construction Management	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2
<b>Construction Elements</b>					<b>Maximum Project Growth</b>		<b>15%</b>
Yes	CON-2	Relocations	Potential for modifications and claims	**Use a higher impact number for 3B and 4	Negligible	Likely	1

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	CON-3	Environmental Mitigation	Availability of local plantings Unique construction methods Environmental Windows Marginal site access. Active species monitoring requirements during construction.		Significant	Likely	4
Yes	CON-4	SSB: Breezy Point to Sandy Hook	Challenging site access. Environmental Window restrictions. Standby time due to weather/storm surge delays, sea state conditions and site constraints. Navigation impacts.	Site access - no land based access. Marine based construction. Need floating/onsite batch plant. Site constraints require more prefabricated elements. Weather - given the exposure and the very long construction time for the large barrier system in Alt 2, there might be substantial risk/contingency related to a severe storm hitting during construction and wrecking much of the partially built structures. The severe weather dynamics that come into play for the transect area are unlike any other location in the HATS and 30+ years of construction.	Significant	Likely	4
Yes	CON-5	SSB: Throgs Neck	Poor site access. Environmental Window restrictions. Standby time due to weather/storm surge delays, site constraints, currents. Navigation impacts.	Navigation impacts not as severe as VN. Site access - no land based access. Marine based construction. Standby Time - This location has extreme tides and currents.	Moderate	Likely	3
Yes	CON-6	IFF SSB and RRF Navigable Barriers	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints. Navigation impacts. Site access constraints	Weather delays - more sheltered than outer SSBs Site access - urban areas, limited laydown and shore access, marine access is good.	Moderate	Likely	3
Yes	CON-7	Shoreline Based Measures	Recreational and Environmental Windows		Negligible	Likely	1

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	CON-8	Induced Flooding Features	Environmental Windows Marginal site access. More complex construction elements	Recreational windows is not a concern. Construction elements - cofferdams, tide gates, etc.	Negligible	Likely	1
Yes	CON-9	Residual Risk Features	Environmental Windows Marginal site access. Tide Gates	Nav gates covered under a separate item.	Negligible	Likely	1
Yes	CON-10	Interior Drainage Features	Site access		Negligible	Likely	1
Yes	CON-11	Cultural Resource Mitigation	Site access issues including submerged resources		Negligible	Likely	1
Yes	CON-12	Individual Structure Protection / Non-Structural	Potential for modifications or claims is high for modifications to existing structures. Site access.		Moderate	Likely	3
Yes	CON-13	Planning, Engineering, & Design	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
Yes	CON-14	Construction Management	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
<b>Quantities for Current Scope</b>					<b>Maximum Project Growth 20%</b>		
Yes	Q-2	Relocations	Parametric Cost - No Quantities.		Moderate	Likely	3
Yes	Q-3	Environmental Mitigation	Limited physical site data. High uncertainty related to quantities given the level of design	Mitigation recommendations will need to be incorporated into the costs.	Marginal	Likely	2
Yes	Q-4	SSB: Breezy Point to Sandy Hook	Limited physical site data. High uncertainty related to quantities given the level of design	Quantities largely scaled from various VN elements. Quantities could decrease with an innovative construction technique.	Moderate	Likely	3
Yes	Q-5	SSB: Throgs Neck	High uncertainty related to quantities given the level of design	Quantities scaled from various VN and JB elements.	Moderate	Likely	3

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	Q-6	IFF SSB and RRF Navigable Barriers	Limited physical site data. Very high uncertainty related to quantities given the level of design.	Quantities scaled from HR.	Significant	Likely	4
Yes	Q-7	Shoreline Based Measures	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment	Lack of geotech data - uncertainty in foundation costs.	Marginal	Likely	2
Yes	Q-8	Induced Flooding Features	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment	Lack of geotech data - uncertainty in foundation costs.	Marginal	Likely	2
Yes	Q-9	Residual Risk Features	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment		Marginal	Likely	2
Yes	Q-10	Interior Drainage Features	Parametric design - high uncertainty		Moderate	Likely	3
Yes	Q-11	Cultural Resource Mitigation	no concern		Negligible	Possible	0
Yes	Q-12	Individual Structure Protection / Non-Structural	High uncertainty in quantities - quantities based off a typical building.	Buildings in high frequency flood plains tend to be older, drive qtys up	Significant	Likely	4
Yes	Q-13	Planning, Engineering, & Design	Level of confidence based on design and assumptions?	Likelihood of quantity changes/updates on the project features will have a marginal cost impact on the PED.	Marginal	Likely	2
Yes	Q-14	Construction Management	no concerns		Negligible	Possible	0
<b>Specialty Fabrication or Equipment</b>					<b>Maximum Project Growth</b>		<b>50%</b>
Yes	FE-2	Relocations	no concerns		Marginal	Unlikely	0
Yes	FE-3	Environmental Mitigation	Risk of specialty feature functioning the first time.		Negligible	Possible	0
Yes	FE-4	SSB: Breezy Point to Sandy Hook	No design work completed on MEP. Fabrication of sector gates is very complex. Lift gates fabrication is minimally complex. Confidence in supplier's ability?	Similar to VN. Confidence in Supplier's ability - future outlook is good for more similar structures. Availability of Suppliers should increase.	Moderate	Likely	3



Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	FE-5	SSB: Throgs Neck	No design work completed on MEP. Fabrication of sector gates is very complex. Lift gates fabrication is minimally complex. Confidence in supplier's ability?	Sector gate span width is 1/3 of VN. Confidence in Supplier's ability - future outlook is good for more similar structures. Availability of Suppliers should increase.	Moderate	Likely	3
Yes	FE-6	IFF SSB and RRF Navigable Barriers	No design work completed on MEP Conventional gates.		Marginal	Possible	1
Yes	FE-7	Shoreline Based Measures	Equipment for placing stone.		Marginal	Possible	1
Yes	FE-8	Induced Flooding Features	Tide Gates		Marginal	Possible	1
Yes	FE-9	Residual Risk Features	Tide Gates		Marginal	Possible	1
Yes	FE-10	Interior Drainage Features	no concerns		Marginal	Unlikely	0
Yes	FE-11	Cultural Resource Mitigation	Unusual parts, materials, and equipment		Negligible	Possible	0
Yes	FE-12	Individual Structure Protection / Non-Structural	limited concern - road closure gates		Marginal	Possible	1
Yes	FE-13	Planning, Engineering, & Design	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Floating Sector Gates - Fabrication of sector gates is very complex.	Marginal	Possible	1
Yes	FE-14	Construction Management	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Floating Sector Gates - Fabrication of sector gates is very complex.	Marginal	Possible	1
<b>Cost Estimate Assumptions</b>					<b>Maximum Project Growth 25%</b>		
Yes	EST-2	Relocations	Parametric Cost		Significant	Likely	4
Yes	EST-3	Environmental Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Marginal	Very LIKELY	3
Yes	EST-4	SSB: Breezy Point to Sandy Hook	Hybrid approach - parametric.	Cost scaled from various VN Elements (Class 4 Estimate).	Moderate	Likely	3

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EST-5	SSB: Throgs Neck	Hybrid approach - parametric.	Costs scaled from various VN and JB elements (class 4 estimate)	Moderate	Likely	3
Yes	EST-6	IFF SSB and RRF Navigable Barriers	Hybrid approach - parametric.	Cost scaled from HR Sector Gate.	Moderate	Likely	3
Yes	EST-7	Shoreline Based Measures	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-8	Induced Flooding Features	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-9	Residual Risk Features	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-10	Interior Drainage Features	Parametric estimate.		Moderate	Very LIKELY	4
Yes	EST-11	Cultural Resource Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Negligible	Very LIKELY	2
Yes	EST-12	Individual Structure Protection / Non-Structural	Parametric approach		Moderate	Likely	3
Yes	EST-13	Planning, Engineering, & Design	no concern		Negligible	Unlikely	0
Yes	EST-14	Construction Management	no concern		Negligible	Unlikely	0
<b>External Project Risks</b>					<b>Maximum Project Growth 20%</b>		
Yes	EX-2	Relocations	Recent heavy volatility on material supply and fuel costs.	Federal and non-federal funding - higher concern with projects that span multiple political cycles.	Marginal	Likely	2

