



Climate & Weather Information for Water Utilities & Stormwater Managers: Flooding

July 28, 2020

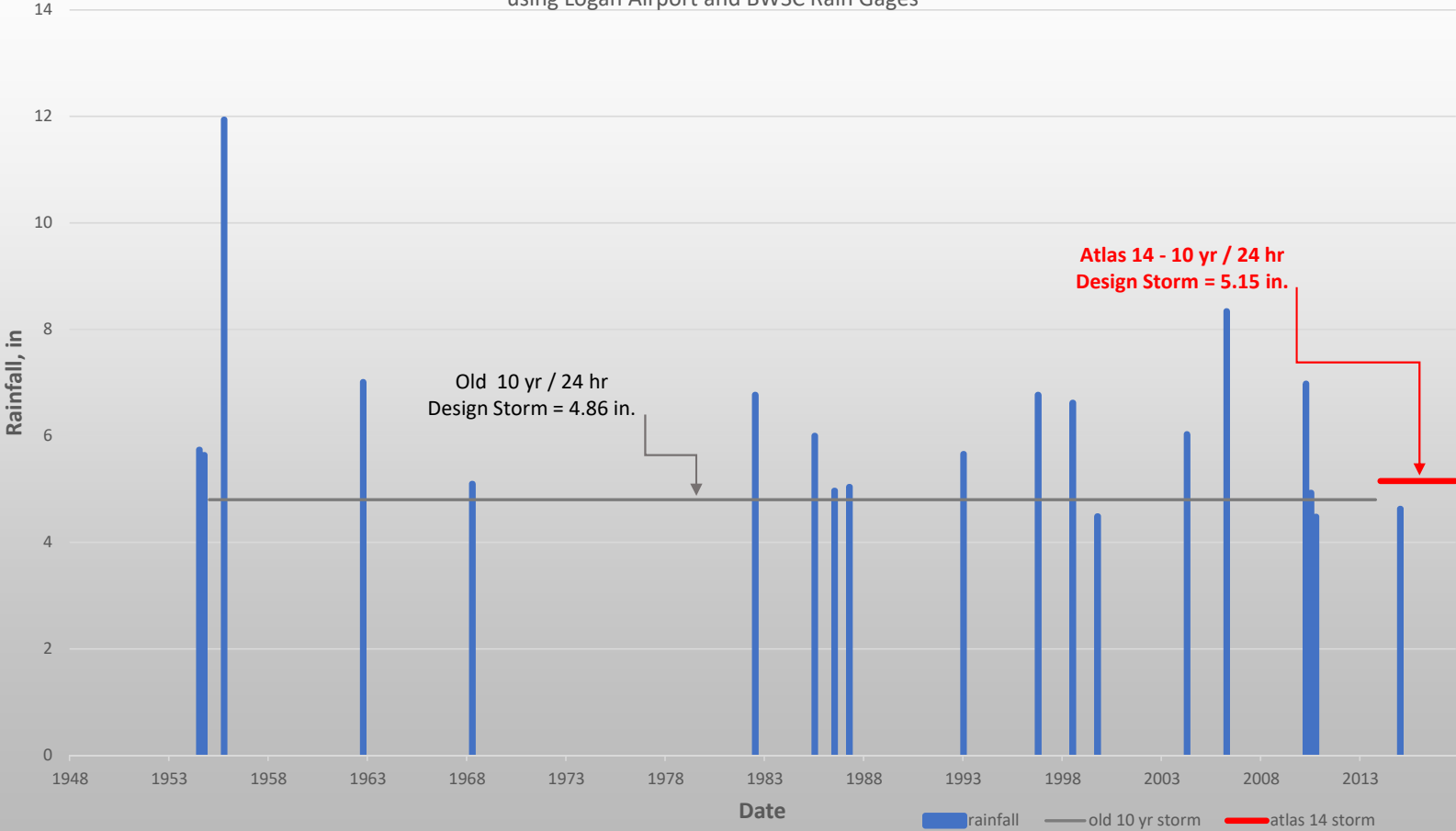
Charlie Jewell
Director of Planning and Sustainability

BWSC Collection System

- 1,536 miles of sewer and drain pipes
- (156 miles combined, 710 miles sanitary, 670 miles storm drain)
- Sewers range from 8 inch to 108 inch
- Drains range from 12 inch to 240 x 186 inch
- 9 pump stations
- 417 outfalls
- 50,605 manholes

Twenty Largest Storms from 1948 to 2017

using Logan Airport and BWSC Rain Gages



Rainfall – Storm Surge

Forecasted Annual Rainfall Increases (inches)			
Commission Wastewater Facilities Plan			
Scenario	2035	2060	2100
Medium	1.4	2.4	3.9
Precuatory	1.7	3.8	6.8
Forecasted Annual Rainfall (inches)			
Commission Wastewater Facilities Plan			
Scenario	2035	2060	2100
Medium	50	50.9	52.4
Precuatory	50.3	52.4	55.4
Current - 48.6			
Forecasted 10 year 24 hour design storm (inches)			
Commission Wastewater Facilities Plan			
Scenario	2035	2060	2100
Medium	5.5	5.76	6.08
Precuatory	5.6	6.03	6.65
Current - 4.8			
Forecasted 10 year 24 hour design storm Peak Intensity (inches)			
Commission Wastewater Facilities Plan			
Scenario	2035	2060	2100
Medium	1.76	1.83	1.93
Precuatory	1.78	1.91	2.11
Current - 1.52			

Storm Surge (ft)			
2 year	2.85		
1,000 year	6.19		
Using 100 year - 5.12			
Flood Elevations - SLR and Storm Surge (Worst Case Scenarios) (ft BCB)			
Wastewater Facilities Plan		BRAG	
2035	17.88	2030	16.26
2060	19.11	2050	16.96
2100	23.50	2100	23.86

BRAG – Boston Research Advisory Group

Sea Level Rise

Sea Level Rise - Commission Wastewater Facilities Plan			
Mean Higher High Water Sea Level (ft)			
Commission Wastewater Facilities Plan			
Scenario	2035	2060	2100
Medium	12.1 (0.87)	12.94 (1.71)	15.04 (3.81)
Precuatory	12.76 (1.53)	13.99 (2.76)	18.38 (7.15)
Current - 11.23			
Sea Level Rise (Inches)			
Commission Wastewater Facilities Plan			
Scenario	2035	2060	2100
Medium	10.44	20.52	45.72
Precuatory	18.36	33.12	85.80

Sea Level Rise - BRAG				
BRAG (ft) (Likely Range)				
Scenario	2030	2050	2070	2100
Low	0.3 - 0.7	0.6 - 1.4	1.1 - 2.3	1.8 - 3.8
Medium	0.3 - 0.7	0.7 - 1.4	1.3 - 2.6	2.4 - 5.1
High	0.3 - 0.7	0.7 - 1.5	1.5 - 3.1	3.2 - 7.4
BRAG (inches) (Likely Range)				
Scenario	2030	2050	2070	2100
Low	3.6 - 8.4	7.2 - 16.8	13.2 - 27.6	21.6 - 45.6
Medium	3.6 - 8.4	8.4 - 16.8	15.6 - 31.2	28.8 - 61.2
High	3.6 - 8.4	8.4 - 18.0	18.0 - 37.2	38.4 - 88.8
BRAG (ft) (Maximum)				
Scenario	2030	2050	2070	2100
Low	1.2	2.3	3.6	6.2
Medium	1.2	2.3	4.1	8.0
High	1.2	2.4	4.8	10.5
BRAG (inches) (Maximum)				
Scenario	2030	2050	2070	2100
Low	14.4	27.6	43.2	74.4
Medium	14.4	27.6	49.2	96
High	14.4	28.8	57.6	126
(High = highest emmissions scenario)				
(Medium = emissions stay at current levels)				
(Low - emissions are reduced to less than a third of current levels by 2050)				

Sea Level Rise - Climate Ready Boston - BPDA			
Climate Ready Boston (inches)			
	2030	2050	2070
	9	21	36
BPDA (Inches)- 40			
Evaluate the vulnerability of new projects			

