



ResilienCity Community Partners
A Turner & EE Cruz Joint Venture

North/West Battery Park City Resiliency Project

Interior Drainage Update

OCTOBER 16, 2023



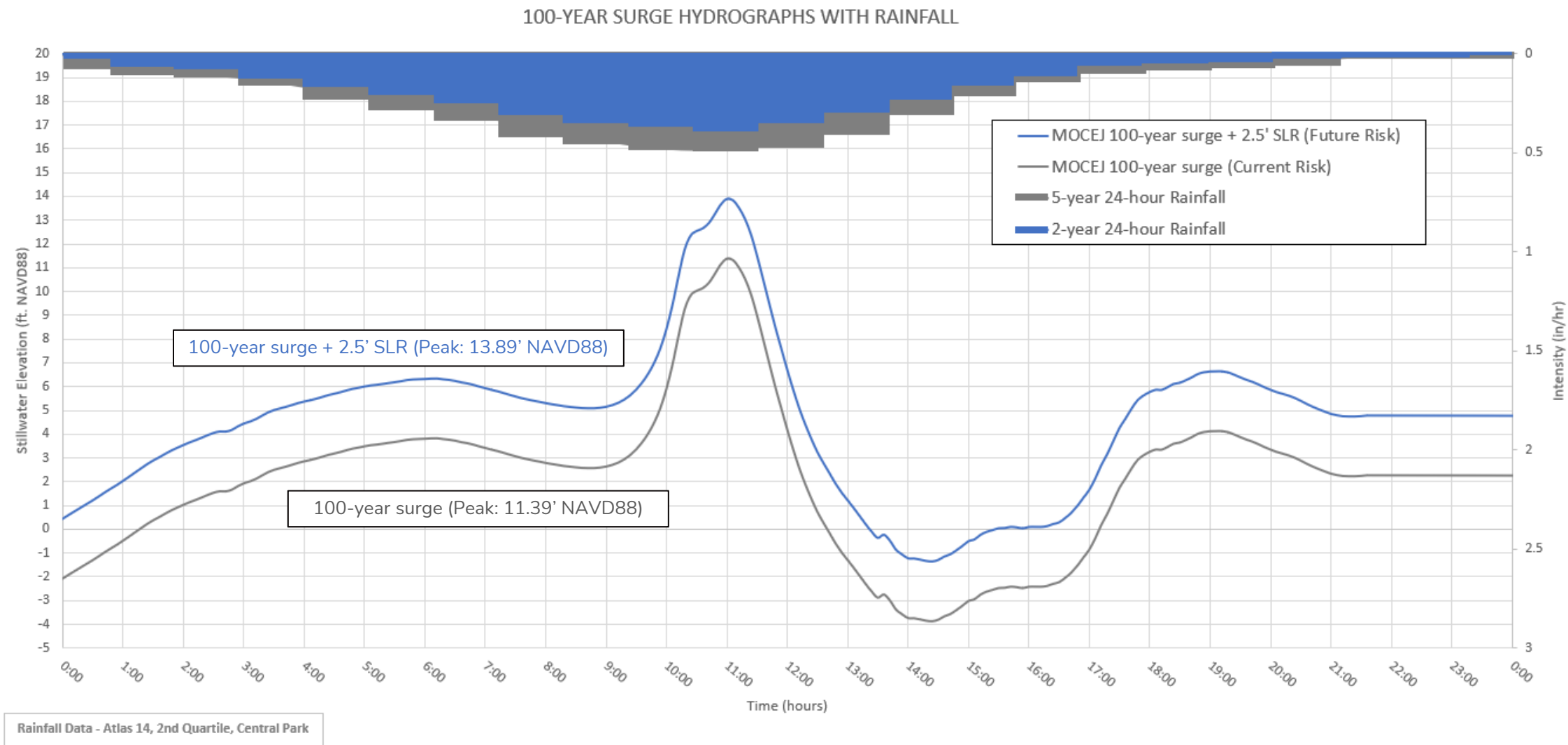
N/W BPCR Drainage Goals

Two main drainage objectives:

1. Isolate the protected area such that floodwater is prevented from entering through existing sewer connections during coastal storm surges.
2. Manage interior flooding within the protected area associated with a coincident coastal storm surge and rainfall event to minimize interior flooding.