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-3	Environmental Mitigation	New rules or regulations. Recent heavy volatility on material supply and fuel costs. Legal action / lawsuits Community acceptance	**higher impact than other alternatives	Significant	Likely	4
Yes	EX-4	SSB: Breezy Point to Sandy Hook	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept. Environmental interests - more significant	Environmental interests - will this still function as an estuary? Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Significant	Likely	4
Yes	EX-5	SSB: Throgs Neck	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept.	Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3
Yes	EX-6	IFF SSB and RRF Navigable Barriers	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Significant	Likely	4
Yes	EX-7	Shoreline Based Measures	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-8	Induced Flooding Features	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3
Yes	EX-9	Residual Risk Features	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3
Yes	EX-10	Interior Drainage Features	Bidding competition from other projects / shortage of contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3
Yes	EX-11	Cultural Resource Mitigation	Lack of agreement with coordinating agencies on execution of programmatic agreement. Public concerns		Marginal	Possible	1
Yes	EX-12	Individual Structure Protection / Non-Structural	Bidding competition - lack of interest Loss of use for lower levels - is compensation required?	Compensation could be required if a homeowner loses a lower level apartment. Will apply to a limited number of buildings. **Notes for NYC - significant, very likely	Marginal	Likely	2
Yes	EX-13	Planning, Engineering, & Design	Political Influences, lack of support, etc.		Significant	Likely	4
Yes	EX-14	Construction Management	Political Influences, lack of support, etc.		Significant	Likely	4

Risk Level					
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

**Table 23: Alternative 3A Risk Register**

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
<b>Project Scope Growth</b>						<b>Maximum Project Growth</b>	<b>40%</b>
Yes	PS-1	Lands and Damages					FALSE
Yes	PS-2	Relocations	Potential for scope growth, added features, and quantities. No field investigations, utility surveys, or desktop reviews of public records completed.	Cost based off linear feet of feature and site specific modifiers. No design completed. Temporary displacements not accounted for? Major pieces of infrastructure (i.e. pipe lines) not accounted for.	Significant	Likely	4
Yes	PS-3	Environmental Mitigation	Sufficient mitigation opportunities exist? Potential for scope growth, added features Limited field investigations to support assumptions.	Smaller but multiple areas to mitigate. May not have the space to mitigate. Scope Growth - Changes in Endangered Species Monitoring Requirements, environmental windows. More certainty in the scope to mitigate compared to Alt. 2	Significant	Likely	4
Yes	PS-4	SSB: Verrazano Narrows	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Navigation passage dimensions could increase. Crest elevation changes. Uncertainty on location/alignment. Multi functional infrastructure (bridge/tunnel) Design/construction techniques could be impacted by environmental review / visual impacts.	Other locations/alignments investigated - increase cost significantly. Impact and likelihood applied assuming alignment A. Contingency should be ~80-100%. Alignment A has poor geotechnical conditions. Alignments G and H could be significantly better.	Critical	Likely	5

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-5	SSB: Arthur Kill	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Navigation passage dimensions could increase. Crest elevation changes. Uncertainty on location/alignment. Multi functional infrastructure (bridge)	Multi functional infrastructure (bridge) - less of a concern Nav Pass width - likely to stay within boundaries studied.	Marginal	Possible	1
Yes	PS-6	SSB: Jamaica Bay	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes. Multi functional infrastructure (bridge) Design/construction techniques could be impacted by environmental review / visual impacts	Reasonably high level of confidence in geotechnical data - nearby bridge. High confidence in nav pass dimensions - barge traffic. Different gate type might be required due to visual impacts.	Marginal	Possible	1
Yes	PS-7	SSB: Throgs Neck	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Navigation gate width could increase. Crest elevation changes. Design/construction techniques could be impacted by environmental review / visual impacts	Navigation gate width could increase - Not likely too change. Low amount of engineering completed / site data collected.	Marginal	Possible	1
Yes	PS-8	IFF SSB and RRF Navigable Barriers	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Uncertainty on location/alignment. Uncertainty on navigation and flow requirements.	Scope Growth - Gowanus and Newtown Creek contamination concerns.	Significant	Very LIKELY	5

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-9	Shoreline Based Measures	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Scope growth - aesthetics, beach nourishment Scope Growth related to highly developed areas and potential contamination around Coney Island Creek. Potential realignment if VN alignment is changed. Not reflected here.	Marginal	Likely	2
Yes	PS-10	Induced Flooding Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Scope Growth - IFF placement is limited to areas where water elevations increase 0.5 ft. Decreased Scope Growth - IFFs may not be required. Scope Growth - Potential for alignment changes, transition features not defined, beach access	Moderate	Likely	3
Yes	PS-11	Residual Risk Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Crest elevation changes - less of a concern. Scope growth - small alignment changes, tie-ins, nature based features, all JB features may not be accounted for Scope growth - close proximity to NPS property. Scope growth - contaminated sediment	Significant	Likely	4
Yes	PS-12	Interior Drainage Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions.	Parametric design and cost. Limit engineering completed. Future conditions may not be adequately accounted for. Pump station not required.	Moderate	Likely	3
Yes	PS-13	Cultural Resource Mitigation	Additional impacts from design changes. NPS Properties and Landmark Properties Limited field investigations to support assumptions.	Additional mitigation may be required that is not accounted for following review by the Resource Agencies.	Marginal	Very LIKELY	3
Yes	PS-14	Individual Structure Protection / Non-Structural	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions.	Scope growth - not a significant concern.	Moderate	Unlikely	1

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-15	Planning, Engineering, & Design	Potential for scope growth and added features	Project Scope Growth - PED Contingency should be directly correlated to the overall weighted construction contingency. Field Investigations, Numerical, and Physical Modeling, Adaptive Management and Monitoring	Significant	Likely	4
Yes	PS-16	Construction Management	Potential for scope growth and added features	Project Scope Growth - CM Contingency should be directly correlated to the overall weighted construction contingency.	Significant	Likely	4
<b>Acquisition Strategy</b>				<b>Maximum Project Growth 30%</b>			
Yes	AS-2	Relocations	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.		Marginal	Likely	2
Yes	AS-3	Environmental Mitigation	Contracting plan is not developed. Many small contracts.	No expertise for mitigating behind a SSB	Marginal	Likely	2
Yes	AS-4	SSB: Verrazano Narrows	Limited bid competition expected for the SSBs. Contracting plan is not developed.	Limited bid competition - one of the largest SSBs in the world.	Marginal	Likely	2
Yes	AS-5	SSB: Arthur Kill	Limited bid competition expected for the SSBs. Contracting plan is not developed.	Similar to VN - Floating sector gate.	Marginal	Likely	2
Yes	AS-6	SSB: Jamaica Bay	Limited bid competition expected for the SSBs. Contracting plan is not developed.		Marginal	Likely	2
Yes	AS-7	SSB: Throgs Neck	Limited bid competition expected for the SSBs. Contracting plan is not developed.	Floating Sector Gate more similar to VN.	Marginal	Likely	2
Yes	AS-8	IFF SSB and RRF Navigable Barriers	Contracting plan is not developed.	Bid competition is less of a concern	Marginal	Possible	1
Yes	AS-9	Shoreline Based Measures	Contracting plan is not developed. Lack of Material Suppliers (stone)	Contractors are likely available who can perform the work.	Marginal	Unlikely	0
Yes	AS-10	Induced Flooding Features	Contracting plan is not developed. Lack of Material Suppliers (stone)	Contractors are likely available who can perform the work. Limited competition for contractors who can install deployable flood gates, etc.	Marginal	Unlikely	0



Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	AS-11	Residual Risk Features	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.	Contractors are likely available who can perform the work. Non federal interests will be interested in constructing local projects.	Moderate	Likely	3
Yes	AS-12	Interior Drainage Features	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.	Contractors are likely available who can perform the work. Non federal interests will be interested in constructing local projects.	Moderate	Likely	3
Yes	AS-13	Cultural Resource Mitigation	no concerns		Negligible	Possible	0
Yes	AS-14	Individual Structure Protection / Non-Structural	Contracting plan is not developed. Design-build possible. Many small contracts. SB or 8a Contracting likely.		Moderate	Likely	3
Yes	AS-15	Planning, Engineering, & Design	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2
Yes	AS-16	Construction Management	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2
<b>Construction Elements</b>					<b>Maximum Project Growth 15%</b>		
Yes	CON-2	Relocations	Potential for modifications and claims		Negligible	Likely	1
Yes	CON-3	Environmental Mitigation	Availability of local plantings Unique construction methods Environmental Windows Marginal site access. Active species monitoring requirements during construction.		Significant	Likely	4