CHALLENGE:
**RISKS OF FLOODING WITH SEA LEVEL RISE
AND STORM SURGE – YEAR 2060**

YEAR 2060 RAIN
SEA LEVEL RISE, NO STORM SURGE



YEAR 2060 RAIN
SEA LEVEL RISE, WITH STORM SURGE





P2060
with Surge - 19.11 bcb

Printed on: Nov. 2019

Legend

p2060_surge_sl19p11ftbcb



BOSTON HARBOR

2030 STORMS

GARR SEPTEMBER 9TH,1999, W/ 2030 SLR

GARR JUNE 12TH,1998, W/ 2030 SLR

GARR AUGUST 2ND, 2017, W/ 2030 SLR

AIRMASS 2-YEAR W/ 2030 SLR

AIRMASS 10-YEAR W/ 2030 SLR

FRONTAL 10-YEAR W/ 2030 SLR

TROPICAL 10-YEAR W/ 2030 SLR

FRONTAL 50-YEAR W/ 2030 SLR

NOR'EASTER 10-YEAR W/ 2030 SLR

NOR'EASTER 50-YEAR W/ 2030 SLR

NOR'EASTER 50-YEAR W/ 2030 SLR + 100-YEAR STORM SURGE

TROPICAL 100-YEAR W/ 2030 SLR +100-YEAR STORM SURGE

NOR'EASTER 100-YEAR W/ 2030 SLR + 100-YEAR STORM SURGE

TROPICAL 500-YEAR W/ 2030 SLR + 500-YEAR STORM SURGE

2070 STORMS

GARR SEPTEMBER 9TH,1999, W/ 2070 SLR

GARR JUNE 12TH,1998, W/ 2070 SLR

GARR AUGUST 2ND, 2017 W/ 2070 SLR

AIRMASS 2-YEAR W/ 2070 SLR

AIRMASS 10-YEAR W/ 2070 SLR

FRONTAL 10-YEAR W/ 2070 SLR

TROPICAL 10-YEAR W/ 2070 SLR

FRONTAL 50-YEAR W/ 2070 SLR

NOR'EASTER 50-YEAR W/ 2070 SLR + 100-YEAR STORM SURGE

NOR'EASTER 100-YEAR W/ 2070 SLR + 500-YEAR STORM SURGE

TROPICAL 100-YEAR W/ 2070 SLR +100-YEAR STORM SURGE

TROPICAL 500-YEAR W/ 2070 SLR + 500-YEAR STORM SURGE

GARR – Gauge-Adjusted Radar Rainfall
Airmass – summer thunderstorm
Frontal Storms – advancing warm or cold airmasses
Tropical – Hurricanes
Nor'easters – Nor'easters

MODEL SCENARIOS

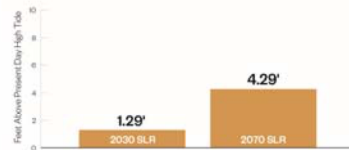
Thunderstorm

Storm Motion

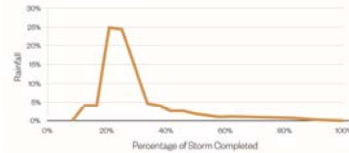


Storm Direction: **66.0 degrees** | Northeast
Speed: **25 miles per hour**

Sea Level Rise (SLR)

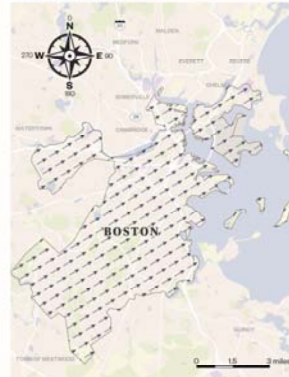


Storm Accumulation

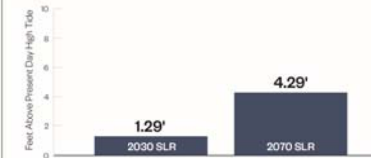


Frontal

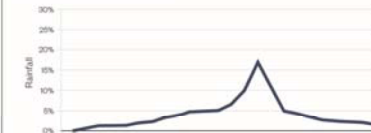
Storm Motion



Sea Level Rise (SLR)



Storm Accumulation



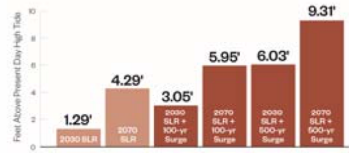
Tropical

Storm Motion

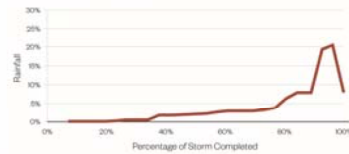


Storm Direction: **270.0 Degrees** | West
Speed: **24.8 miles per hour**

Sea Level Rise (SLR) and Storm Surge

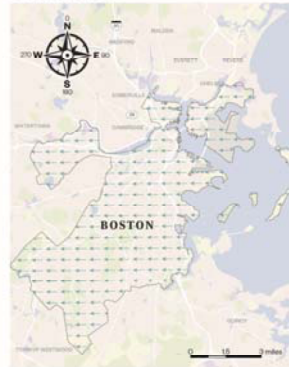


Storm Accumulation



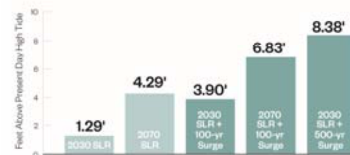
Nor'easter

Storm Motion

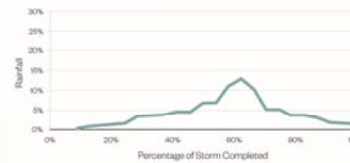


Storm Direction: **270.0 Degrees** | West
Speed: **21.1 miles per hour**

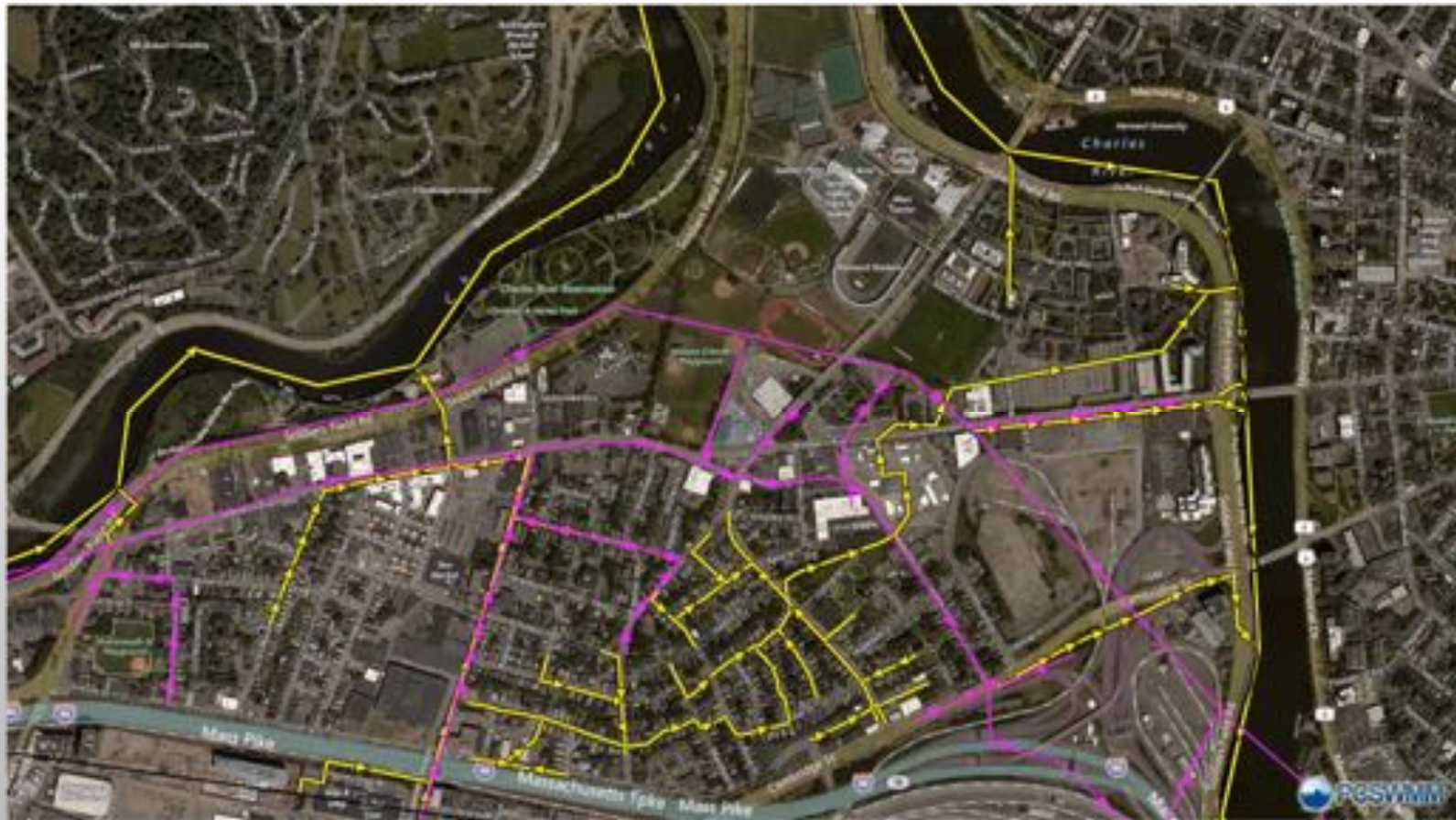
Sea Level Rise (SLR) and Storm Surge



Storm Accumulation



JUNE 1998 EVENT – MODEL PREDICTED FLOODING ANIMATION
(6.77 INCHES OF RAIN, 43 HOURS)