Rainfall & Surge: Current and Future Risk



Events Examined

Objective	Criteria
Maintain flooding <1' average depth	<p>Current risk: 100-year coastal storm, 5-year NOAA2Q 50th Percentile 24-hour rainfall, Present Day Sea Level</p> <p>Future risk: 100-year coastal storm, 2-year NOAA2Q 50th Percentile 24-hour rainfall, 30" SLR</p>

Joint Annual Exceedance Probability (AEP) of Rainfall and Surge Assuming Event Independence								
		Rainfall Return Period (x-yr)						
		1	2	5	10	20	50	100
Storm Surge Return Period (x-yr)	1	100.0%	50.0%	20.0%	10.0%	5.0%	2.0%	1.0%
	2	50.0%	25.0%	10.0%	5.0%	2.5%	1.0%	0.5%
	5	20.0%	10.0%	4.0%	2.0%	1.0%	0.4%	0.2%
	10	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%	0.1%
	20	5.0%	2.5%	1.0%	0.5%	0.3%	0.1%	0.1%
	50	2.0%	1.0%	0.4%	0.2%	0.1%	0.04%	0.02%
	100	1.0%	0.5%	0.2%	0.1%	0.1%	0.02%	0.01%
Sample 1% AEP Events for FEMA Base Flood Mapping Sensitivity Analysis								

