



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

July 28, 2020

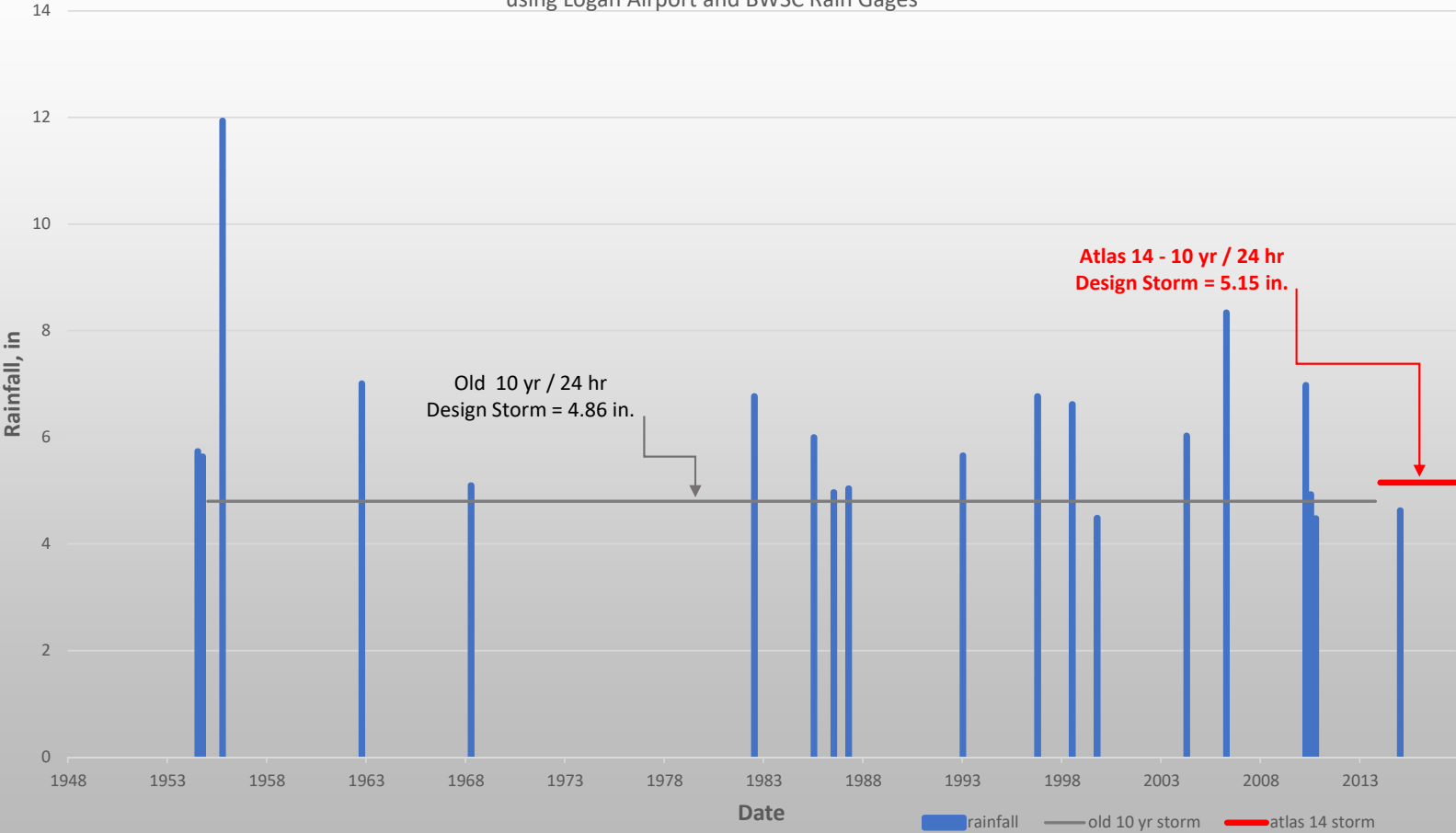
Charlie Jewell
Director of Planning and Sustainability

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)

<u>Wastewater Facilities Plan</u>		<u>BRAG</u>	
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