Airmass Storm

A Story Map

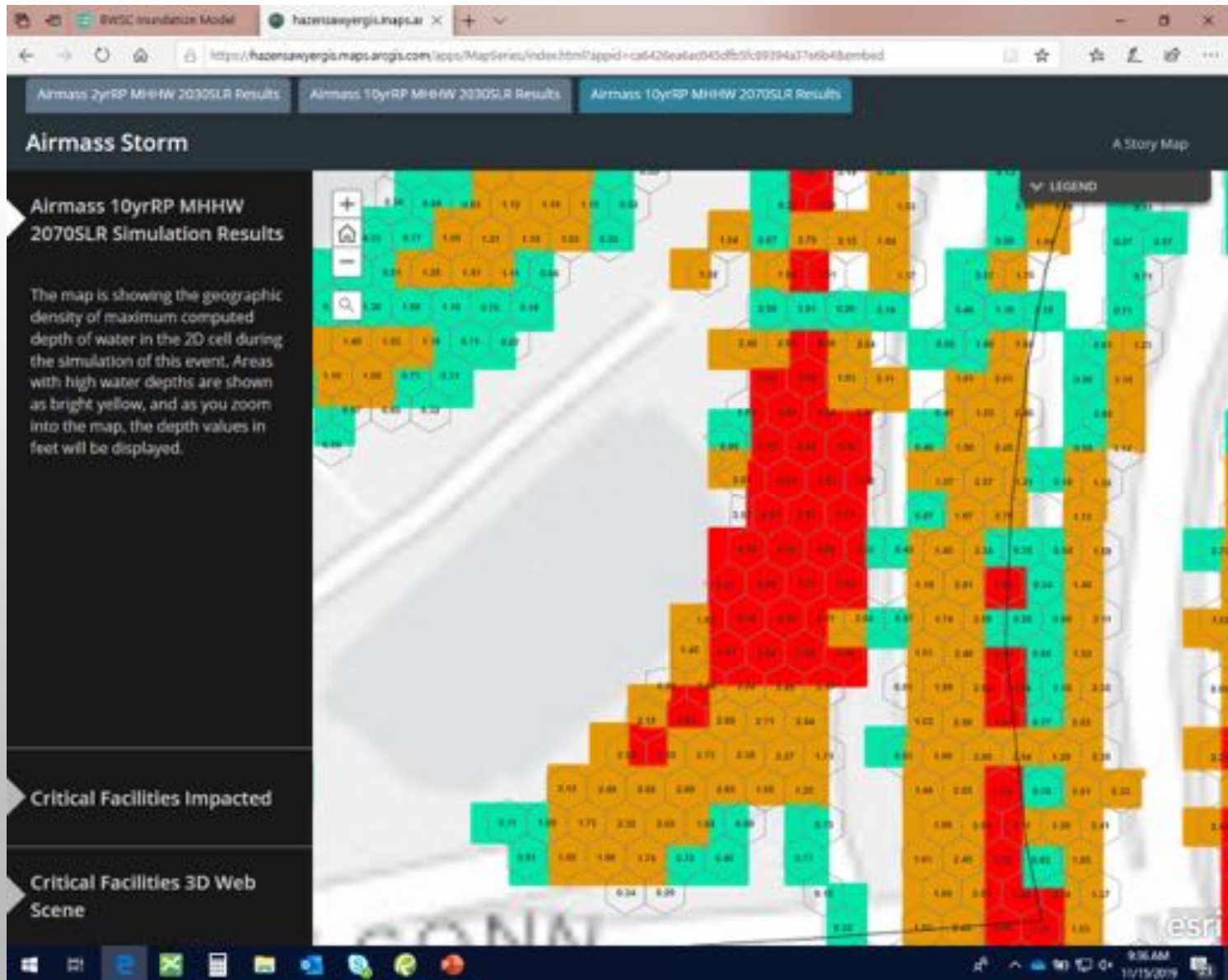
Airmass 10yrRP MHHW 2070SLR Simulation Results

The map is showing the geographic density of maximum computed depth of water in the 2D cell during the simulation of this event. Areas with high water depths are shown as bright yellow, and as you zoom into the map, the depth values in feet will be displayed.