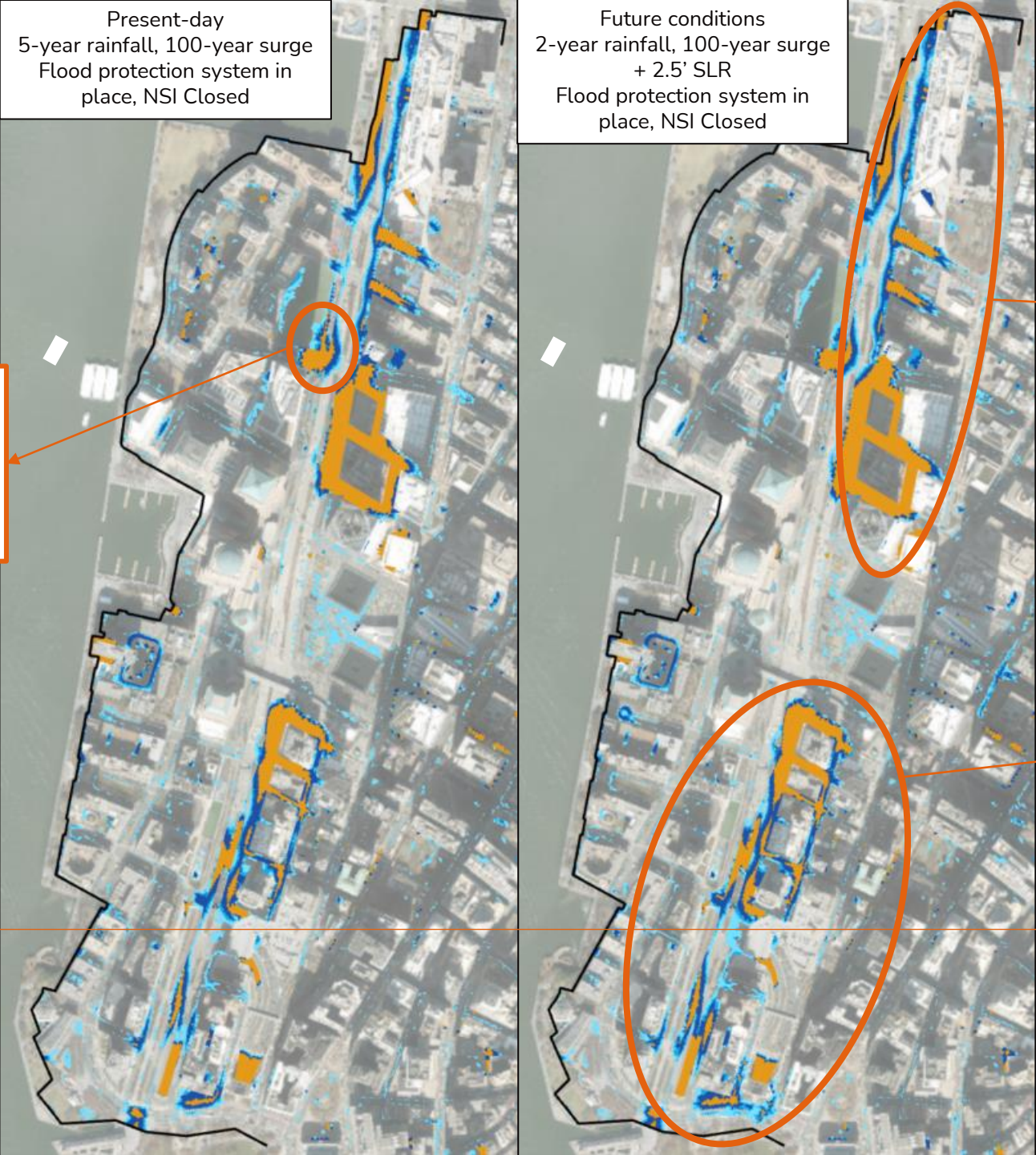


Regulator Sluice Gate (AECOM)

- Closed regulator sluice gate
- Prevents unprotected interceptor sewer from flooding into protected area

- Rain-on-mesh methodology
 - Rainfall is applied directly to the 2D surface and flows overland to reach the sewer network.
 - Allows for the assessment of localized flooding and drainage issues that may prevent water from reaching sewer catch basins.

Baseline Flooding with Isolation



This flooding on BPCA property is mostly due to overland flow from adjacent flooded areas. These include the CSO system flooding from the SE and the combined and stormwater system flooding from the north.

This portion of the combined system floods because it is unable to discharge through a CSO outfall. Once flooded, it can flow south overland.

Other city-led projects are being developed that will potentially mitigate flooding in the southern portion of BPC / other parts of Lower Manhattan.

↑ Approximate delineation of end of N/W BPCR project extent
↓ South BPC project

Legend	
NWBPC flood barrier system (08/16)	—
Maximum Depth (ft)	
1" – 4"	Light Blue
4" – 6"	Medium Blue
6" – 1'	Dark Blue
>1'	Orange

Proposed Drainage Improvements

Preferred Solution

Pumping from CSOs