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	CON-4	SSB: Verrazano Narrows	Poor site access. Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints. Navigation impacts.	Site Access - Marine based construction, cofferdams, etc. Temporary navigation channel? Repetition in construction elements - benefit. Existing debris, wrecks, and siphons could obstruct pile driving and other deep foundation elements for VN island construction.	Moderate	Likely	3
Yes	CON-5	SSB: Arthur Kill	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints. Navigation impacts.	Good site access	Moderate	Possible	2
Yes	CON-6	SSB: Jamaica Bay	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints.	Site Access - Marine based construction, cofferdams, etc. Repetition in construction elements - benefit.	Moderate	Possible	2
Yes	CON-7	SSB: Throgs Neck	Poor site access. Environmental Window restrictions. Standby time due to weather/storm surge delays, site constraints, currents. Navigation impacts.	Navigation impacts not as severe as VN. Site access - no land based access. Marine based construction. Standby Time - This location has extreme tides and currents.	Moderate	Likely	3
Yes	CON-8	IFF SSB and RRF Navigable Barriers	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints. Navigation impacts. Site access constraints	Weather delays - more sheltered than outer SSBs Site access - urban areas, limited laydown and shore access, marine access is good.	Moderate	Likely	3
Yes	CON-9	Shoreline Based Measures	Environmental Windows Marginal site access. More complex construction elements	Recreational windows is not a concern. Construction elements - cofferdams, tide gates, etc.	Marginal	Likely	2
Yes	CON-10	Induced Flooding Features	Environmental Windows Marginal site access. More complex construction elements	Recreational windows is not a concern. Construction elements - cofferdams, tide gates, etc.	Marginal	Likely	2

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	CON-11	Residual Risk Features	Environmental Windows Marginal site access. Tide Gates	Nav gates covered under a separate item.	Negligible	Likely	1
Yes	CON-12	Interior Drainage Features	Site Access		Negligible	Likely	1
Yes	CON-13	Cultural Resource Mitigation	Site access issues including submerged resources		Negligible	Likely	1
Yes	CON-14	Individual Structure Protection / Non-Structural	Potential for modifications or claims is high for modifications to existing structures. Site access.		Moderate	Likely	3
Yes	CON-15	Planning, Engineering, & Design	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
Yes	CON-16	Construction Management	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
<b>Quantities for Current Scope</b>					<b>Maximum Project Growth 20%</b>		
Yes	Q-2	Relocations	Parametric Cost - No Quantities.		Moderate	Likely	3
Yes	Q-3	Environmental Mitigation	Limited physical site data. High uncertainty related to quantities given the level of design	Mitigation recommendations will need to be incorporated into the costs.	Marginal	Likely	2
Yes	Q-4	SSB: Verrazano Narrows	Limited physical site data. High uncertainty related to quantities given the level of design.	Limited physical site data / anticipate better geotechnical conditions at alignments G and H.	Moderate	Possible	2
Yes	Q-5	SSB: Arthur Kill	Limited physical site data. Very high uncertainty related to quantities given the level of design.	Quantities - water depth across AK is much less (more variability) than the water depth across VN sector gate. Land based construction of islands should reduce scaled VN qtys. Geotechnical data - better conditions than VN.	Moderate	Possible	2

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	Q-6	SSB: Jamaica Bay	Limited physical site data High uncertainty related to quantities given the level of design.		Moderate	Possible	2
Yes	Q-7	SSB: Throgs Neck	Limited physical site data. Very high uncertainty related to quantities given the level of design.		Moderate	Likely	3
Yes	Q-8	IFF SSB and RRF Navigable Barriers	Limited physical site data. Very high uncertainty related to quantities given the level of design.	Quantities scaled from HR.	Significant	Likely	4
Yes	Q-9	Shoreline Based Measures	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment	Lack of geotech data - uncertainty in foundation costs.	Marginal	Likely	2
Yes	Q-10	Induced Flooding Features	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment	Lack of geotech data - uncertainty in foundation costs.	Marginal	Likely	2
Yes	Q-11	Residual Risk Features	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment		Marginal	Likely	2
Yes	Q-12	Interior Drainage Features	Parametric design - high uncertainty		Moderate	Likely	3
Yes	Q-13	Cultural Resource Mitigation	no concern		Negligible	Possible	0
Yes	Q-14	Individual Structure Protection / Non-Structural	High uncertainty in quantities - quantities based off a typical building.	Buildings in high frequency flood plains tend to be older, drive qrys up	Significant	Likely	4
Yes	Q-15	Planning, Engineering, & Design	Level of confidence based on design and assumptions?	Likelihood of quantity changes/updates on the project features will have a marginal cost impact on the PED.	Marginal	Likely	2
Yes	Q-16	Construction Management	no concerns		Negligible	Possible	0
<b>Specialty Fabrication or Equipment</b>				<b>Maximum Project Growth</b>			<b>50%</b>
Yes	FE-2	Relocations	no concerns		Marginal	Unlikely	0

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	FE-3	Environmental Mitigation	Risk of specialty feature functioning the first time.		Negligible	Possible	0
Yes	FE-4	SSB: Verrazano Narrows	No design work completed on MEP. Fabrication of sector gates is very complex. Lift gates fabrication in minimally complex. Some questions about who could supply and who could install the floating sector gate. Difficult to transport the floating sector gates.	Sector Gates require steel pipe not produced in US. The ball and socket fabrications for the floating sector gate at Verrazano Narrows are significantly complex undertakings. The firm that fabricated the ball and socket for Maeslant (Skoda, Czech Republic) is no longer in business. Hence, an alternate firm capable of fabricating the ball and socket devices will need to be identified.	Moderate	Likely	3
Yes	FE-5	SSB: Arthur Kill	No design work completed on MEP. Fabrication of sector gates is very complex. Lift gates fabrication in minimally complex.	Similar to VN.	Moderate	Likely	3
Yes	FE-6	SSB: Jamaica Bay	No design work completed on MEP. Fabrication of sector gates and lift gates minimally complex.		Marginal	Likely	2
Yes	FE-7	SSB: Throgs Neck	No design work completed on MEP. Fabrication of sector gates is very complex. Lift gates fabrication is minimally complex.	Sector gate span width is 1/3 of VN.	Moderate	Likely	3
Yes	FE-8	IFF SSB and RRF Navigable Barriers	No design work completed on MEP Conventional gates.		Marginal	Possible	1
Yes	FE-9	Shoreline Based Measures	Equipment for placing stone. Tide Gates		Marginal	Possible	1
Yes	FE-10	Induced Flooding Features	Tide Gates		Marginal	Possible	1
Yes	FE-11	Residual Risk Features	Tide Gates		Marginal	Possible	1
Yes	FE-12	Interior Drainage Features	no concerns		Marginal	Unlikely	0
Yes	FE-13	Cultural Resource Mitigation	Unusual parts, materials, and equipment		Negligible	Possible	0

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	FE-14	Individual Structure Protection / Non-Structural	limited concern - road closure gates		Marginal	Possible	1
Yes	FE-15	Planning, Engineering, & Design	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Floating Sector Gates - Fabrication of sector gates is very complex.	Marginal	Possible	1
Yes	FE-16	Construction Management	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Floating Sector Gates - Fabrication of sector gates is very complex.	Marginal	Possible	1
<b>Cost Estimate Assumptions</b>				<b>Maximum Project Growth 25%</b>			
Yes	EST-2	Relocations	Parametric Cost		Significant	Likely	4
Yes	EST-3	Environmental Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Marginal	Very LIKELY	3
Yes	EST-4	SSB: Verrazano Narrows	The Mobilization, JOOH, HOOH, Profit, Bonds, and Insurance costs are applied as a percentage of the feature/phase cost. No material supply quotes. Heavy reliance on cost book data.	Sector Gate - Where will it be fabricated? May need an exemption for foreign supplier.	Marginal	Likely	2
Yes	EST-5	SSB: Arthur Kill	Hybrid approach - parametric.	Cost scaled from VN Sector Gate.	Moderate	Likely	3
Yes	EST-6	SSB: Jamaica Bay	The Mobilization, JOOH, HOOH, Profit, Bonds, and Insurance costs are applied as a percentage of the feature/phase cost. No material supply quotes. Heavy reliance on cost book data.		Marginal	Likely	2
Yes	EST-7	SSB: Throgs Neck	Hybrid approach - parametric.	Cost scaled from VN Sector Gate.	Moderate	Likely	3
Yes	EST-8	IFF SSB and RRF Navigable Barriers	Hybrid approach - parametric.	Cost scaled from HR Sector Gate.	Moderate	Likely	3
Yes	EST-9	Shoreline Based Measures	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EST-10	Induced Flooding Features	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-11	Residual Risk Features	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-12	Interior Drainage Features	Parametric estimate.		Moderate	Very LIKELY	4
Yes	EST-13	Cultural Resource Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Negligible	Very LIKELY	2
Yes	EST-14	Individual Structure Protection / Non-Structural	Parametric approach		Moderate	Likely	3
Yes	EST-15	Planning, Engineering, & Design	no concern		Negligible	Unlikely	0
Yes	EST-16	Construction Management	no concern		Negligible	Unlikely	0
<b>External Project Risks</b>					<b>Maximum Project Growth 20%</b>		
Yes	EX-2	Relocations	Recent heavy volatility on material supply and fuel costs.	Federal and non-federal funding - higher concern with projects that span multiple political cycles.	Marginal	Likely	2
Yes	EX-3	Environmental Mitigation	New rules or regulations. Recent heavy volatility on material supply and fuel costs. Legal action / lawsuits Community acceptance	**higher impact than other alternatives	Significant	Likely	4