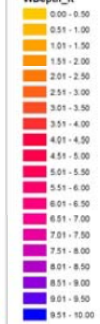




P2060
with Surge - 19.11 bcb

Printed on: Nov. 2019

Legend
p2060_surge_sl19p11ftbcb
WDepth_ft



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

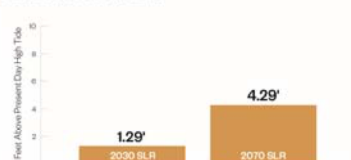
Thunderstorm

Storm Motion

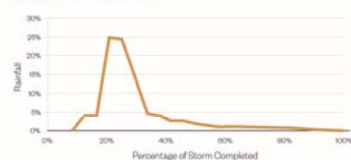


Storm Direction: **66.0 degrees** | Northeast
Speed: **25 miles per hour**

Sea Level Rise (SLR)



Storm Accumulation



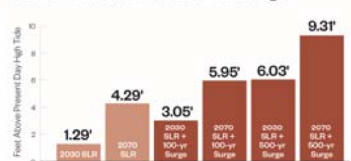
Tropical

Storm Motion

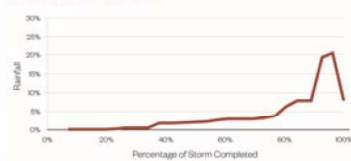


Storm Direction: **270.0 Degrees** | West
Speed: **24.8 miles per hour**

Sea Level Rise (SLR) and Storm Surge

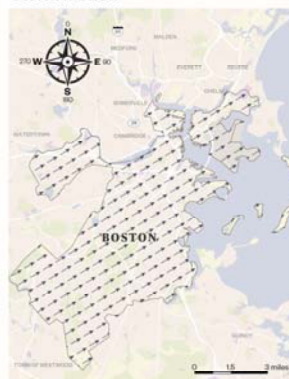


Storm Accumulation

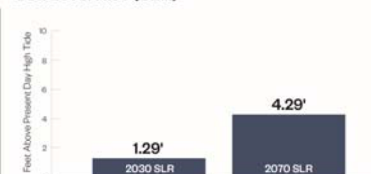


Frontal

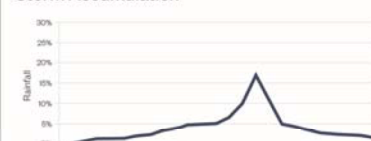
Storm Motion



Sea Level Rise (SLR)