- Requires larger pump stations due to large upstream drainage area
- Provide opportunity to prevent flooding from happening in the first place by reducing system HGL

Pumping from Storm Water (SW) Outfalls

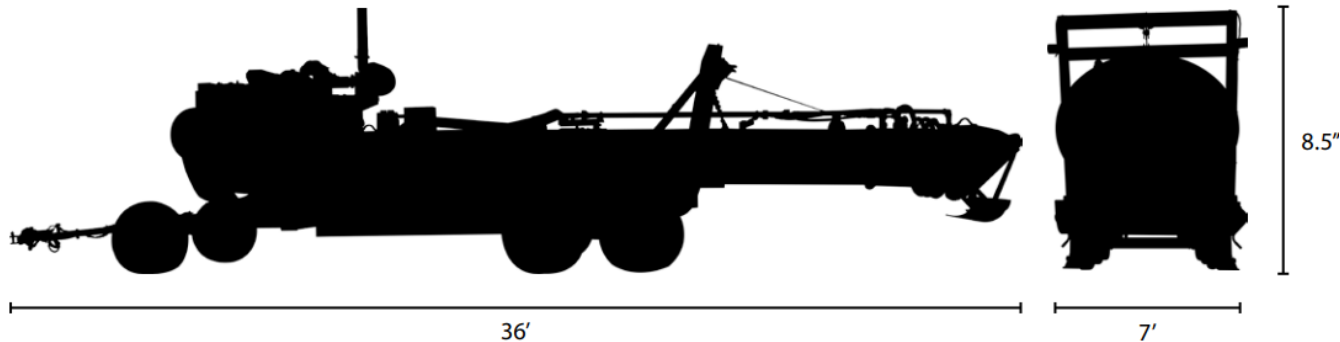
- Smaller pump stations due to smaller drainage areas
- Will not prevent flooding from CSO system but can remove flooded water from the surface if CSO system flooding reaches stormwater inlets
- Requires additional drainage improvements to bring flooding into SW system and convey it to pump stations

Temporary vs. Permanent Pumping Comparison

	Temporary Accreditable Pump Systems	Compact Subgrade Pump Station
Siting	Permanent subgrade wet-wells (approx. 30 x 30)	Permanent subgrade structure (approx. 50 x 50)
Concept Cost	5-10M for Equipment 20 – 30M for WW and Piping	Capital 30 – 60M
Operation & Maintenance	Remote storage (~4 trailers) requires significant mobilization and lifting equipment, annual deployment for certification/training, triggered deployment prior to storm event	Annual exercising for certification/training
Risk and Reliability	Significant deployment risk, not many temporary systems of this size in US	Highly reliable and proven approach
Co-Benefits		Possible co-benefit for Extreme Rain/Cloudburst Events