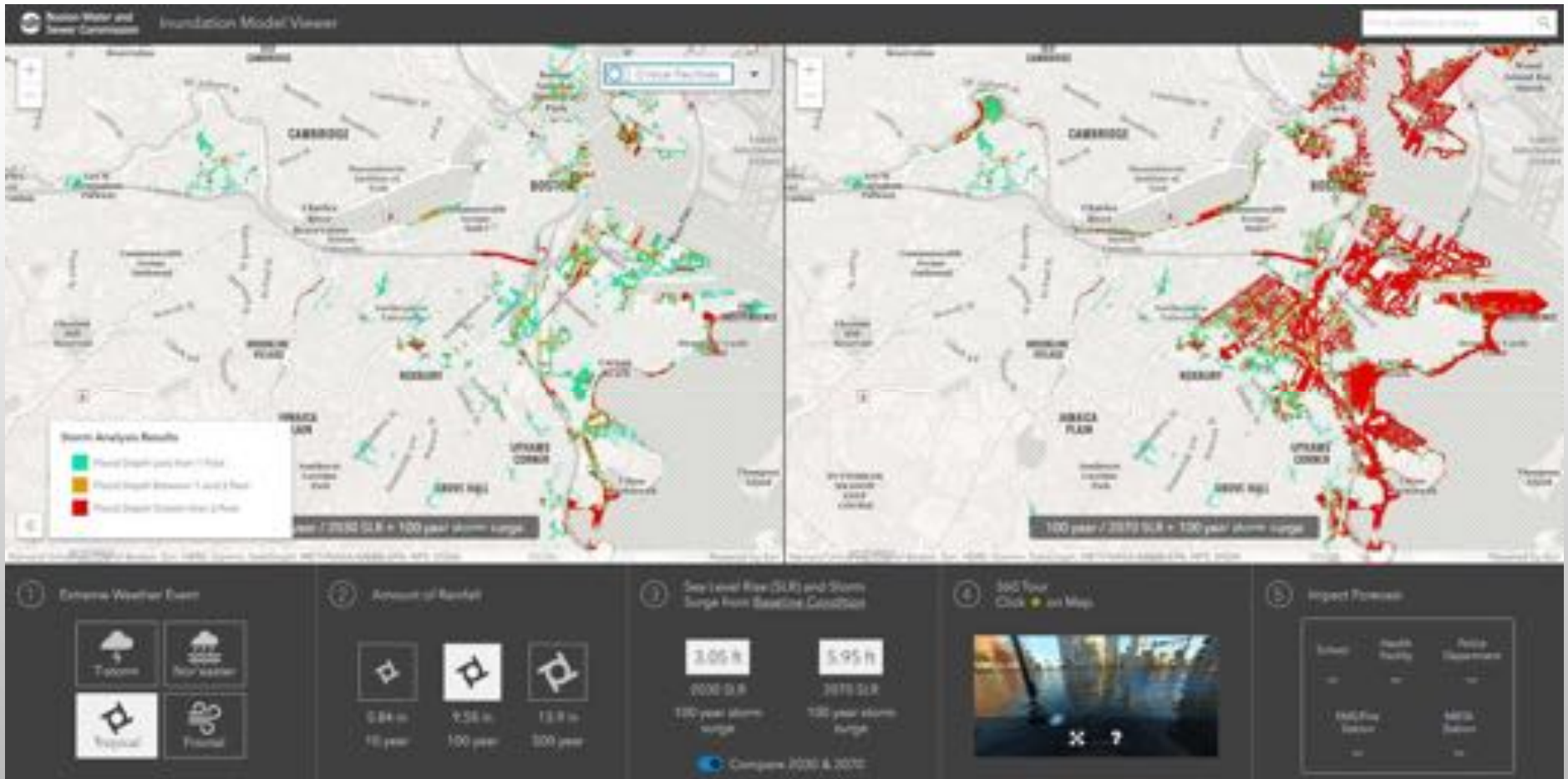
Critical Facilities Impacted

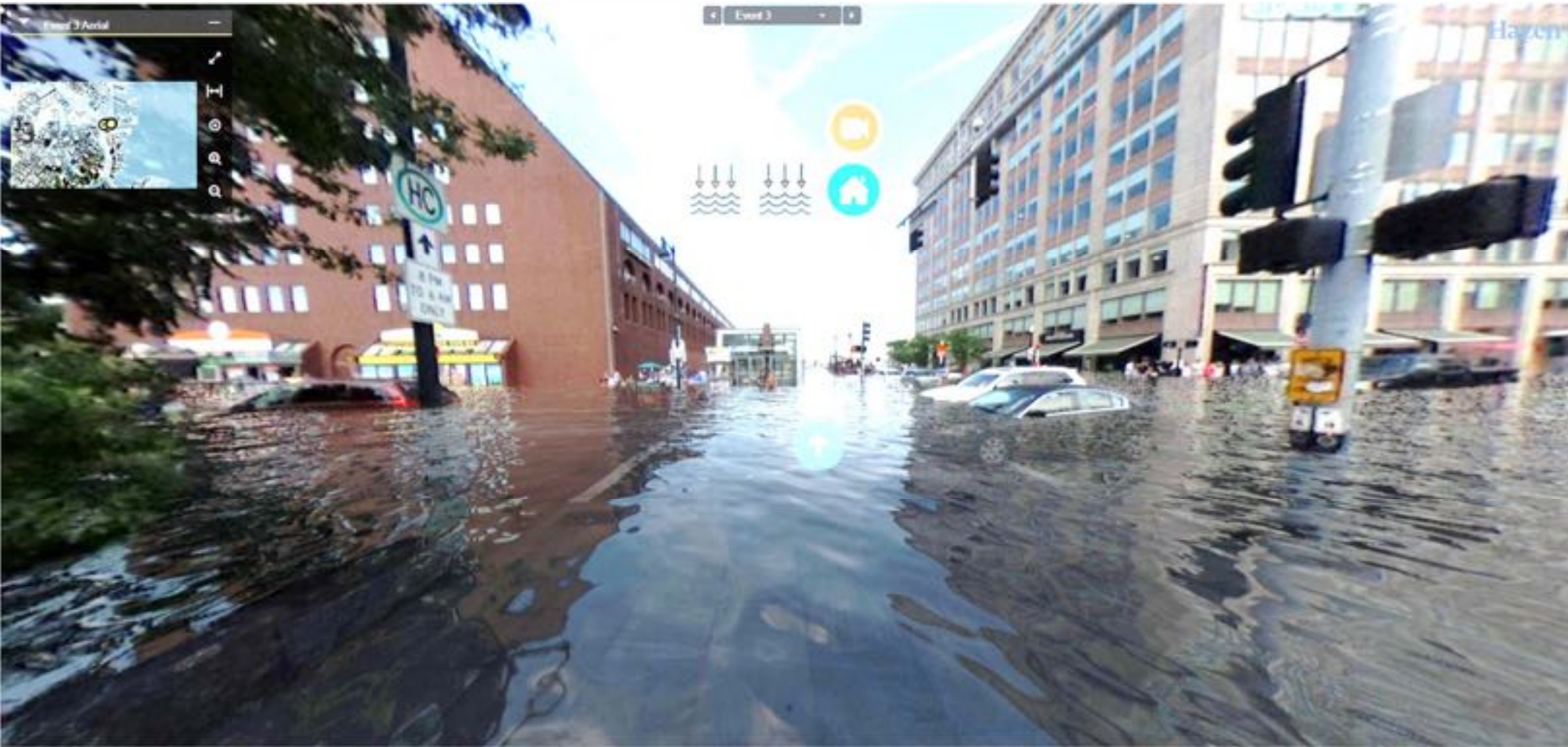
Critical Facilities 3D Web Scene





INUNDATION MODEL VIEWER – 2030 VS. 2070 COMPARISON





Inundation Overview

Sea Level Rise

- 2030
- 2070

Neighborhood

All

Critical Facility Type

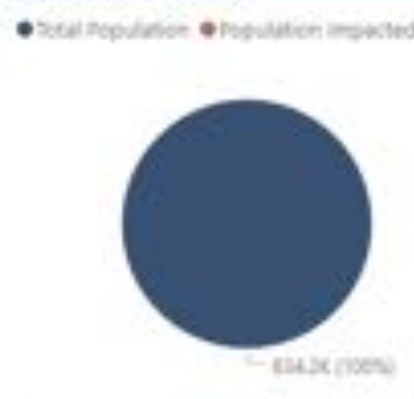
All



Storm Summary

Storm	Population Impacted	Critical Facilities Impacted	Cumulative Facilities Risk Level
August 2017 Event (2030 SLR)	18,749	38	1113
August 2017 Event (2070 SLR)	34,895	115	8658
Frontal (10-yr w/ 2030 SLR)	6,666	25	1321
Frontal (10-yr w/ 2070 SLR)	45,881	108	8944
Frontal (50-yr w/ 2030 SLR)	11,327	32	1482
Frontal (50-yr w/ 2070 SLR)	50,138	113	9035
Hurricane Doris	24,221	64	1904
June 1998 Event (2030 SLR)	60,841	170	4876
June 1998 Event (2070 SLR)	90,832	232	13070
Nor'easter (100-yr w/ 2030 SLR & 100-yr surge)	41,382	101	6589
Nor'easter (100-yr w/ 2070 SLR & 500-yr surge)	140,387	222	14542
Nor'easter (10-yr w/ 2030 SLR)	5,422	16	974
Nor'easter (10-yr w/ 2070 SLR)	45,772	105	8099
Nor'easter (50-yr w/ 2030 SLR & 100-yr surge)	38,708	96	6425
Nor'easter (50-yr w/ 2030 SLR)	11,069	29	1429
Nor'easter (50-yr w/ 2070 SLR & 100-yr surge)	128,242	273	1459
Nor'easter (50-yr w/ 2070 SLR)	45,021	104	8601
September 1999 Event (2030 SLR)	28,548	66	1979
September 1999 Event (2070 SLR)	65,043	137	9438
Thunderstorm (10-yr w/ 2030 SLR)	72,853	179	5673
Thunderstorm (10-yr w/ 2070 SLR)	100,707	239	12966
Thunderstorm (2-yr w/ 2030 SLR)	20,948	68	1812
Thunderstorm (2-yr w/ 2070 SLR)	54,673	143	9235
Tropical (100-yr w/ 2030 SLR & 100-yr surge)	28,121	121	4992
Tropical (100-yr w/ 2070 SLR & 100-yr surge)	80,989	196	17332
Tropical (10-yr w/ 2030 SLR & 10-yr surge)	7,483	23	849
Tropical (10-yr w/ 2070 SLR & 10-yr surge)	50,097	117	9395
Tropical (500-yr w/ 2030 SLR & 500-yr surge)	108,138	254	19897