Storm Accumulation



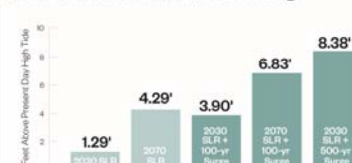
Nor'easter

Storm Motion

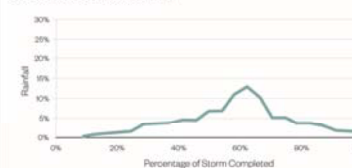


Storm Direction: **270.0 Degrees** | West
Speed: **21.1 miles per hour**

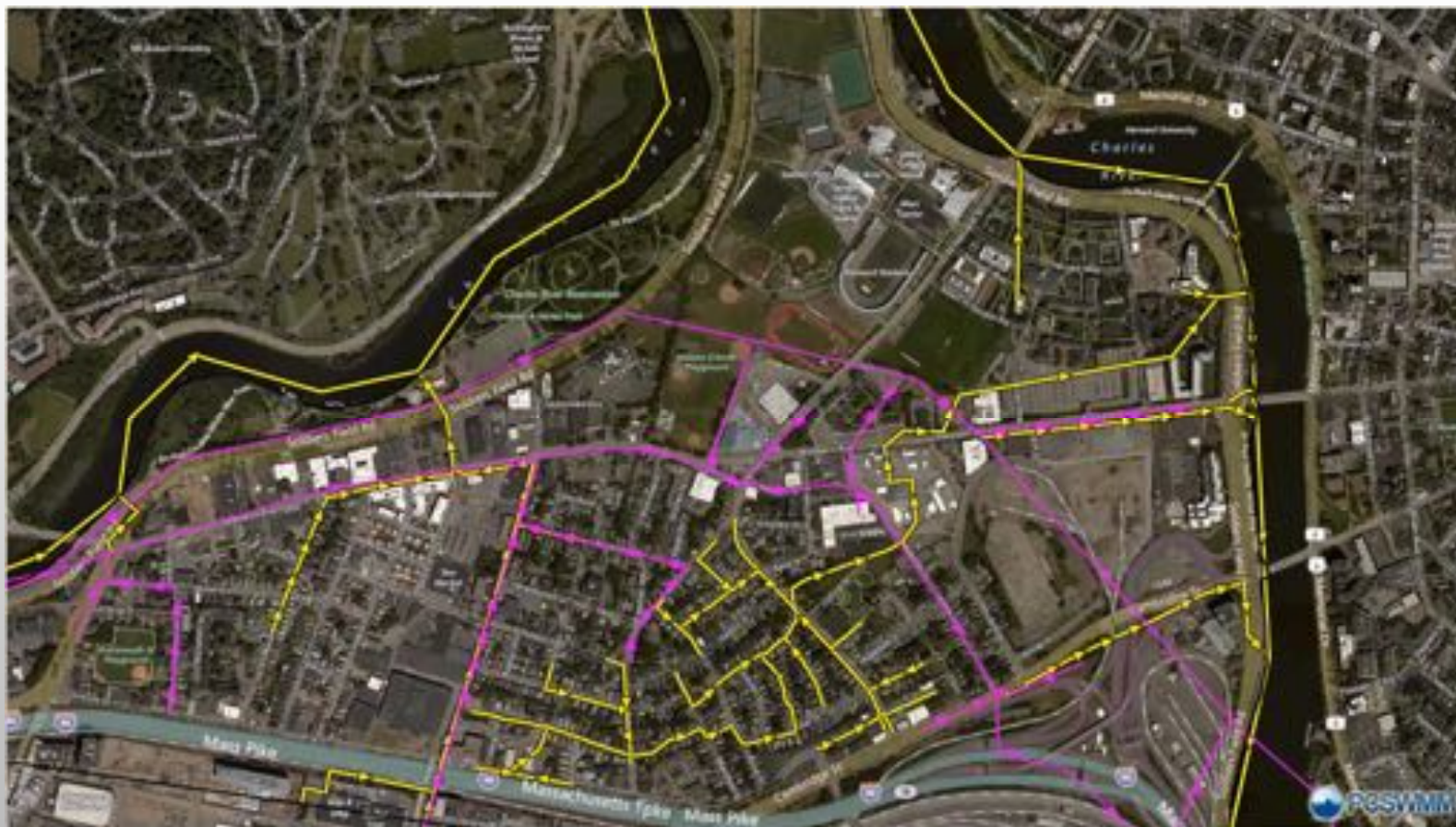
Sea Level Rise (SLR) and Storm Surge

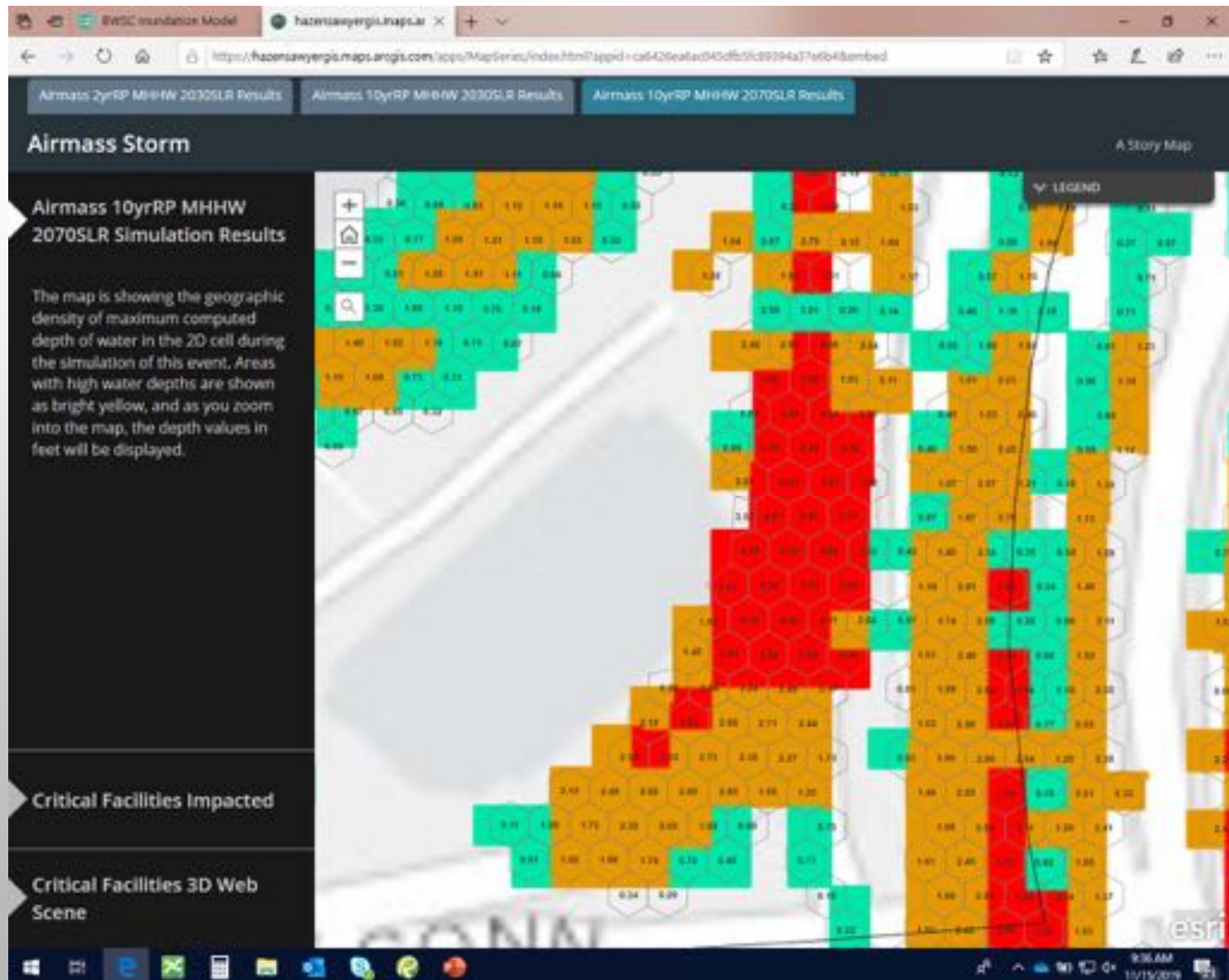


Storm Accumulation