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-4	SSB: Verrazano Narrows	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept.	Potential for larger vessels in future impacts navigation through proposed barrier. Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3
Yes	EX-5	SSB: Arthur Kill	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept.	Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3
Yes	EX-6	SSB: Jamaica Bay	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept.	Navigation industry buy-off on this concept - much less of a factor. Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3
Yes	EX-7	SSB: Throgs Neck	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept.	Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3



Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-8	IFF SSB and RRF Navigable Barriers	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Significant	Likely	4
Yes	EX-9	Shoreline Based Measures	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3
Yes	EX-10	Induced Flooding Features	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3
Yes	EX-11	Residual Risk Features	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3
Yes	EX-12	Interior Drainage Features	Bidding competition from other projects / shortage of contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-13	Cultural Resource Mitigation	Lack of agreement with coordinating agencies on execution of programmatic agreement. Public concerns		Marginal	Possible	1
Yes	EX-14	Individual Structure Protection / Non-Structural	Bidding competition - lack of interest Loss of use for lower levels - is compensation required?	Compensation could be required if a homeowner loses a lower level apartment. Will apply to a limited number of buildings. **Notes for NYC - significant, very likely	Marginal	Likely	2
Yes	EX-15	Planning, Engineering, & Design	Political Influences, lack of support, etc.		Significant	Likely	4
Yes	EX-16	Construction Management	Political Influences, lack of support, etc.		Significant	Likely	4

Risk Level					
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3
	Negligible	Marginal	Moderate	Significant	Critical

**Table 24: Alternative 3B Risk Register**

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
<b>Project Scope Growth</b>					<b>Maximum Project Growth</b>		<b>40%</b>
Yes	PS-1	Lands and Damages					FALSE
Yes	PS-2	Relocations	Potential for scope growth, added features, and quantities. No field investigations, utility surveys, or desktop reviews of public records completed.	Cost based off linear feet of feature and site specific modifiers. No design completed. Temporary displacements not accounted for? Major pieces of infrastructure (i.e. pipe lines) not accounted for.	Significant	Very LIKELY	5
Yes	PS-3	Environmental Mitigation	Sufficient mitigation opportunities exist? Potential for scope growth, added features Limited field investigations to support assumptions.	Smaller but multiple areas to mitigate. May not have the space to mitigate. Scope Growth - Changes in Endangered Species Monitoring Requirements, environmental windows. More certainty in the scope to mitigate compared to Alt. 2	Significant	Likely	4
Yes	PS-4	SSB: Arthur Kill	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Navigation passage dimensions could increase. Crest elevation changes. Uncertainty on location/alignment. Multi functional infrastructure (bridge)	Multi functional infrastructure (bridge) - less of a concern Nav Pass width - likely to stay within boundaries studied.	Marginal	Possible	1

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-5	SSB: Kill Van Kull	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Uncertainty on location/alignment.	Project Scope Growth - No SBM developed yet for Alignment D. Project Scope Growth - Navigation community had concerns with original alignment. Alignment D used for baseline and could resolve concerns from the Navigation Community. Alignment C could increase cost by ~250% Significant crest elevation changes not expected	Marginal	Possible	1
Yes	PS-6	SSB: Jamaica Bay	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes. Multi functional infrastructure (bridge) Design/construction techniques could be impacted by environmental review / visual impacts	Reasonably high level of confidence in geotechnical data - nearby bridge. High confidence in nav pass dimensions - barge traffic. Different gate type might be required due to visual impacts.	Marginal	Possible	1
Yes	PS-7	SSBs: Gowanus, Newtown & Flushing	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Uncertainty on location/alignment. Uncertainty on navigation and flow requirements.	Scope Growth - Gowanus and Newtown Creek contamination concerns.	Significant	Very LIKELY	5
Yes	PS-8	IFF SSB and RRF Navigable Barriers	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Uncertainty on location/alignment. Uncertainty on navigation and flow requirements.	Scope Growth - Gowanus and Newtown Creek contamination concerns.	Significant	Very LIKELY	5

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-9	Shoreline Based Measures	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Scope growth - aesthetics, beach nourishment Scope Growth related to highly developed areas (i.e. Manhattan) and contamination. More transitions, public space, etc.	Significant	Likely	4
Yes	PS-10	Induced Flooding Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Scope Growth - IFF placement is limited to areas where water elevations increase 0.5 ft. Decreased Scope Growth - IFFs may not be required. Scope Growth - Potential for alignment changes, transition features not defined, beach access	Moderate	Likely	3
Yes	PS-11	Residual Risk Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Crest elevation changes - less of a concern. Scope growth - small alignment changes, tie-ins, nature based features, all JB features may not be accounted for Scope growth - close proximity to NPS property. Scope growth - contaminated sediment	Significant	Likely	4
Yes	PS-12	Interior Drainage Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions.	Parametric design and cost. Limit engineering completed. Future conditions may not be adequately accounted for. 5-year flow assumption may not be correct. Pump station not required.	Significant	Likely	4
Yes	PS-12	Cultural Resource Mitigation	Additional impacts from design changes. NPS Properties and Landmark Properties Limited field investigations to support assumptions.	Additional mitigation may be required that is not accounted for following review by the Resource Agencies.	Marginal	Very LIKELY	3
Yes	PS-13	Individual Structure Protection / Non- Structural	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions.	Scope growth - not a significant concern.	Moderate	Unlikely	1

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-14	Planning, Engineering, & Design	Potential for scope growth and added features	Project Scope Growth - PED Contingency should be directly correlated to the overall weighted construction contingency. Field Investigations, Numerical, and Physical Modeling, Adaptive Management and Monitoring	Significant	Likely	4
Yes	PS-15	Construction Management	Potential for scope growth and added features	Project Scope Growth - CM Contingency should be directly correlated to the overall weighted construction contingency.	Significant	Likely	4
<b>Acquisition Strategy</b>					<b>Maximum Project Growth</b>		<b>30%</b>
Yes	AS-2	Relocations	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.		Marginal	Likely	2
Yes	AS-3	Environmental Mitigation	Contracting plan is not developed. Many small contracts.		Marginal	Likely	2
Yes	AS-4	SSB: Arthur Kill	Limited bid competition expected for the SSBs. Contracting plan is not developed.	Similar to VN - Floating sector gate.	Marginal	Likely	2
Yes	AS-5	SSB: Kill Van Kull	Limited bid competition expected for the SSBs. Contracting plan is not developed.	Similar to VN - Floating sector gate.	Marginal	Likely	2
Yes	AS-6	SSB: Jamaica Bay	Limited bid competition expected for the SSBs. Contracting plan is not developed.		Marginal	Likely	2
Yes	AS-7	SSBs: Gowanus, Newtown & Flushing	Contracting plan is not developed.	Bid competition is less of a concern	Marginal	Possible	1
Yes	AS-8	IFF SSB and RRF Navigable Barriers	Contracting plan is not developed.	Bid competition is less of a concern	Marginal	Possible	1
Yes	AS-9	Shoreline Based Measures	Contracting plan is not developed. Lack of Material Suppliers (stone)	Contractors are likely available who can perform the work.	Marginal	Unlikely	0

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	AS-10	Induced Flooding Features	Contracting plan is not developed. Lack of Material Suppliers (stone)	Contractors are likely available who can perform the work. Limited competition for contractors who can install deployable flood gates, etc.	Marginal	Unlikely	0
Yes	AS-11	Residual Risk Features	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.	Contractors are likely available who can perform the work. Non federal interests will be interested in constructing local projects.	Moderate	Likely	3
Yes	AS-12	Interior Drainage Features	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.	Contractors are likely available who can perform the work. Non federal interests will be interested in constructing local projects.	Moderate	Likely	3
Yes	AS-12	Cultural Resource Mitigation	no concerns		Negligible	Possible	0
Yes	AS-13	Individual Structure Protection / Non- Structural	Contracting plan is not developed. Design-build possible. Many small contracts. SB or 8a Contracting likely.		Moderate	Likely	3
Yes	AS-14	Planning, Engineering, & Design	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2
Yes	AS-15	Construction Management	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2
<b>Construction Elements</b>					<b>Maximum Project Growth</b>		<b>15%</b>
Yes	CON-2	Relocations	Potential for modifications and claims	Higher impact number for 3B and 4 due to population density.	Marginal	Likely	2
Yes	CON-3	Environmental Mitigation	Availability of local plantings Unique construction methods Environmental Windows Marginal site access. Active species monitoring requirements during construction.		Significant	Likely	4