Temporary Pump Options

- Submersible Hydraulic Unit



Images from MWI Pumps

- Centrifugal At-Grade Units

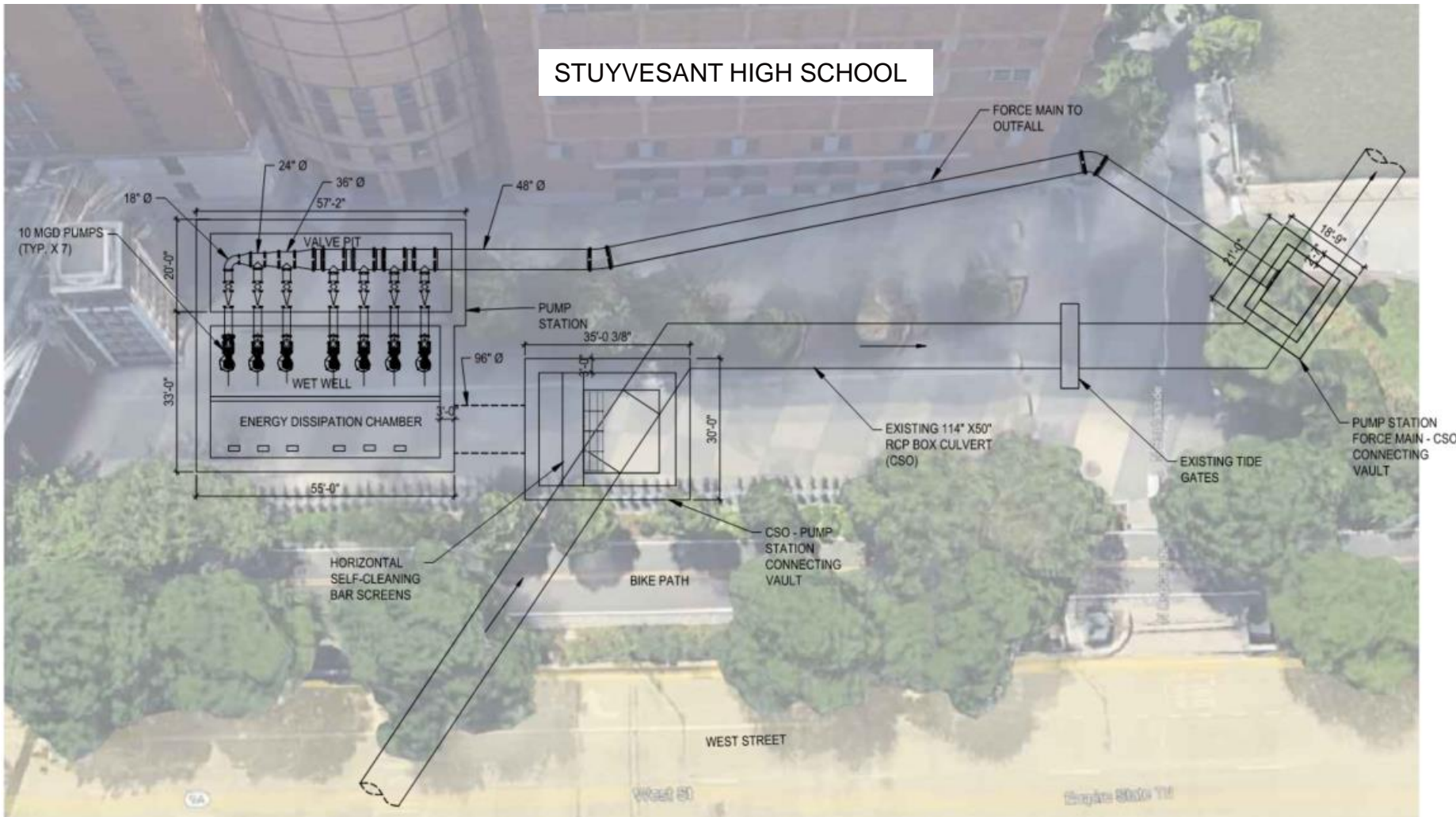


*Images from
BBA Pumps*

Potential Pump Station Locations

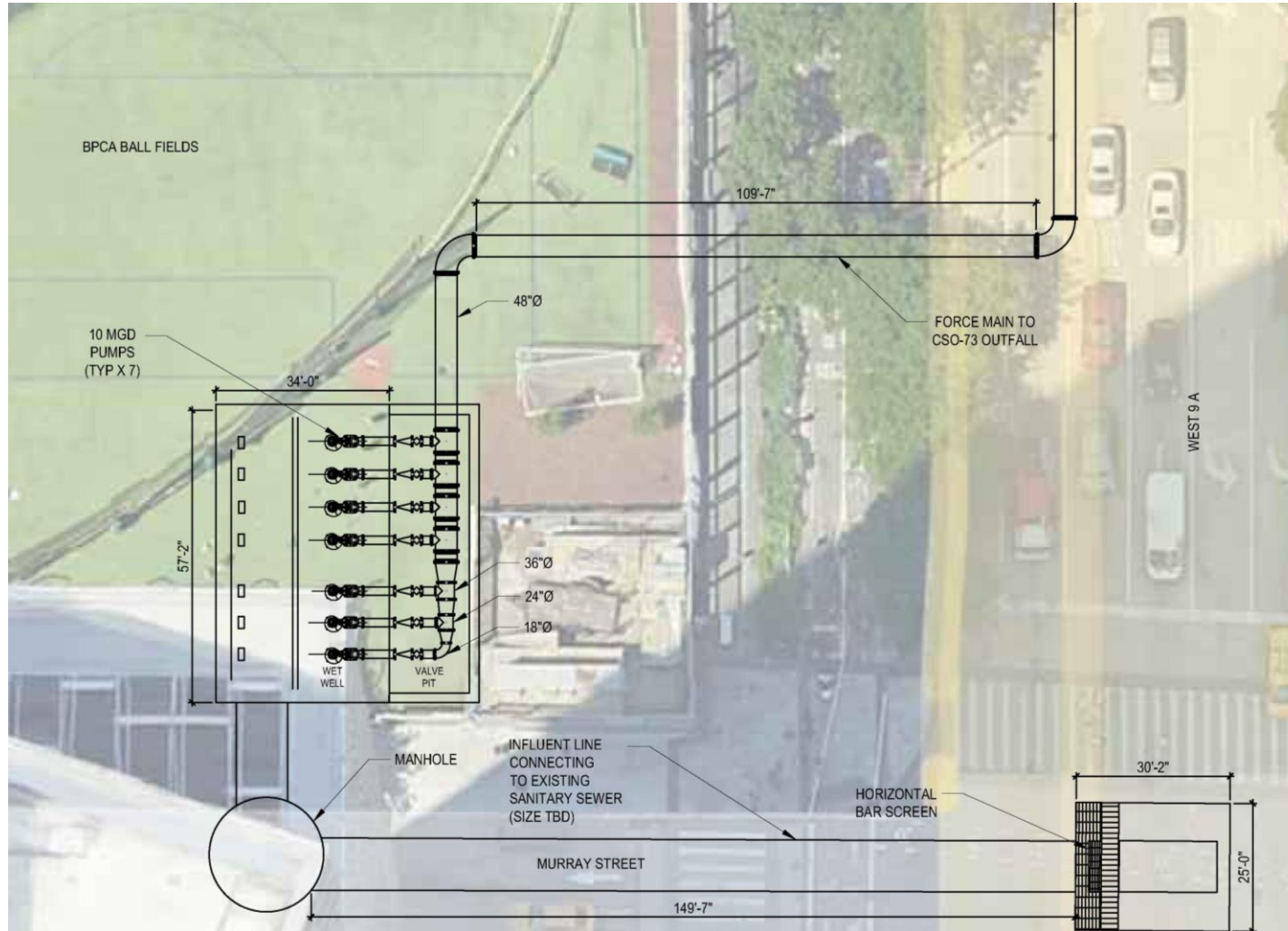


Pump Station Location #1 and Components