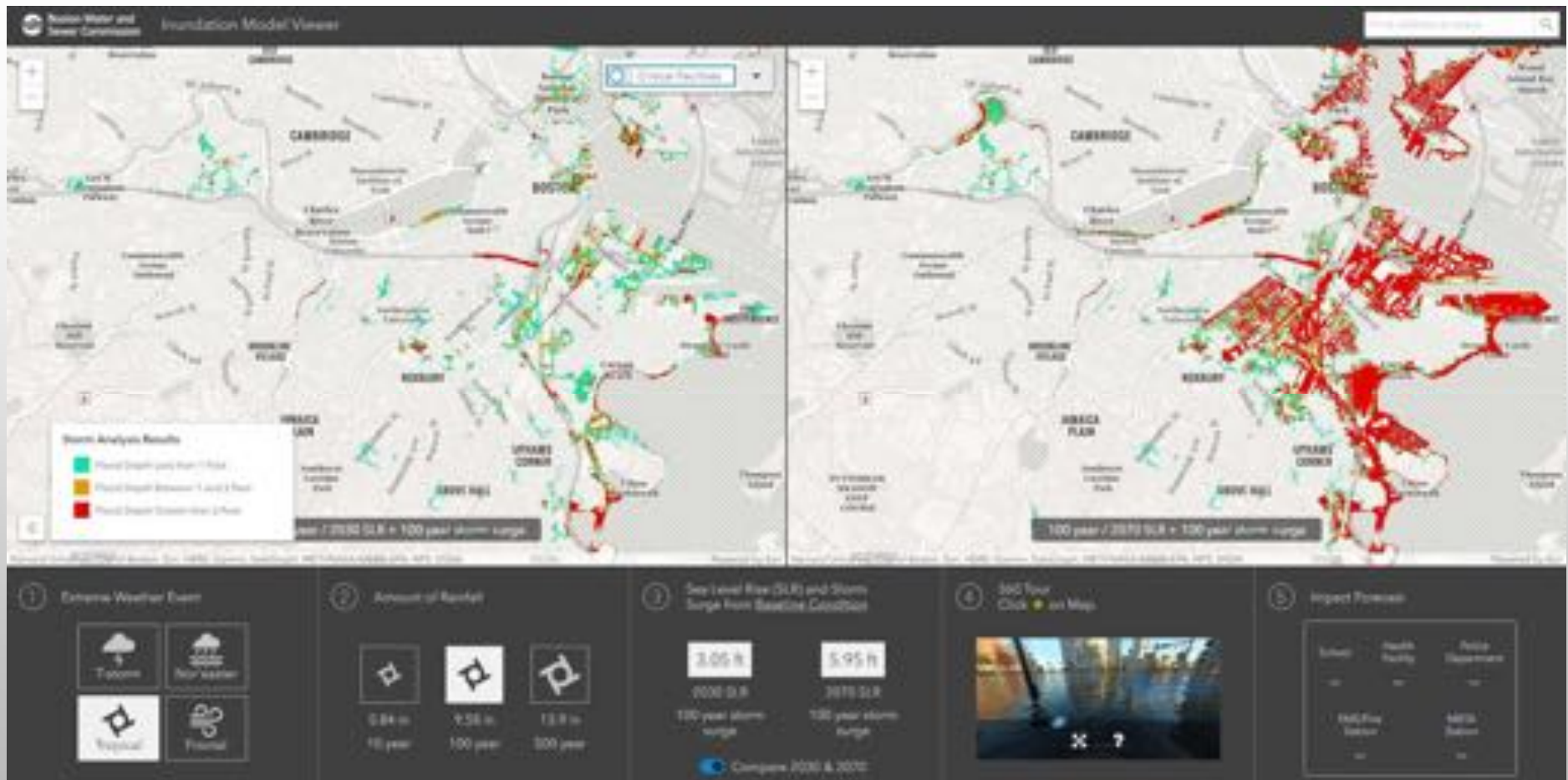


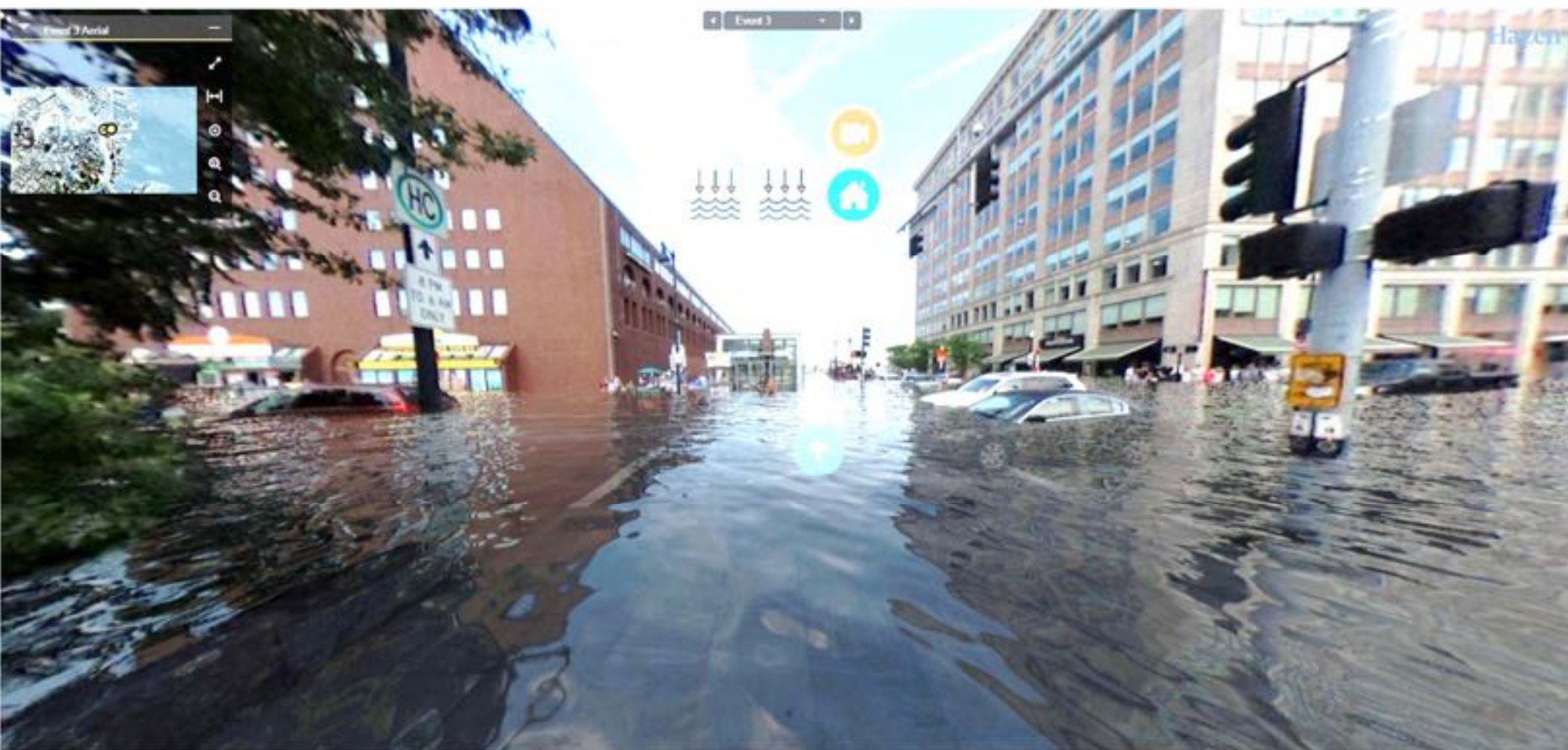
JUNE 1998 EVENT – MODEL PREDICTED FLOODING ANIMATION
(6.77 INCHES OF RAIN, 43 HOURS)