Population Impacted



Critical Facilities Mapping

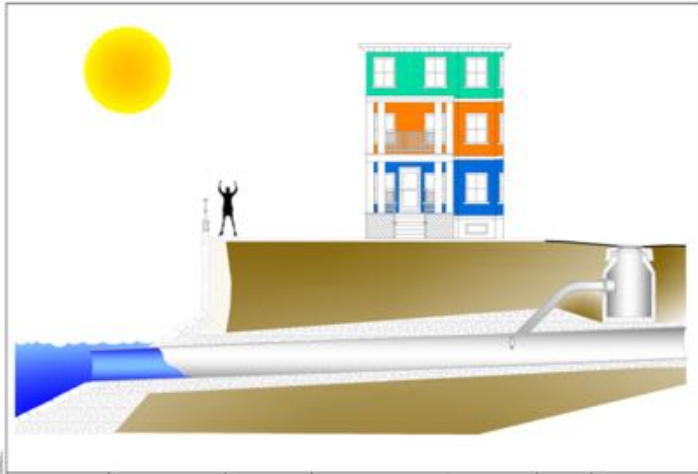


Critical Facility Impacts

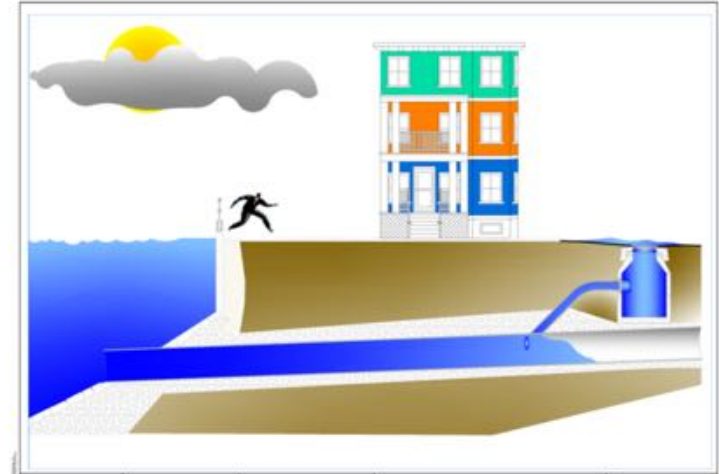
Critical Facility	Max Duration (hrs)	Max Depth (ft)	Avg Depth (ft)	Risk Level
Emergency Ctr	80.7	16.0	3.0	4
Boston Public Library	34.5	3.4	1.3	4
Charlestown Community Center	12.2	6.7	1.5	4
Condon Community Center	33.8	6.4	1.9	4
Curley Community Center	68.2	16.0	3.9	4
Grove Hall Community Center	3.5	0.5	0.2	2
Harborside Community Center - Umama Barnes	80.7	14.2	2.8	4
Karl Community Center	66.8	6.8	1.4	4
Lashy-Holloran Community Center	65.7	10.6	2.5	4
Orchard Gardens Community Center	3.5	1.0	0.1	3
Paris Street Community Center	97.8	10.0	2.3	4
The Hurley School	33.2	12.3	2.7	4
Total	86.7	30.0	2.4	4