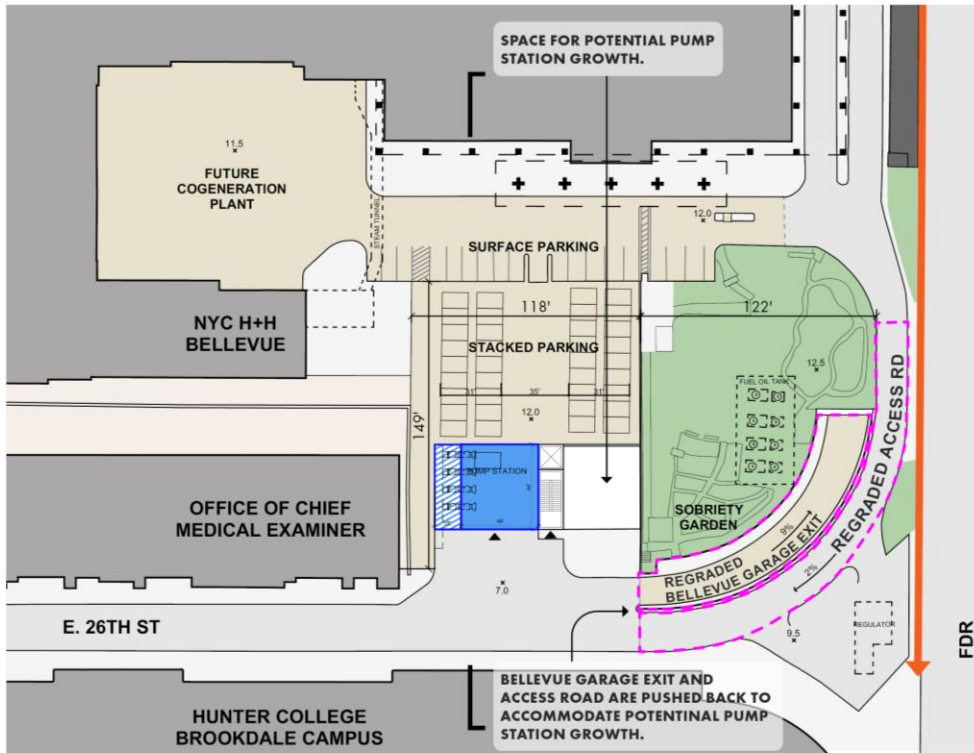
- Six 10 MGD (90 HP) submersible constant speed pumps & 1 stand-by
- Wet well: 33' x 55'
- Valve pit: 57' x 20'
- Inlet bar screen/grid is needed to protect pumping units from solids and debris in the CSO
- Electrical equipment will also need to be sited