INUNDATION MODEL VIEWER – 2030 VS. 2070 COMPARISON





Inundation Overview

Sea Level Rise

2030
2070

Neighborhood

All

Critical Facility Type

All



Hazen

Storm Summary

Storm	Population Impacted	Critical Facilities Impacted	Cumulative Facilities Risk Level
August 2017 Event (2030 SLR)	16,749	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	9095
Hurricane Doris	24,221	64	1904
June 1998 Event (2030 SLR)	60,841	170	4876
June 1998 Event (2070 SLR)	50,832	232	13070
Nor'easter (100-yr w/ 2030 SLR & 100-yr surge)	41,392	101	6589
Nor'easter (100-yr w/ 2070 SLR & 500-yr surge)	140,387	272	34542
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	6405
Nor'easter (50-yr w/ 2030 SLR)	11,069	29	1429
Nor'easter (50-yr w/ 2070 SLR & 100-yr surge)	128,342	273	3459
Nor'easter (50-yr w/ 2070 SLR)	45,021	104	8601
September 1999 Event (2030 SLR)	28,548	66	1919
September 1999 Event (2070 SLR)	65,041	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	9095
Tropical (500-yr w/ 2030 SLR & 500-yr surge)	108,138	254	19097

Population Impacted

● Total Population ● Population impacted



Critical Facilities Mapping

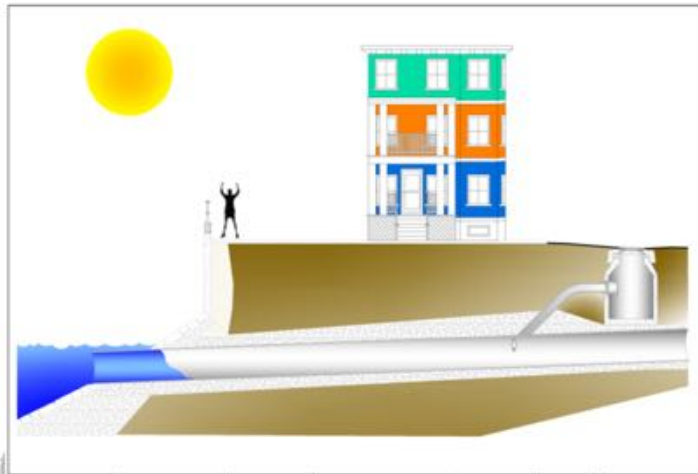


Critical Facility Impacts

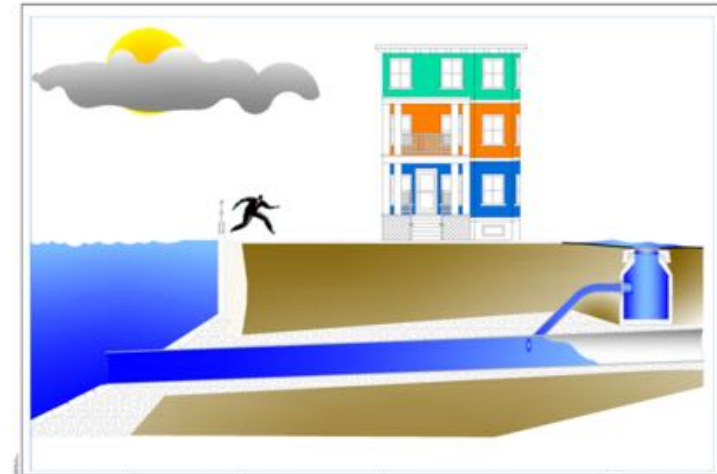
Critical Facility	Max Duration (hrs)	Max Depth (ft)	Avg Depth (ft)	Risk Level
Emergency Ctr	80.7	16.0	3.0	4
Boston Public Library	34.5	3.4	1.3	4
Charlestown Community Center	12.2	6.7	1.5	4
Cordon Community Center	33.8	6.4	1.9	4
Curley Community Center	88.2	16.0	3.9	4
Grove Hall Community Center	3.5	0.5	0.2	2
Harborside Community Center - Ursula 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	2.3	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