TIDE GATES

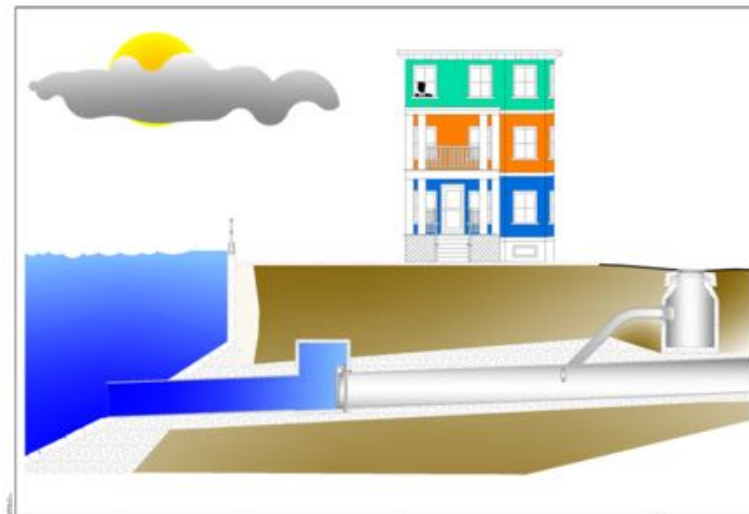




Storm Drain Outfall at Low Tide

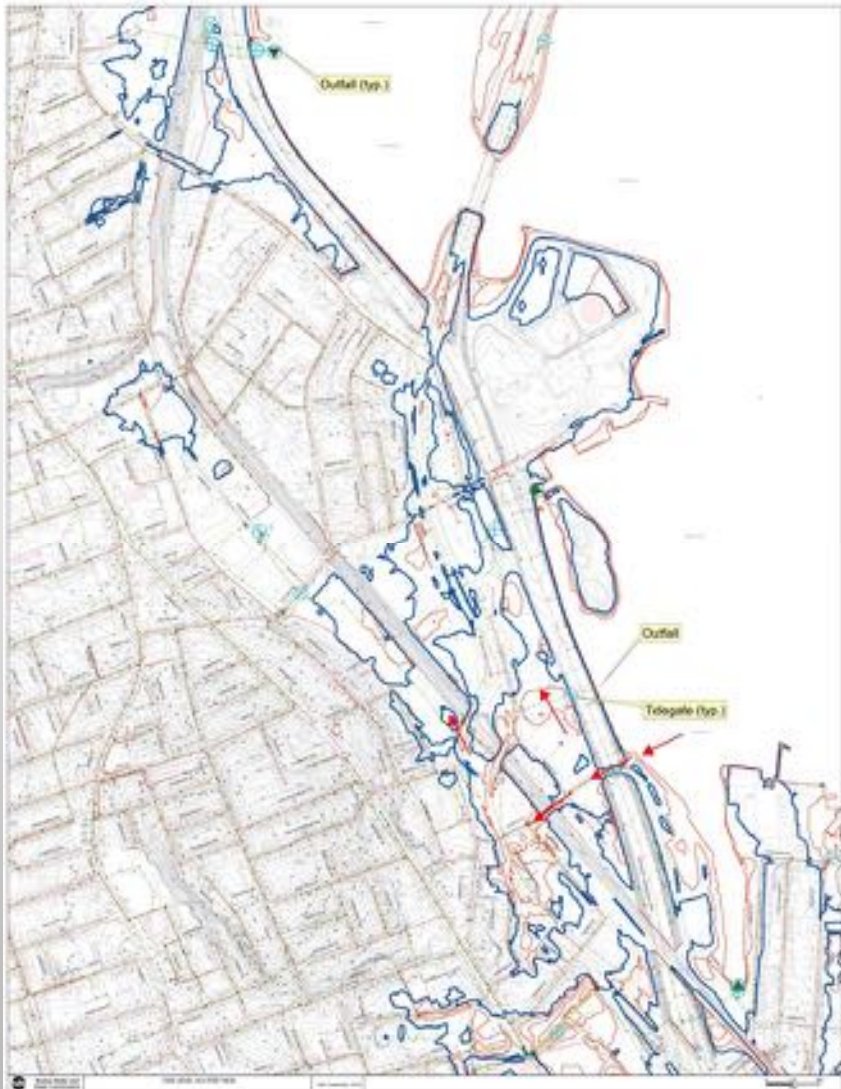


Storm Drain Outfall at High Tide without Tide Gate



Storm Drain Outfall at High Tide with Tide Gate

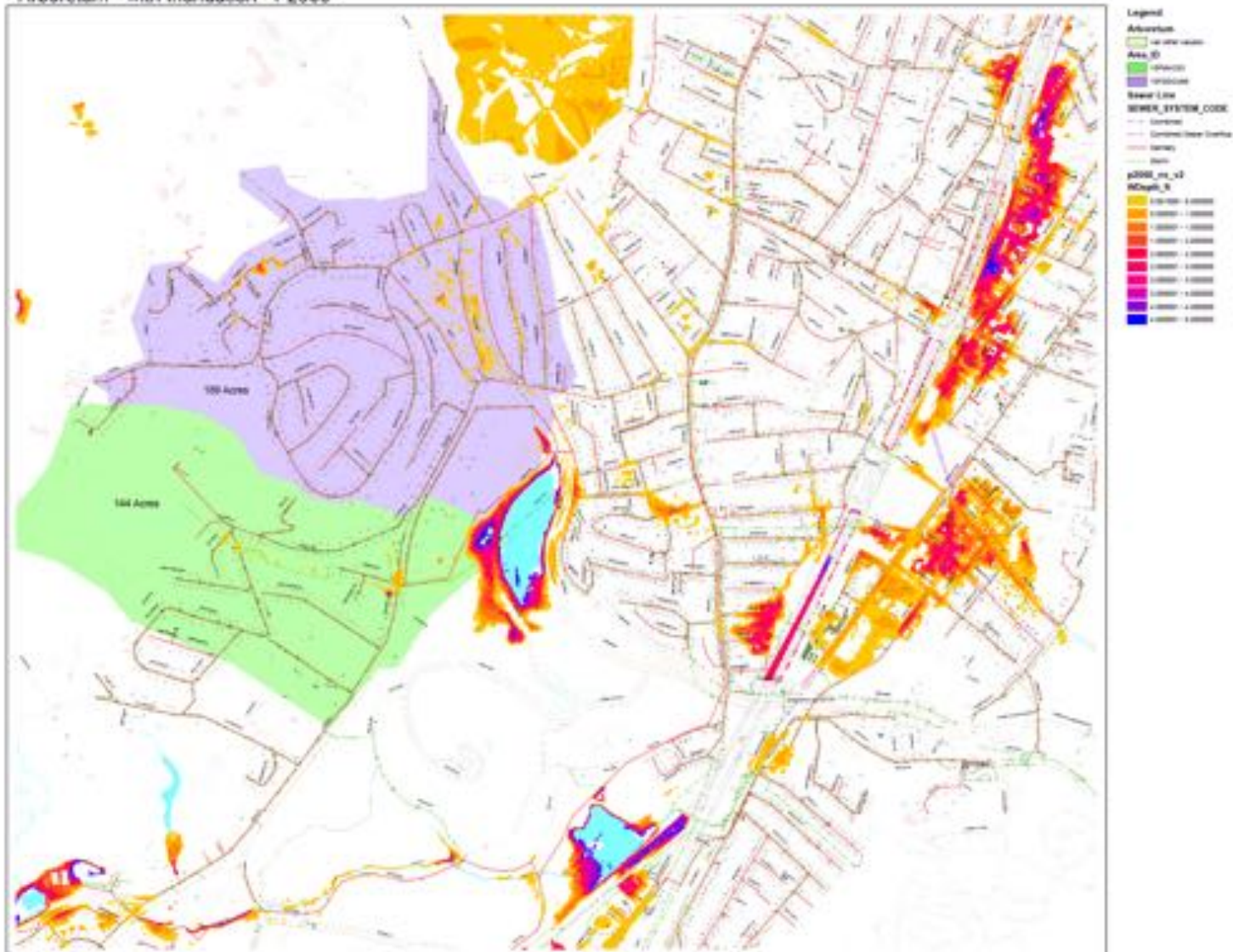
Outfall Screening



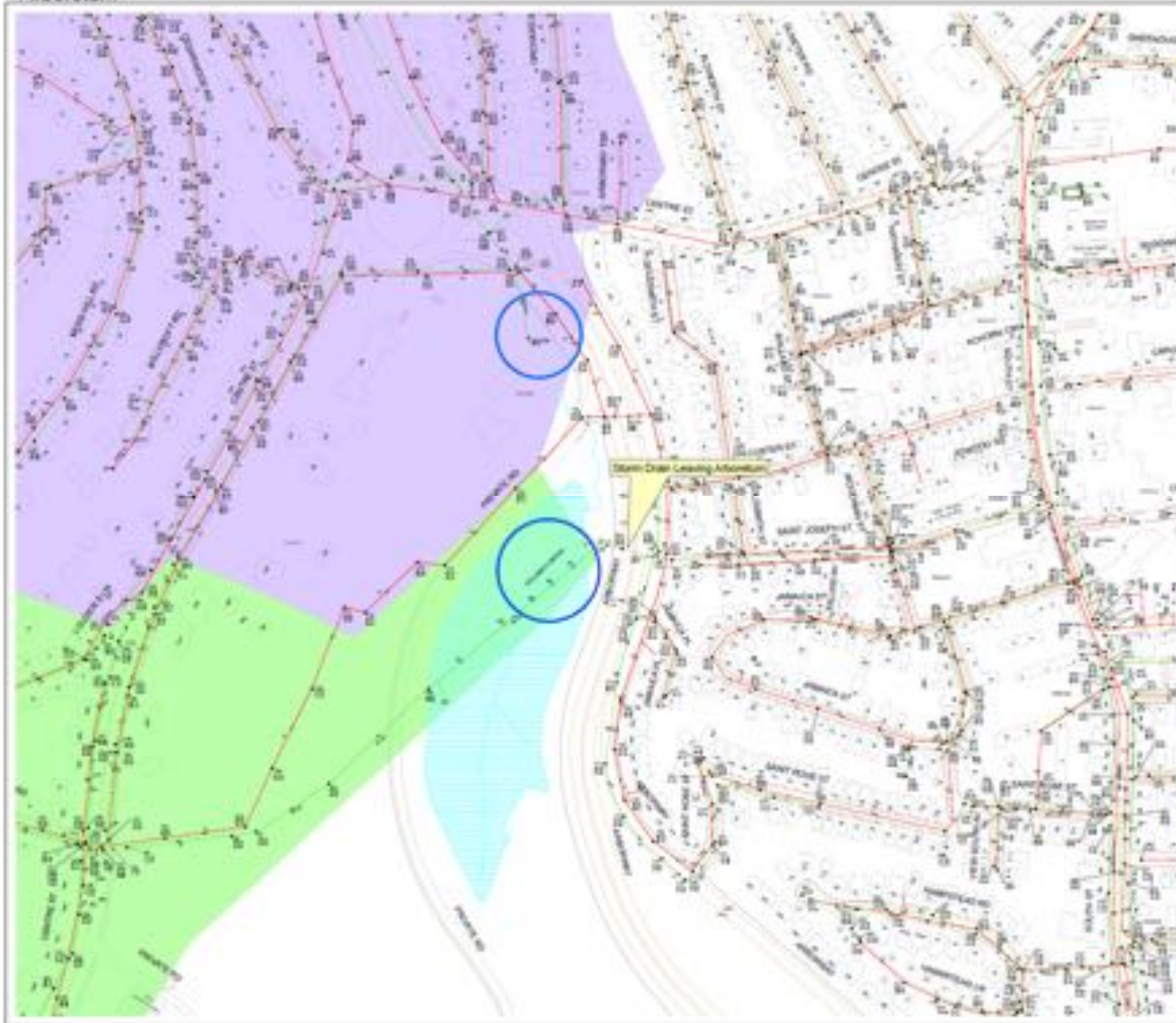
NEW TIDE GATES
MT. WASHINGTON AVE



Arboretum - with Inundation - P2060



Arboretum



- Legend
- Arboretum
 - Water
 - Area ID
 - 100000
 - 100000
 - Sewer Line
 - SEWER_SYSTEM_CODE
 - 100000
 - 100000
 - 100000
 - 100000