Pump Station Location #2 and Components

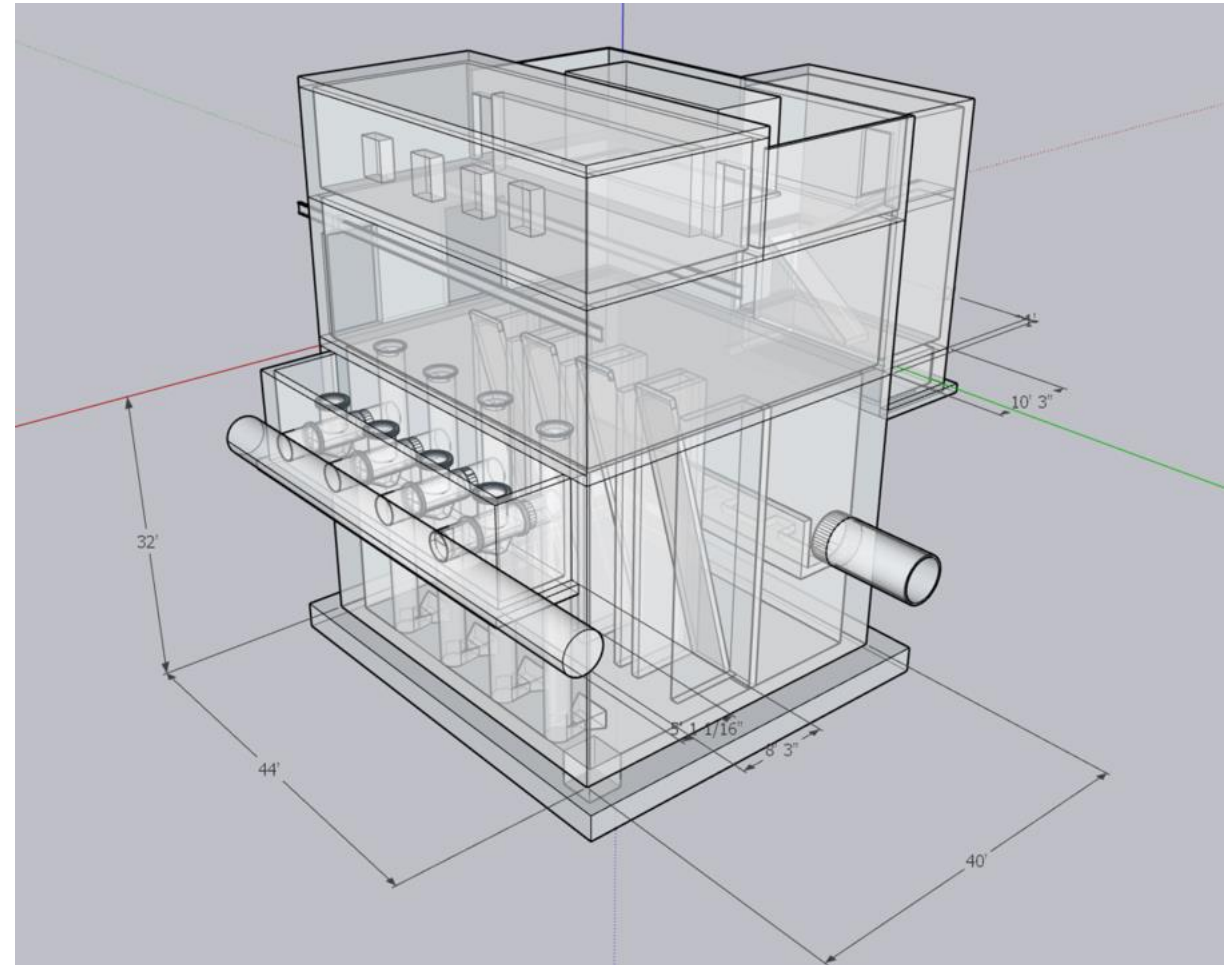


- Six 10 MGD (90 HP) submersible constant speed pumps & 1 stand-by
- Wet well: 34' x 57'
- Valve pit: 57' x 20'
- Inlet bar screen/grid is needed to protect pumping units from solids and debris in the CSO
- 1,000' of force main to connect to CSO
- Electrical equipment will also need to be sited