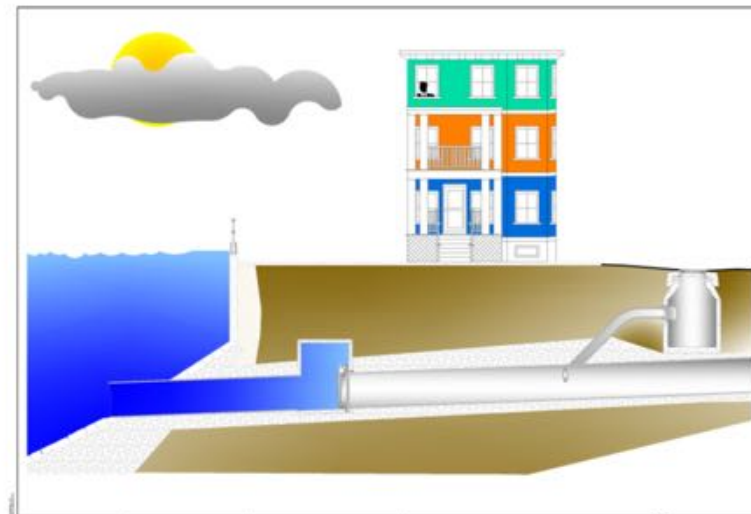




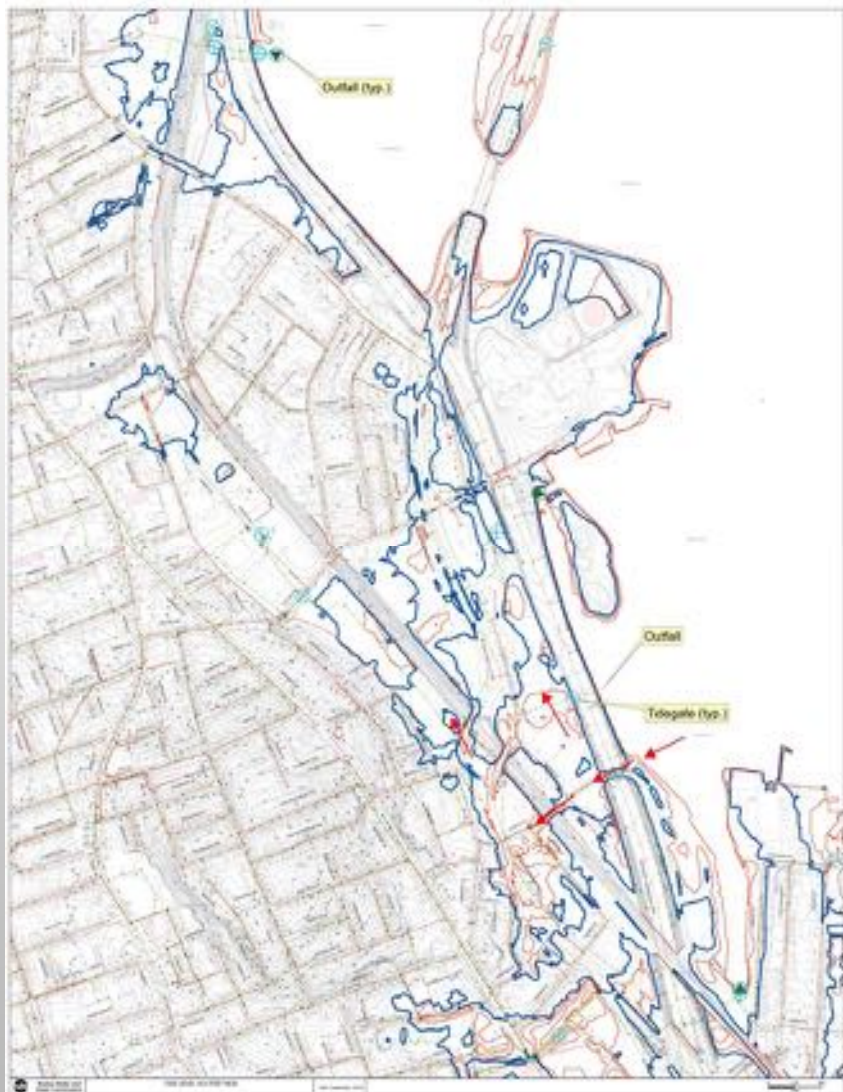
Storm Drain Outfall at Low Tide



Storm Drain Outfall at