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	CON-4	SSB: Arthur Kill	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints. Navigation impacts.	Weather delays - more sheltered than outer harbor areas. Navigation impacts - More impacts than VN because VN had a temporary navigation channel. Site access - Land based Construction	Moderate	Possible	2
Yes	CON-5	SSB: Kill Van Kull	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints. Navigation impacts.	Weather delays - more sheltered than outer harbor areas. Navigation impacts - More impacts than VN because VN had a temporary navigation channel. Site access - Land based Construction	Moderate	Possible	2
Yes	CON-6	SSB: Jamaica Bay	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints.	Site Access - Marine based construction, cofferdams, etc. Repetition in construction elements - benefit.	Moderate	Possible	2
Yes	CON-7	SSBs: Gowanus, Newtown & Flushing	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints. Navigation impacts. Site access constraints	Weather delays - more sheltered than outer SSBs Site access - urban areas, limited laydown and shore access, marine access is good.	Moderate	Likely	3
Yes	CON-8	IFF SSB and RRF Navigable Barriers	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints. Navigation impacts. Site access constraints	Weather delays - more sheltered than outer SSBs Site access - urban areas, limited laydown and shore access, marine access is good.	Moderate	Likely	3
Yes	CON-9	Shoreline Based Measures	Environmental Windows Marginal site access. More complex construction elements	Recreational windows is not a concern. Construction elements - cofferdams, tide gates, etc.	Marginal	Likely	2
Yes	CON-10	Induced Flooding Features	Environmental Windows Marginal site access. More complex construction elements	Recreational windows is not a concern. Construction elements - cofferdams, tide gates, etc.	Marginal	Likely	2



Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	CON-11	Residual Risk Features	Environmental Windows Marginal site access. Tide Gates	Nav gates covered under a separate item.	Negligible	Likely	1
Yes	CON-12	Interior Drainage Features	Site access		Negligible	Likely	1
Yes	CON-12	Cultural Resource Mitigation	Site access issues including submerged resources		Negligible	Likely	1
Yes	CON-13	Individual Structure Protection / Non-Structural	Potential for modifications or claims is high for modifications to existing structures. Site access.		Moderate	Likely	3
Yes	CON-14	Planning, Engineering, & Design	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
Yes	CON-15	Construction Management	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
<b>Quantities for Current Scope</b>					<b>Maximum Project Growth</b>		<b>20%</b>
Yes	Q-2	Relocations	Parametric Cost - No Quantities.		Moderate	Likely	3
Yes	Q-3	Environmental Mitigation	Limited physical site data. High uncertainty related to quantities given the level of design	Mitigation recommendations will need to be incorporated into the costs.	Marginal	Likely	2
Yes	Q-4	SSB: Arthur Kill	Limited physical site data. Very high uncertainty related to quantities given the level of design.	Quantities - water depth across AK is much less (more variability) than the water depth across VN sector gate. Land based construction of islands should reduce scaled VN qrys. Geotechnical data - better conditions than VN.	Moderate	Possible	2

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	Q-5	SSB: Kill Van Kull	Limited physical site data. Very high uncertainty related to quantities given the level of design.	Quantities - water depth across AK is much less (more variability) than the water depth across VN sector gate. Land based construction of islands should reduce scaled VN qtys.  Geotechnical data - better conditions than VN. Should expect lower foundation quantities	Moderate	Possible	2
Yes	Q-6	SSB: Jamaica Bay	Limited physical site data High uncertainty related to quantities given the level of design.		Moderate	Possible	2
Yes	Q-7	SSBs: Gowanus, Newtown & Flushing	Limited physical site data. Very high uncertainty related to quantities given the level of design.	Quantities scaled from HR.	Significant	Likely	4
Yes	Q-8	IFF SSB and RRF Navigable Barriers	Limited physical site data. Very high uncertainty related to quantities given the level of design.	Quantities scaled from HR.	Significant	Likely	4
Yes	Q-9	Shoreline Based Measures	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment	Lack of geotech data - uncertainty in foundation costs.	Marginal	Likely	2
Yes	Q-10	Induced Flooding Features	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment	Lack of geotech data - uncertainty in foundation costs.	Marginal	Likely	2
Yes	Q-11	Residual Risk Features	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment		Marginal	Likely	2
Yes	Q-12	Interior Drainage Features	Parametric design - high uncertainty		Moderate	Likely	3
Yes	Q-13	Cultural Resource Mitigation	no concern		Negligible	Possible	0

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	Q-13	Individual Structure Protection / Non-Structural	High uncertainty in quantities - quantities based off a typical building.	Buildings in high frequency flood plains tend to be older, drive qtys up	Significant	Likely	4
Yes	Q-14	Planning, Engineering, & Design	Level of confidence based on design and assumptions?	Likelihood of quantity changes/updates on the project features will have a marginal cost impact on the PED.	Marginal	Likely	2
Yes	Q-15	Construction Management	no concerns		Negligible	Possible	0
<b>Specialty Fabrication or Equipment</b>					<b>Maximum Project Growth</b>		<b>50%</b>
Yes	FE-2	Relocations	no concerns		Marginal	Unlikely	0
Yes	FE-3	Environmental Mitigation	Risk of specialty feature functioning the first time.		Negligible	Possible	0
Yes	FE-4	SSB: Arthur Kill	No design work completed on MEP. Fabrication of sector gates is very complex. Lift gates fabrication in minimally complex. Confidence in supplier's ability?	Similar to VN.	Moderate	Likely	3
Yes	FE-5	SSB: Kill Van Kull	No design work completed on MEP. Fabrication of sector gates is very complex. Lift gates fabrication in minimally complex. Confidence in supplier's ability? Difficult material delivery conditions.	Similar to VN. Confidence in Supplier's ability - future outlook is good for more similar structures. Availability of Suppliers should increase. Material Supply - temporary MOF?	Moderate	Likely	3
Yes	FE-6	SSB: Jamaica Bay	No design work completed on MEP. Fabrication of sector gates and lift gates minimally complex.		Marginal	Likely	2
Yes	FE-7	SSBs: Gowanus, Newtown & Flushing	No design work completed on MEP Conventional gates.		Marginal	Possible	1
Yes	FE-8	IFF SSB and RRF Navigable Barriers	No design work completed on MEP Conventional gates.		Marginal	Possible	1

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	FE-9	Shoreline Based Measures	Equipment for placing stone. Tide Gates		Marginal	Possible	1
Yes	FE-10	Induced Flooding Features	Tide Gates		Marginal	Possible	1
Yes	FE-11	Residual Risk Features	Tide Gates		Marginal	Possible	1
Yes	FE-12	Interior Drainage Features	Large Pump Stations required		Marginal	Likely	2
Yes	FE-12	Cultural Resource Mitigation	Unusual parts, materials, and equipment		Negligible	Possible	0
Yes	FE-13	Individual Structure Protection / Non-Structural	limited concern - road closure gates		Marginal	Possible	1
Yes	FE-14	Planning, Engineering, & Design	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Floating Sector Gates - Fabrication of sector gates is very complex.	Marginal	Possible	1
Yes	FE-15	Construction Management	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Floating Sector Gates - Fabrication of sector gates is very complex.	Marginal	Possible	1
<b>Cost Estimate Assumptions</b>					<b>Maximum Project Growth</b>		<b>25%</b>
Yes	EST-2	Relocations	Parametric Cost		Significant	Likely	4
Yes	EST-3	Environmental Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Marginal	Likely	2
Yes	EST-4	SSB: Arthur Kill	Hybrid approach - parametric.		Moderate	Likely	3
Yes	EST-5	SSB: Kill Van Kull	Hybrid approach - parametric.	Cost scaled from VN Sector Gate.	Moderate	Likely	3
Yes	EST-6	SSB: Jamaica Bay	The Mobilization, JOOH, HOOH, Profit, Bonds, and Insurance costs are applied as a percentage of the feature/phase cost. No material supply quotes. Heavy reliance on cost book data.		Marginal	Likely	2

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EST-7	SSBs: Gowanus, Newtown & Flushing	Hybrid approach - parametric.	Cost scaled from HR Sector Gate.	Moderate	Likely	3
Yes	EST-8	IFF SSB and RRF Navigable Barriers	Hybrid approach - parametric.	Cost scaled from HR Sector Gate.	Moderate	Likely	3
Yes	EST-9	Shoreline Based Measures	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-10	Induced Flooding Features	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-11	Residual Risk Features	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-12	Interior Drainage Features	Parametric estimate.		Significant	Likely	4
Yes	EST-13	Cultural Resource Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Negligible	Very LIKELY	2
Yes	EST-13	Individual Structure Protection / Non- Structural	Parametric approach		Moderate	Likely	3
Yes	EST-14	Planning, Engineering, & Design	no concern		Negligible	Unlikely	0
Yes	EST-15	Construction Management	no concern		Negligible	Unlikely	0