Permanent Subgrade Pump Station



Comparable 60 MGD Pump Station from Bellevue Hospital



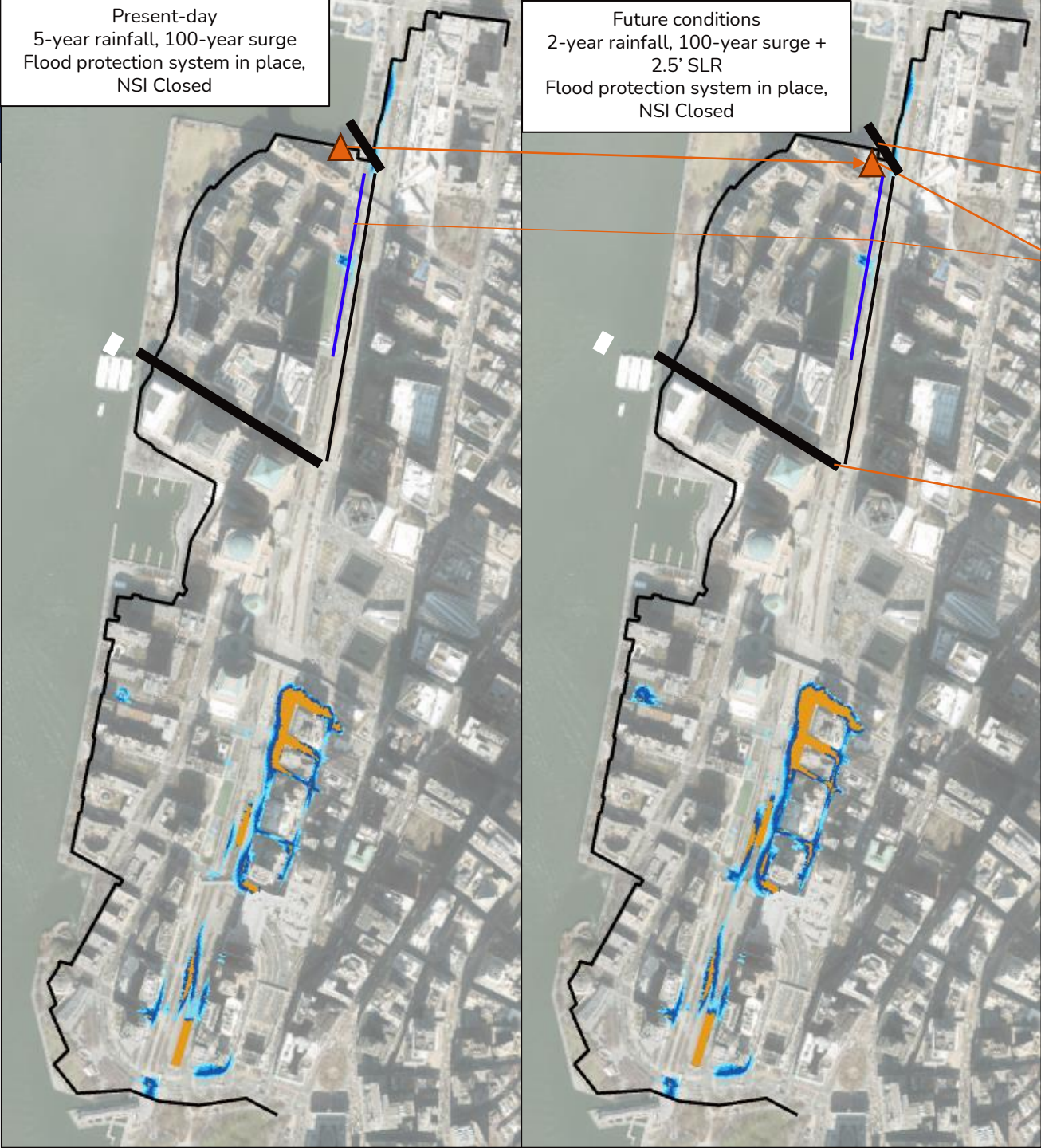
Combined Sewer Overflow

60 MGD pump station
with proposed conveyance
to the pump station
mitigates all flooding over
1' from combined system
in the north project area.

Combined Sewer Overflow

Present-day
5-year rainfall, 100-year surge
Flood protection system in place,
NSI Closed

Future conditions
2-year rainfall, 100-year surge +
2.5' SLR
Flood protection system in place,
NSI Closed



Legend	
NWBPC flood barrier system (08/16)	

Maximum Depth (ft)	
1" – 4"	
4" – 6"	
6" – 1'	
>1'	

- Limited flooding on Battery Park City property, most flooding occurs along and east of 9A/West Street
- Pumping from stormwater outfalls limited in effectiveness, pumping from combined sewer overflows can provide a larger impact
- 60 MGD combined pump station and pump station conveyance piping mitigates flooding over 1' from the combined sewer network
- Temporary pumping to manage such large flows is difficult to deploy, maintain, and certify
- Next step: evaluate 'cloudburst' events and subsequently assess drainage modifications that could protect from a broader range of storm events, expected to become more frequent in the future with climate change

Next Step: Cloudburst Investigation

Initial Criteria

Objective	Criteria
Maintain flooding <1' average depth	<p>Current risk: 100-year coastal storm, 5-year NOAA2Q 50th Percentile 24-hour rainfall, Present Day Sea Level</p> <p>Future risk: 100-year coastal storm, 2-year NOAA2Q 50th Percentile 24-hour rainfall, 30" SLR</p>

Cloudburst Scenarios

Pluvial Analysis

Rainfall Return Period	Durations (hr)	Assumed Boundary Conditions
Current 10-year	1, 3	Present-day MHHW
Current 100-year	1, 3	Present-day MHHW
		Total

Future Pluvial + Surge/SLR Analysis

Rainfall Return Period	Durations (hr)	Assumed Boundary Conditions
Future 100-year	1, 3	2050s SLR
Future 100-year	1, 3	100-year surge + 2050s SLR

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	5	20.0%	10.0%	4.0%	2.0%	1.0%	0.4%	0.2%
	10	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%	0.1%
	20	5.0%	2.5%	1.0%	0.5%	0.3%	0.1%	0.1%
	50	2.0%	1.0%	0.4%	0.2%	0.1%	0.04%	0.02%
	100	1.0%	0.5%	0.2%	0.1%	0.1%	0.02%	0.01%

Sample 1% AEP Events for FEMA Base Flood Mapping Sensitivity Analysis

1% AEP