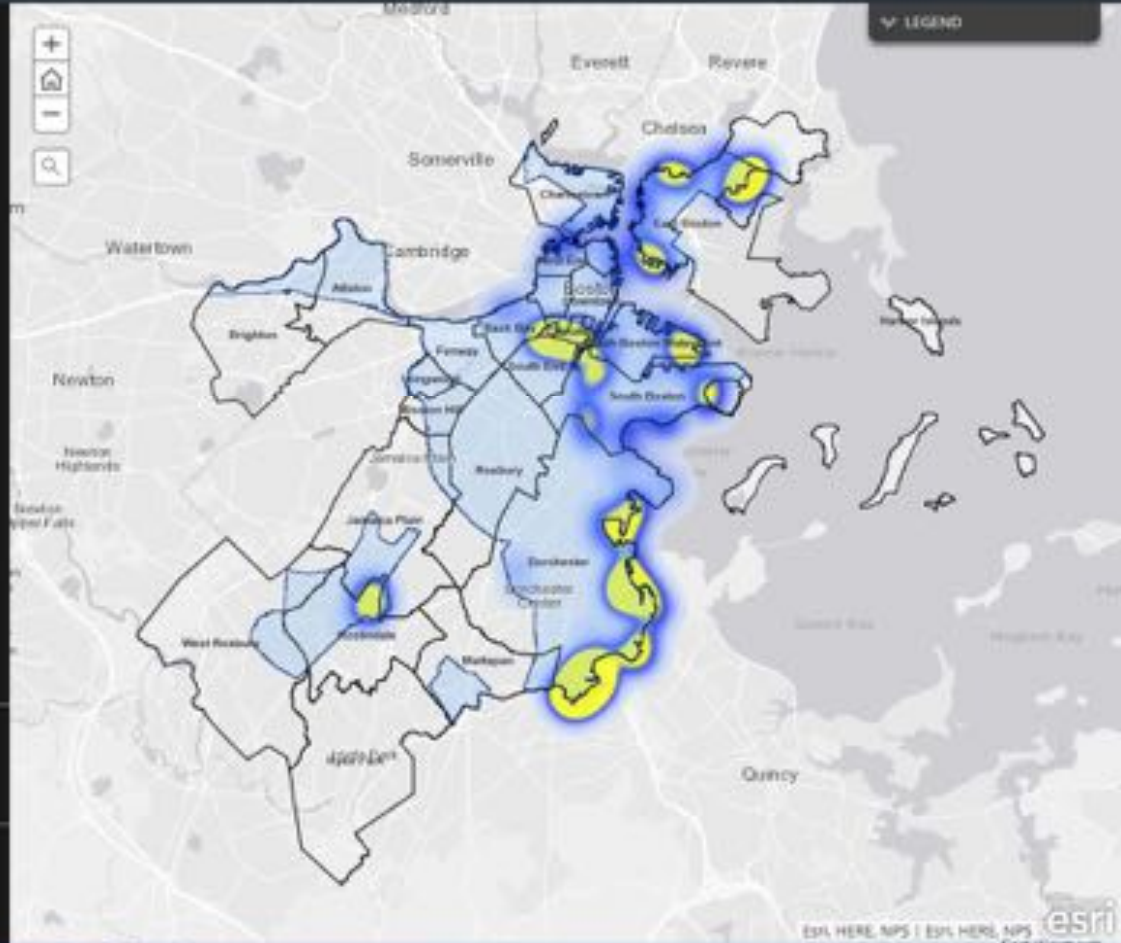
50 year 48 hr Simulation Results

Nor'easter Storm

A Story Map

Nor'easter 50 year 48 hr Simulation Results

The map is showing the geographic density of maximum computed depth of water in the 2D cell during the simulation of this event. Areas with high water depths are shown as bright yellow, and as you zoom into the map, the depth values in feet will be displayed.



Critical Facilities Impacted

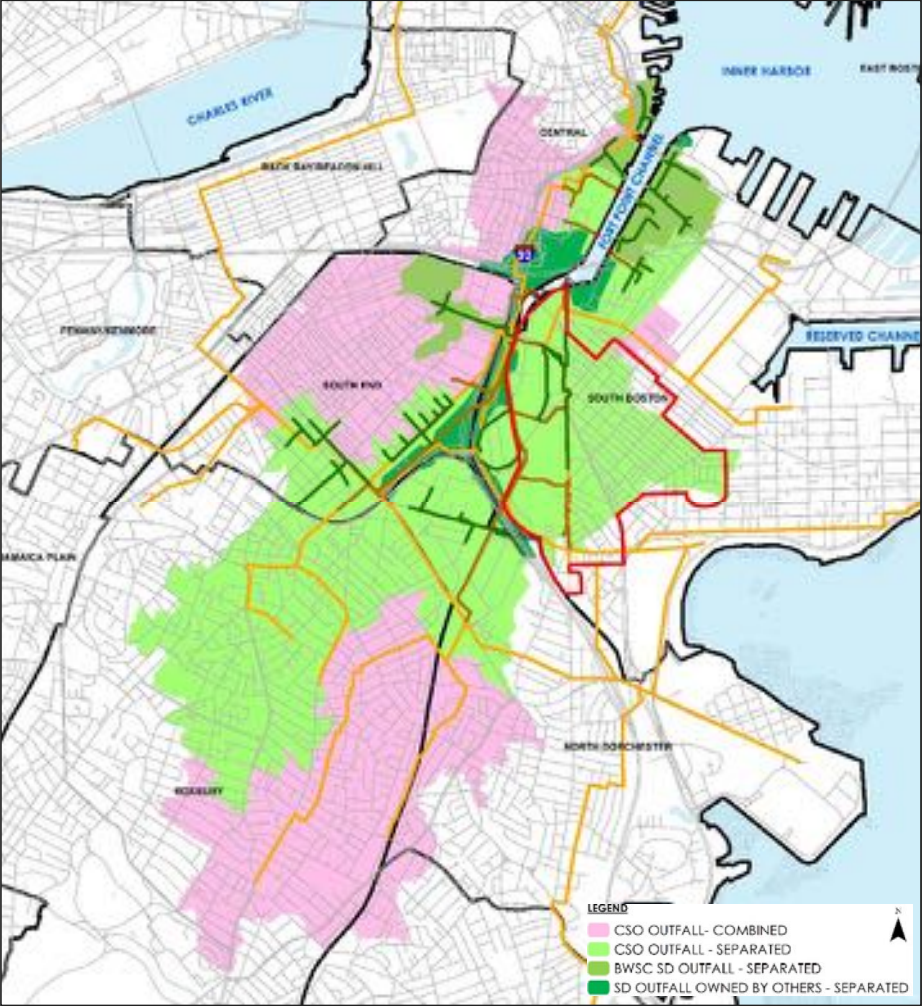
Critical Facilities 3D Web Scene

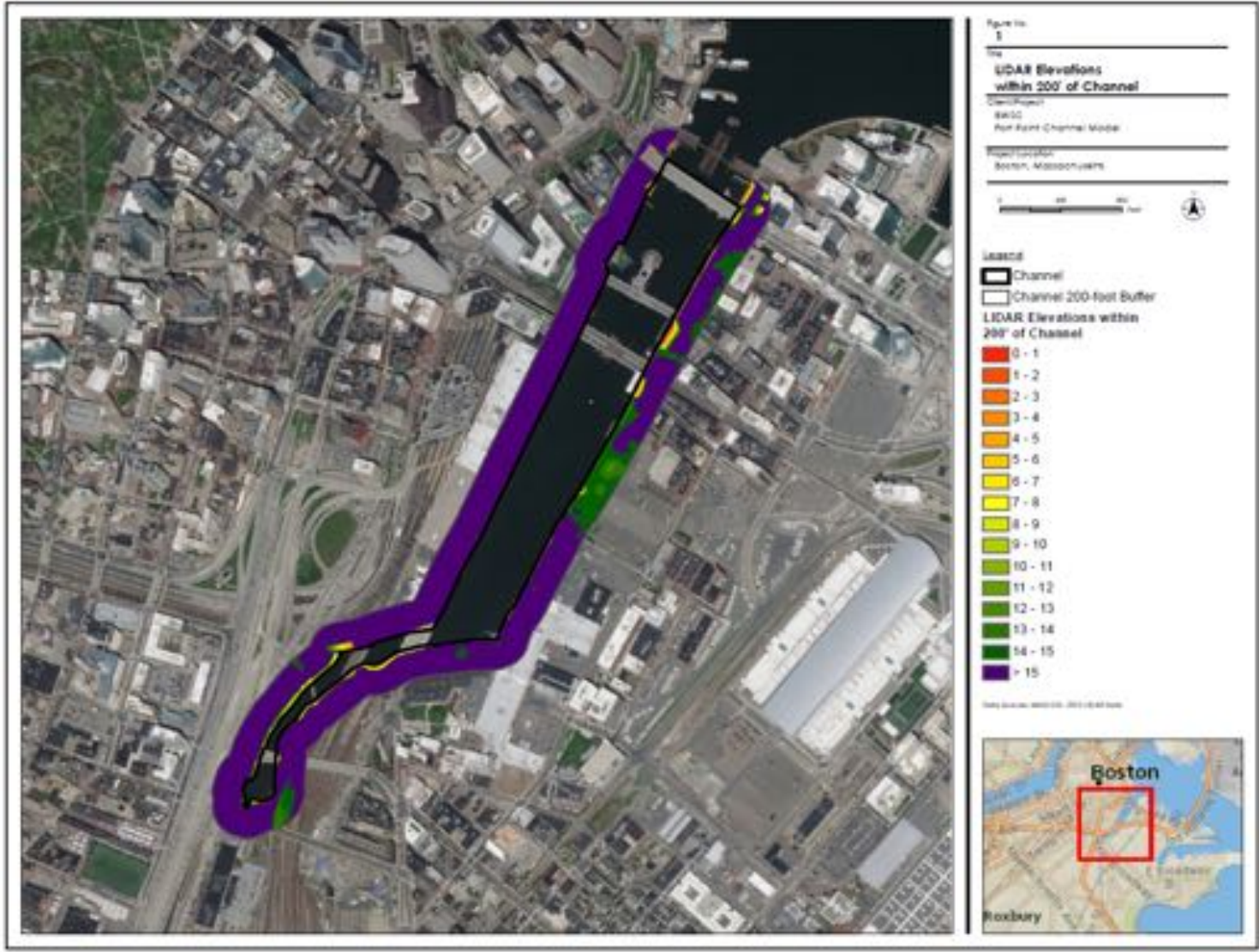
FPC Tributary Area – 2030

9% of Boston falls within FPC Watershed

Tributary Areas:

Combined Areas	1,232
Separated Areas	1,674
Total Area	2,906





Fort Point Channel

ACCESSIBLE RAMPS AT KEY LOCATIONS

SHEET PILING TO PREVENT GROUND WATER PENETRATION

OUTFALL WITH TIDEGATE

15.00
4' SLR
1% STORM

13.50
4' SLR
1% STORM

12.00
EXISTING
HARBORWALK GRADE

4.00 ft. AIRSPACE MOUTH PROTECT

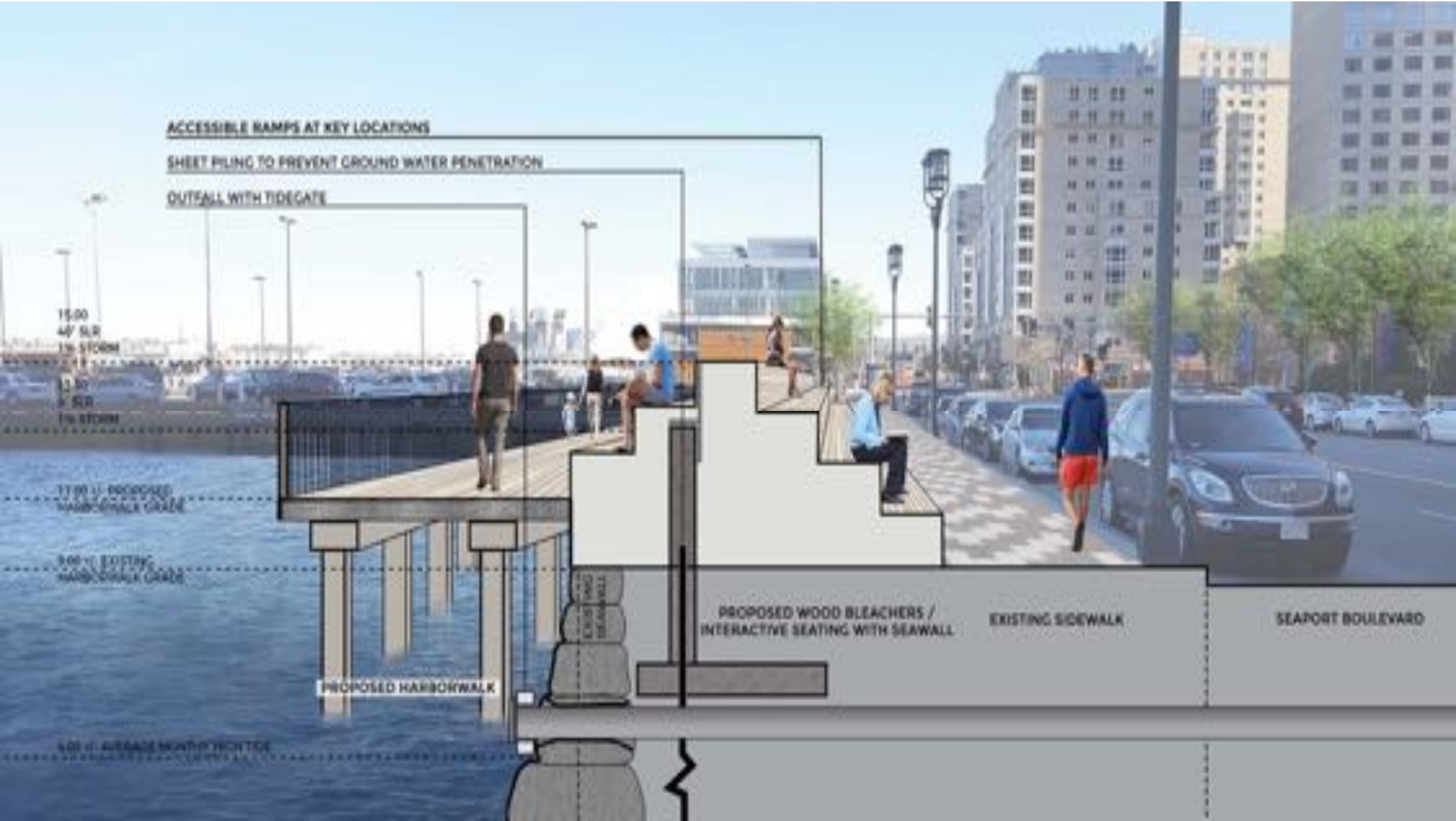
PROPOSED HARBORWALK

EXISTING SEAWALL

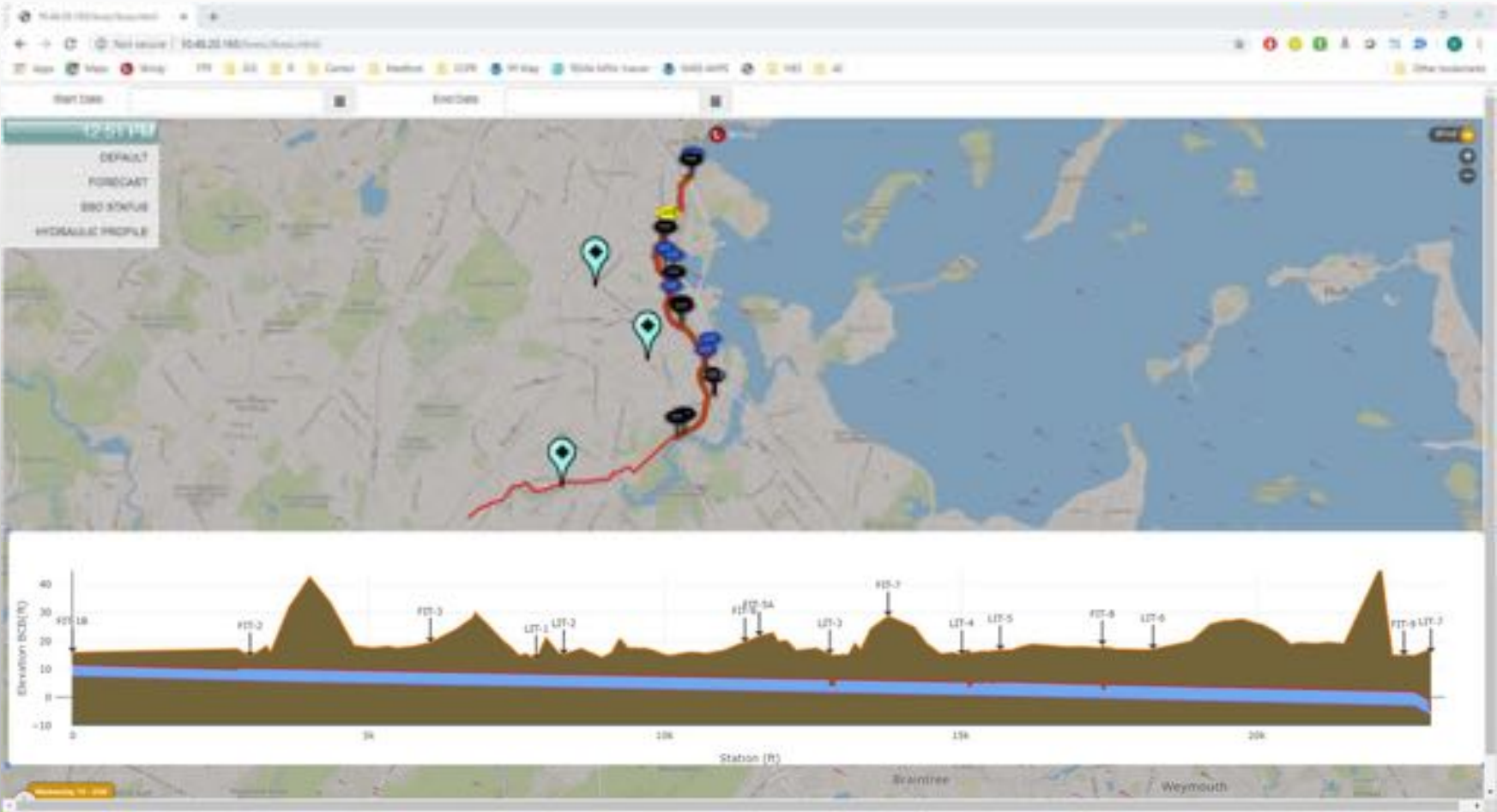
PROPOSED WOOD BLEACHERS /
INTERACTIVE SEATING WITH SEAWALL

EXISTING SIDEWALK

SEAPORT BOULEVARD



Smart Sewers



Questions

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