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
<b>External Project Risks</b>				<b>Maximum Project Growth</b>			<b>20%</b>
Yes	EX-2	Relocations	Recent heavy volatility on material supply and fuel costs.	Federal and non-federal funding - higher concern with projects that span multiple political cycles.	Marginal	Likely	2
Yes	EX-3	Environmental Mitigation	New rules or regulations. Recent heavy volatility on material supply and fuel costs. Legal action / lawsuits Community acceptance Federal and non-federal funding sources.		Significant	Likely	4
Yes	EX-4	SSB: Arthur Kill	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept.	Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3
Yes	EX-5	SSB: Kill Van Kull	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept.	Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3
Yes	EX-6	SSB: Jamaica Bay	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept.	Navigation industry buy-off on this concept - much less of a factor. Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-7	SSBs: Gowanus, Newtown & Flushing	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Significant	Likely	4
Yes	EX-8	IFF SSB and RRF Navigable Barriers	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Significant	Likely	4
Yes	EX-9	Shoreline Based Measures	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.	Numerous community boards. Risk for public opposition.	Significant	Likely	4
Yes	EX-10	Induced Flooding Features	Federal and non-federal funding sources.		Moderate	Likely	3
Yes	EX-11	Residual Risk Features	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3
Yes	EX-12	Interior Drainage Features	Political Influences, lack of support, etc.		Moderate	Likely	3
Yes	EX-12	Cultural Resource Mitigation	Lack of agreement with coordinating agencies on execution of programmatic agreement. Public concerns		Marginal	Possible	1

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-13	Individual Structure Protection / Non- Structural	Recent heavy volatility on material supply and fuel costs.	Compensation could be required if a homeowner loses a lower level apartment. Will apply to a limited number of buildings. **Notes for NYC - significant, very likely	Significant	Very LIKELY	5
Yes	EX-14	Planning, Engineering, & Design	Political Influences, lack of support, etc.		Significant	Likely	4
Yes	EX-15	Construction Management	Political Influences, lack of support, etc.		Significant	Likely	4



Risk Level					
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3
	Negligible	Marginal	Moderate	Significant	Critical

**Table 25: Alternative 4 Risk Register**

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
<b>Project Scope Growth</b>					<b>Maximum Project Growth</b>		<b>40%</b>
Yes	PS-2	Relocations	Potential for scope growth, added features, and quantities. No field investigations, utility surveys, or desktop reviews of public records completed.	Cost based off linear feet of feature and site specific modifiers. No design completed. Temporary displacements not accounted for? Major pieces of infrastructure (i.e. pipe lines) not accounted for.	Significant	Very LIKELY	5
Yes	PS-3	Environmental Mitigation	Sufficient mitigation opportunities exist? Potential for scope growth, added features Limited field investigations to support assumptions.	Smaller but multiple areas to mitigate. May not have the space to mitigate. Scope Growth - Changes in Endangered Species Monitoring Requirements, environmental windows. More certainty in the scope to mitigate compared to Alt. 2	Significant	Likely	4
Yes	PS-4	SSB: Hackensack	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Potential to be listed as a Superfund site. Navigation gate width could increase. Crest elevation changes.	Superfund site - remediation testing, capping, energy dissipator. Coppercove on south tie-in is a brownfield site. Navigation gate width - matches bridge spans - likely fixed. Crest elevation changes - could be refined - ~0.5 to 1 foot reduction/increase possible.	Marginal	Likely	2

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-5	SSB: Jamaica Bay	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes. Multi functional infrastructure (bridge) Design/construction techniques could be impacted by environmental review / visual impacts	Reasonably high level of confidence in geotechnical data - nearby bridge. High confidence in nav pass dimensions - barge traffic. Different gate type might be required due to visual impacts.	Marginal	Possible	1
Yes	PS-6	SSBs: Gowanus, Newtown & Flushing + RRF	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Uncertainty on location/alignment. Uncertainty on navigation and flow requirements.	Scope Growth - Gowanus and Newtown Creek contamination concerns.	Significant	Very LIKELY	5
Yes	PS-7	Shoreline Based Measures	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Scope growth - aesthetics, beach nourishment Scope Growth related to highly developed areas (i.e. Manhattan) and contamination. More transitions, public space, etc.	Significant	Likely	4
Yes	PS-8	Induced Flooding Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Scope Growth - IFF placement is limited to areas where water elevations increase 0.5 ft. Decreased Scope Growth - IFFs may not be required. Scope Growth - Potential for alignment changes, transition features not defined, beach access Scope Growth - Contaminated sediments is a major concern.	Significant	Likely	4

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-9	Residual Risk Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Crest elevation changes - less of a concern. Scope growth - small alignment changes, tie-ins, nature based features, all JB features may not be accounted for Scope growth - close proximity to NPS property. Scope growth - contaminated sediment	Significant	Likely	4
Yes	PS-10	Interior Drainage Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions.	Parametric design and cost. Limit engineering completed. Future conditions may not be adequately accounted for. 5-year flow assumption may not be correct. Pump station not required.	Significant	Likely	4
Yes	PS-11	Cultural Resource Mitigation	Additional impacts from design changes. NPS Properties and Landmark Properties Limited field investigations to support assumptions.	Additional mitigation may be required that is not accounted for following review by the Resource Agencies.	Marginal	Very LIKELY	3
Yes	PS-12	Individual Structure Protection / Non-Structural	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions.	Scope growth - not a significant concern.	Moderate	Unlikely	1
Yes	PS-13	Planning, Engineering, & Design	Potential for scope growth and added features	Project Scope Growth - PED Contingency should be directly correlated to the overall weighted construction contingency. Field Investigations, Numerical, and Physical Modeling, Adaptive Management and Monitoring	Significant	Likely	4
Yes	PS-14	Construction Management	Potential for scope growth and added features	Project Scope Growth - CM Contingency should be directly correlated to the overall weighted construction contingency.	Significant	Likely	4
<b>Acquisition Strategy</b>					<b>Maximum Project Growth</b>		<b>30%</b>
Yes	AS-2	Relocations	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.		Marginal	Likely	2

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	AS-3	Environmental Mitigation	Contracting plan is not developed. Many small contracts.		Marginal	Likely	2
Yes	AS-4	SSB: Hackensack	Limited bid competition expected for the SSBs. Contracting plan is not developed.		Marginal	Likely	2
Yes	AS-5	SSB: Jamaica Bay	Limited bid competition expected for the SSBs. Contracting plan is not developed.		Marginal	Likely	2
Yes	AS-6	SSBs: Gowanus, Newtown & Flushing + RRF	Contracting plan is not developed.	Bid competition is less of a concern	Marginal	Possible	1
Yes	AS-7	Shoreline Based Measures	Contracting plan is not developed. Lack of Material Suppliers (stone)	Contractors are likely available who can perform the work.	Marginal	Unlikely	0
Yes	AS-8	Induced Flooding Features	Contracting plan is not developed. Lack of Material Suppliers (stone)	Contractors are likely available who can perform the work. Limited competition for contractors who can install deployable flood gates, etc.	Marginal	Unlikely	0
Yes	AS-9	Residual Risk Features	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.	Contractors are likely available who can perform the work. Non federal interests will be interested in constructing local projects.	Moderate	Likely	3
Yes	AS-10	Interior Drainage Features	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.	Contractors are likely available who can perform the work. Non federal interests will be interested in constructing local projects.	Moderate	Likely	3
Yes	AS-11	Cultural Resource Mitigation	no concerns		Negligible	Possible	0
Yes	AS-12	Individual Structure Protection / Non-Structural	Contracting plan is not developed. Design-build possible. Many small contracts. SB or 8a Contracting likely.		Moderate	Likely	3
Yes	AS-13	Planning, Engineering, & Design	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	AS-14	Construction Management	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2
<b>Construction Elements</b>					<b>Maximum Project Growth 15%</b>		
Yes	CON-2	Relocations	Potential for modifications and claims	Higher impact number for 3B and 4 due to population density.	Marginal	Likely	2
Yes	CON-3	Environmental Mitigation	Availability of local plantings Unique construction methods Environmental Windows Marginal site access. Active species monitoring requirements during construction.		Significant	Likely	4
Yes	CON-4	SSB: Hackensack	Poor site access. Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints.	Site access - temporary trestle assumed. Environmental Windows - assumed to impact the productivity for developing the cost and durations. Site not significantly impacted by flash flood events. Complex construction - minimal, some complex construction requirements related to tolerances. Repetition in construction elements - benefit.	Marginal	Possible	1
Yes	CON-5	SSB: Jamaica Bay	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints.	Site Access - Marine based construction, cofferdams, etc. Repetition in construction elements - benefit.	Moderate	Possible	2
Yes	CON-6	SSBs: Gowanus, Newtown & Flushing + RRF	Environmental Window restrictions. Standby time due to weather/storm surge delays and site constraints. Navigation impacts. Site access constraints	Weather delays - more sheltered than outer SSBs Site access - urban areas, limited laydown and shore access, marine access is good.	Moderate	Likely	3
Yes	CON-7	Shoreline Based Measures	Environmental Windows Marginal site access. More complex construction elements	Recreational windows is not a concern. Construction elements - cofferdams, tide gates, etc.	Marginal	Likely	2

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	CON-8	Induced Flooding Features	Environmental Windows Marginal site access. More complex construction elements	Recreational windows is not a concern. Construction elements - cofferdams, tide gates, etc.	Marginal	Likely	2
Yes	CON-9	Residual Risk Features	Environmental Windows Marginal site access. Tide Gates		Negligible	Likely	1
Yes	CON-10	Interior Drainage Features	Site access		Negligible	Likely	1
Yes	CON-11	Cultural Resource Mitigation	Site access issues including submerged resources		Negligible	Likely	1
Yes	CON-12	Individual Structure Protection / Non-Structural	Potential for modifications or claims is high for modifications to existing structures. Site access.		Moderate	Likely	3
Yes	CON-13	Planning, Engineering, & Design	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
Yes	CON-14	Construction Management	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
<b>Quantities for Current Scope</b>					<b>Maximum Project Growth</b>		<b>20%</b>
Yes	Q-2	Relocations	Parametric Cost - No Quantities.		Moderate	Likely	3
Yes	Q-3	Environmental Mitigation	Limited physical site data. High uncertainty related to quantities given the level of design	Mitigation recommendations will need to be incorporated into the costs.	Marginal	Likely	2
Yes	Q-4	SSB: Hackensack	Limited physical site data (and anticipated variable site data) High uncertainty related to quantities given the level of design.	Previous investigations indicated very variable geotechnical conditions.	Moderate	Possible	2

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	Q-5	SSB: Jamaica Bay	Limited physical site data High uncertainty related to quantities given the level of design.		Moderate	Possible	2
Yes	Q-6	SSBs: Gowanus, Newtown & Flushing + RRF	Limited physical site data. Very high uncertainty related to quantities given the level of design.	Quantities scaled from HR.	Significant	Likely	4
Yes	Q-7	Shoreline Based Measures	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment	Lack of geotech data - uncertainty in foundation costs.	Marginal	Likely	2
Yes	Q-8	Induced Flooding Features	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment	Lack of geotech data - uncertainty in foundation costs.	Marginal	Likely	2
Yes	Q-9	Residual Risk Features	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment		Marginal	Likely	2
Yes	Q-10	Interior Drainage Features	Parametric design - high uncertainty		Moderate	Likely	3
Yes	Q-11	Cultural Resource Mitigation	no concern		Negligible	Possible	0
Yes	Q-12	Individual Structure Protection / Non-Structural	High uncertainty in quantities - quantities based off a typical building.	Buildings in high frequency flood plains tend to be older, drive qtys up	Significant	Likely	4
Yes	Q-13	Planning, Engineering, & Design	Level of confidence based on design and assumptions?	Likelihood of quantity changes/updates on the project features will have a marginal cost impact on the PED.	Marginal	Likely	2
Yes	Q-14	Construction Management	no concerns		Negligible	Possible	0
<b>Specialty Fabrication or Equipment</b>					<b>Maximum Project Growth</b>		<b>50%</b>
Yes	FE-2	Relocations	no concerns		Marginal	Unlikely	0
Yes	FE-3	Environmental Mitigation	Risk of specialty feature functioning the first time.		Negligible	Possible	0

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	FE-4	SSB: Hackensack	No design work completed on MEP. Fabrication of sector gates and lift gates minimally complex.	Should be able to deliver gates via barges.	Marginal	Likely	2
Yes	FE-5	SSB: Jamaica Bay	No design work completed on MEP. Fabrication of sector gates and lift gates minimally complex.		Marginal	Likely	2
Yes	FE-6	SSBs: Gowanus, Newtown & Flushing + RRF	No design work completed on MEP Conventional gates.		Marginal	Possible	1
Yes	FE-7	Shoreline Based Measures	Equipment for placing stone. Tide Gates		Marginal	Possible	1
Yes	FE-8	Induced Flooding Features	Tide Gates		Marginal	Possible	1
Yes	FE-9	Residual Risk Features	Tide Gates		Marginal	Possible	1
Yes	FE-10	Interior Drainage Features	Large Pump Stations required		Marginal	Likely	2
Yes	FE-11	Cultural Resource Mitigation	Unusual parts, materials, and equipment		Negligible	Possible	0
Yes	FE-12	Individual Structure Protection / Non-Structural	limited concern - road closure gates		Marginal	Possible	1
Yes	FE-13	Planning, Engineering, & Design	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Conventional Sector Gates - Fabrication of sector gates is not as complex as floating sector gates.	Negligible	Possible	0
Yes	FE-14	Construction Management	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Conventional Sector Gates - Fabrication of sector gates is not as complex as floating sector gates.	Negligible	Possible	0
<b>Cost Estimate Assumptions</b>					<b>Maximum Project Growth</b>		<b>25%</b>
Yes	EST-2	Relocations	Parametric Cost		Significant	Likely	4



Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EST-3	Environmental Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Marginal	Likely	2
Yes	EST-4	SSB: Hackensack	The Mobilization, JOOH, HOOH, Profit, Bonds, and Insurance costs are applied as a percentage of the feature/phase cost. No material supply quotes. Heavy reliance on cost book data.		Marginal	Likely	2
Yes	EST-5	SSB: Jamaica Bay	The Mobilization, JOOH, HOOH, Profit, Bonds, and Insurance costs are applied as a percentage of the feature/phase cost. No material supply quotes. Heavy reliance on cost book data.		Marginal	Likely	2
Yes	EST-6	SSBs: Gowanus, Newtown & Flushing + RRF	Hybrid approach - parametric.	Cost scaled from HR Sector Gate.	Moderate	Likely	3
Yes	EST-7	Shoreline Based Measures	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-8	Induced Flooding Features	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-9	Residual Risk Features	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3
Yes	EST-10	Interior Drainage Features	Parametric estimate.		Significant	Likely	4
Yes	EST-11	Cultural Resource Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Negligible	Very LIKELY	2

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EST-12	Individual Structure Protection / Non-Structural	Parametric approach		Moderate	Likely	3
Yes	EST-13	Planning, Engineering, & Design	no concern		Negligible	Unlikely	0
Yes	EST-14	Construction Management	no concern		Negligible	Unlikely	0
<b>External Project Risks</b>					<b>Maximum Project Growth</b>		<b>20%</b>
Yes	EX-2	Relocations	Recent heavy volatility on material supply and fuel costs.	Federal and non-federal funding - higher concern with projects that span multiple political cycles.	Marginal	Likely	2
Yes	EX-3	Environmental Mitigation	New rules or regulations. Recent heavy volatility on material supply and fuel costs. Legal action / lawsuits Community acceptance Federal and non-federal funding sources.		Significant	Likely	4
Yes	EX-4	SSB: Hackensack	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.	Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3
Yes	EX-5	SSB: Jamaica Bay	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs. Navigation industry buy-off on this concept.	Navigation industry buy-off on this concept - much less of a factor. Bidding competition - are other projects (e.g., HATS, OSW, etc.) being constructed at the same time?	Moderate	Likely	3

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-6	SSBs: Gowanus, Newtown & Flushing + RRF	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Significant	Likely	4
Yes	EX-7	Shoreline Based Measures	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.	Numerous community boards. Risk for public opposition.	Significant	Likely	4
Yes	EX-8	Induced Flooding Features	Federal and non-federal funding sources.		Moderate	Likely	3
Yes	EX-9	Residual Risk Features	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3
Yes	EX-10	Interior Drainage Features	Bidding competition from other projects / shortage of contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3
Yes	EX-11	Cultural Resource Mitigation	Lack of agreement with coordinating agencies on execution of programmatic agreement. Public concerns		Marginal	Possible	1

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-12	Individual Structure Protection / Non-Structural	Bidding competition - lack of interest Loss of use for lower levels - is compensation required?	Compensation could be required if a homeowner loses a lower level apartment. Will apply to a limited number of buildings. **Notes for NYC - significant, very likely	Significant	Very LIKELY	5
Yes	EX-13	Planning, Engineering, & Design	Political Influences, lack of support, etc.		Significant	Likely	4
Yes	EX-14	Construction Management	Political Influences, lack of support, etc.		Significant	Likely	4

Risk Level					
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3
	Negligible	Marginal	Moderate	Significant	Critical

**Table 26: Alternative 5 Risk Register**

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
<b>Project Scope Growth</b>					<b>Maximum Project Growth</b>		<b>40%</b>
Yes	PS-2	Relocations	Potential for scope growth, added features, and quantities. No field investigations, utility surveys, or desktop reviews of public records completed.	Cost based off linear feet of feature and site specific modifiers. No design completed. Temporary displacements not accounted for? Major pieces of infrastructure (i.e. pipe lines) not accounted for.	Significant	Very LIKELY	5
Yes	PS-3	Environmental Mitigation	Sufficient mitigation opportunities exist? Potential for scope growth, added features Limited field investigations to support assumptions.	Smaller but multiple areas to mitigate. May not have the space to mitigate. Scope Growth - Changes in Endangered Species Monitoring Requirements, environmental windows. More certainty in the scope to mitigate compared to Alt. 2	Significant	Likely	4
Yes	PS-5	Shoreline Based Measures	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions. Crest elevation changes.	Scope growth - aesthetics, beach nourishment Scope Growth related to highly developed areas (i.e. Manhattan) and contamination. More transitions, public space, etc.	Significant	Likely	4
Yes	PS-8	Interior Drainage Features	Potential for scope growth, added features, and quantities. Limited field investigations and historical data to support design assumptions.	Parametric design and cost. Limit engineering completed. Future conditions may not be adequately accounted for. 5-year flow assumption may not be correct. Pump station not required.	Significant	Likely	4
Yes	PS-9	Cultural Resource Mitigation	Additional impacts from design changes. NPS Properties and Landmark Properties Limited field investigations to support assumptions.	Additional mitigation may be required that is not accounted for following review by the Resource Agencies.	Marginal	Very LIKELY	3

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	PS-11	Planning, Engineering, & Design	Potential for scope growth and added features	Project Scope Growth - PED Contingency should be directly correlated to the overall weighted construction contingency.  Field Investigations, Numerical, and Physical Modeling, Adaptive Management and Monitoring	Significant	Likely	4
Yes	PS-12	Construction Management	Potential for scope growth and added features	Project Scope Growth - CM Contingency should be directly correlated to the overall weighted construction contingency.	Significant	Likely	4
<b>Acquisition Strategy</b>					<b>Maximum Project Growth</b>		<b>30%</b>
Yes	AS-2	Relocations	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.		Marginal	Likely	2
Yes	AS-3	Environmental Mitigation	Contracting plan is not developed. Many small contracts.		Marginal	Likely	2
Yes	AS-5	Shoreline Based Measures	Contracting plan is not developed. Lack of Material Suppliers (stone)	Contractors are likely available who can perform the work.	Marginal	Unlikely	0
Yes	AS-8	Interior Drainage Features	Contracting plan is not developed. Many small contracts. SB or 8a Contracting likely.	Contractors are likely available who can perform the work.  Non federal interests will be interested in constructing local projects.	Moderate	Likely	3
Yes	AS-9	Cultural Resource Mitigation	no concerns		Negligible	Possible	0
Yes	AS-11	Planning, Engineering, & Design	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2
Yes	AS-12	Construction Management	Contracting plan is not developed. 8a or SB possible	Project will likely be broken up into a few larger projects and many smaller projects.	Marginal	Likely	2
<b>Construction Elements</b>					<b>Maximum Project Growth</b>		<b>15%</b>
Yes	CON-2	Relocations	Potential for modifications and claims		Negligible	Likely	1

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	CON-3	Environmental Mitigation	Availability of local plantings Unique construction methods Environmental Windows Marginal site access. Active species monitoring requirements during construction.		Significant	Likely	4
Yes	CON-5	Shoreline Based Measures	Environmental Windows Marginal site access. More complex construction elements	Recreational windows is not a concern. Construction elements - cofferdams, tide gates, etc.	Marginal	Likely	2
Yes	CON-8	Interior Drainage Features	Site access		Negligible	Likely	1
Yes	CON-9	Cultural Resource Mitigation	Site access issues including submerged resources		Negligible	Likely	1
Yes	CON-11	Planning, Engineering, & Design	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
Yes	CON-12	Construction Management	Complex construction elements. Potential for construction modifications and claims.		Marginal	Likely	2
<b>Quantities for Current Scope</b>					<b>Maximum Project Growth 20%</b>		
Yes	Q-2	Relocations	Parametric Cost - No Quantities.		Moderate	Likely	3
Yes	Q-3	Environmental Mitigation	Limited physical site data. High uncertainty related to quantities given the level of design	Mitigation recommendations will need to be incorporated into the costs.	Marginal	Likely	2
Yes	Q-5	Shoreline Based Measures	Limited physical site data. High uncertainty related to quantities given the level of design and uncertainty in alignment	Lack of geotech data - uncertainty in foundation costs.	Marginal	Likely	2
Yes	Q-8	Interior Drainage Features	Parametric design - high uncertainty		Moderate	Likely	3

Use/View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	Q-9	Cultural Resource Mitigation	no concern		Negligible	Possible	0
Yes	Q-11	Planning, Engineering, & Design	Level of confidence based on design and assumptions?	Likelihood of quantity changes/updates on the project features will have a marginal cost impact on the PED.	Marginal	Likely	2
Yes	Q-12	Construction Management	no concerns		Negligible	Possible	0
<b>Specialty Fabrication or Equipment</b>					<b>Maximum Project Growth</b>		<b>50%</b>
Yes	FE-2	Relocations	no concerns		Marginal	Unlikely	0
Yes	FE-3	Environmental Mitigation	Risk of specialty feature functioning the first time.		Negligible	Possible	0
Yes	FE-5	Shoreline Based Measures	Equipment for placing stone. Tide Gates		Marginal	Possible	1
Yes	FE-8	Interior Drainage Features	Large Pump Stations required		Marginal	Likely	2
Yes	FE-9	Cultural Resource Mitigation	Unusual parts, materials, and equipment		Negligible	Possible	0
Yes	FE-11	Planning, Engineering, & Design	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Conventional Sector Gates - Fabrication of sector gates is not as complex as floating sector gates.	Negligible	Possible	0
Yes	FE-12	Construction Management	Confidence in Supplier's ability? Confidence in Contractor's ability to install?	Conventional Sector Gates - Fabrication of sector gates is not as complex as floating sector gates.	Negligible	Possible	0
<b>Cost Estimate Assumptions</b>					<b>Maximum Project Growth</b>		<b>25%</b>
Yes	EST-2	Relocations	Parametric Cost		Significant	Likely	4
Yes	EST-3	Environmental Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Marginal	Likely	2
Yes	EST-5	Shoreline Based Measures	Limited material supply quotes. Mob., JOOH, etc. % based. Some uncertainty in application of site specific modifiers		Moderate	Likely	3



Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EST-8	Interior Drainage Features	Parametric estimate.		Significant	Likely	4
Yes	EST-9	Cultural Resource Mitigation	Costs are based on similar projects. Potential increase due to site specific conditions.		Negligible	Very LIKELY	2
Yes	EST-11	Planning, Engineering, & Design	no concern		Negligible	Unlikely	0
Yes	EST-12	Construction Management	no concern		Negligible	Unlikely	0
<b>External Project Risks</b>					<b>Maximum Project Growth</b>		<b>20%</b>
Yes	EX-2	Relocations	Recent heavy volatility on material supply and fuel costs.	Federal and non-federal funding - higher concern with projects that span multiple political cycles.	Marginal	Likely	2
Yes	EX-3	Environmental Mitigation	New rules or regulations. Recent heavy volatility on material supply and fuel costs. Legal action / lawsuits Community acceptance Federal and non-federal funding sources.		Significant	Likely	4
Yes	EX-5	Shoreline Based Measures	Bidding competition from other projects / shortage of marine contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.	Numerous community boards. Risk for public opposition.	Significant	Likely	4
Yes	EX-8	Interior Drainage Features	Bidding competition from other projects / shortage of contractors. Federal and non-federal funding sources. Political Influences, lack of support, etc. Recent heavy volatility on material supply and fuel costs.		Moderate	Likely	3

Use/ View	Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Yes	EX-9	Cultural Resource Mitigation	Lack of agreement with coordinating agencies on execution of programmatic agreement. Public concerns		Marginal	Possible	1
Yes	EX-11	Planning, Engineering, & Design	Political Influences, lack of support, etc.		Significant	Likely	4
Yes	EX-12	Construction Management	Political Influences, lack of support, etc.		Significant	Likely	4

## 11 References

- USACE. (2019a). *New York-New Jersey Harbor and Tributaries - Interim Report Cost Appendix*. New York: USACE New York District.
- USACE. (2019b). *New York-New Jersey Harbor and Tributaries - Overview of Engineering Work for the NYNJHATS Interim Report*. New York: USACE New York District.