High Tide without Tide Gate



Storm Drain Outfall at High Tide with Tide Gate

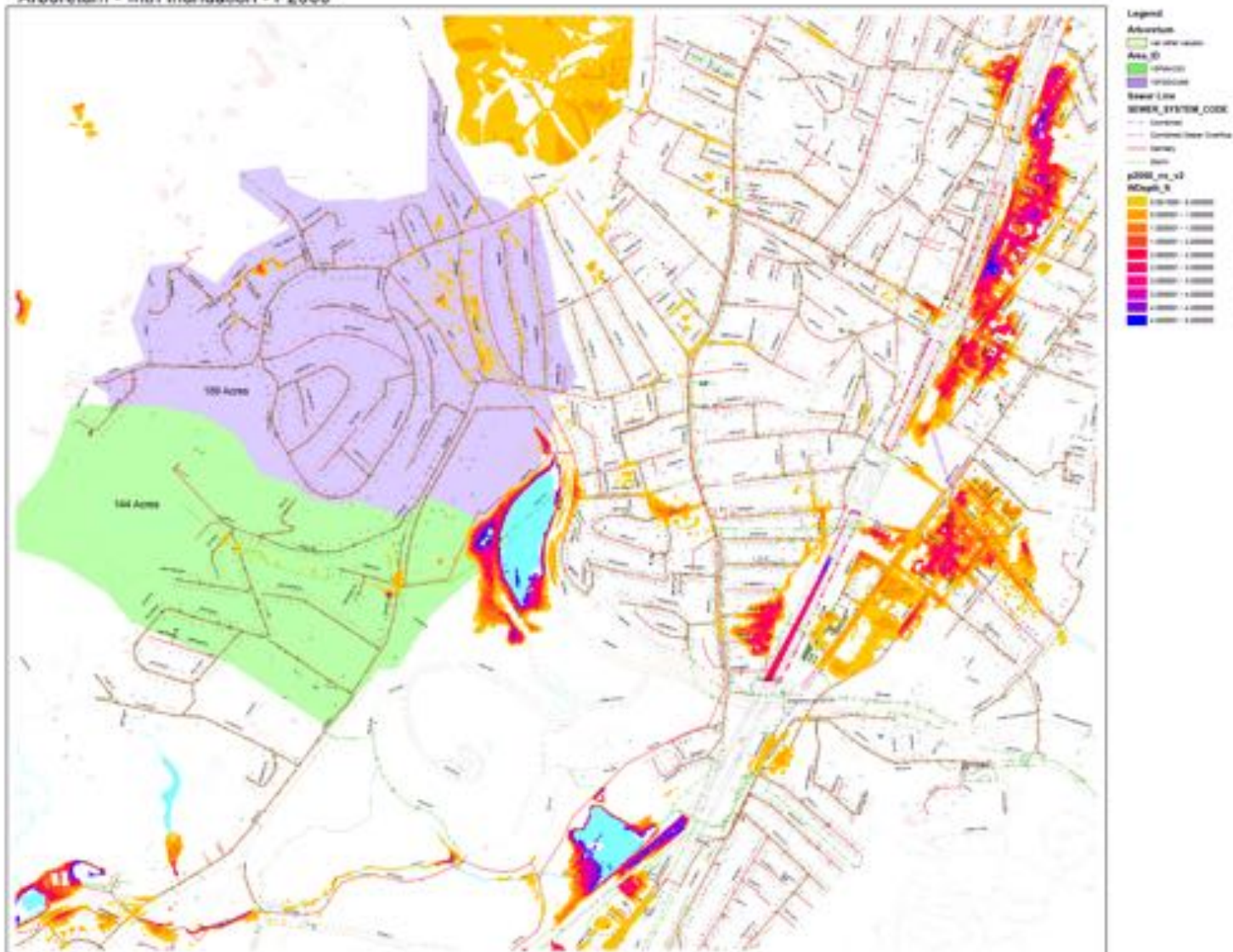


Outfall Screening

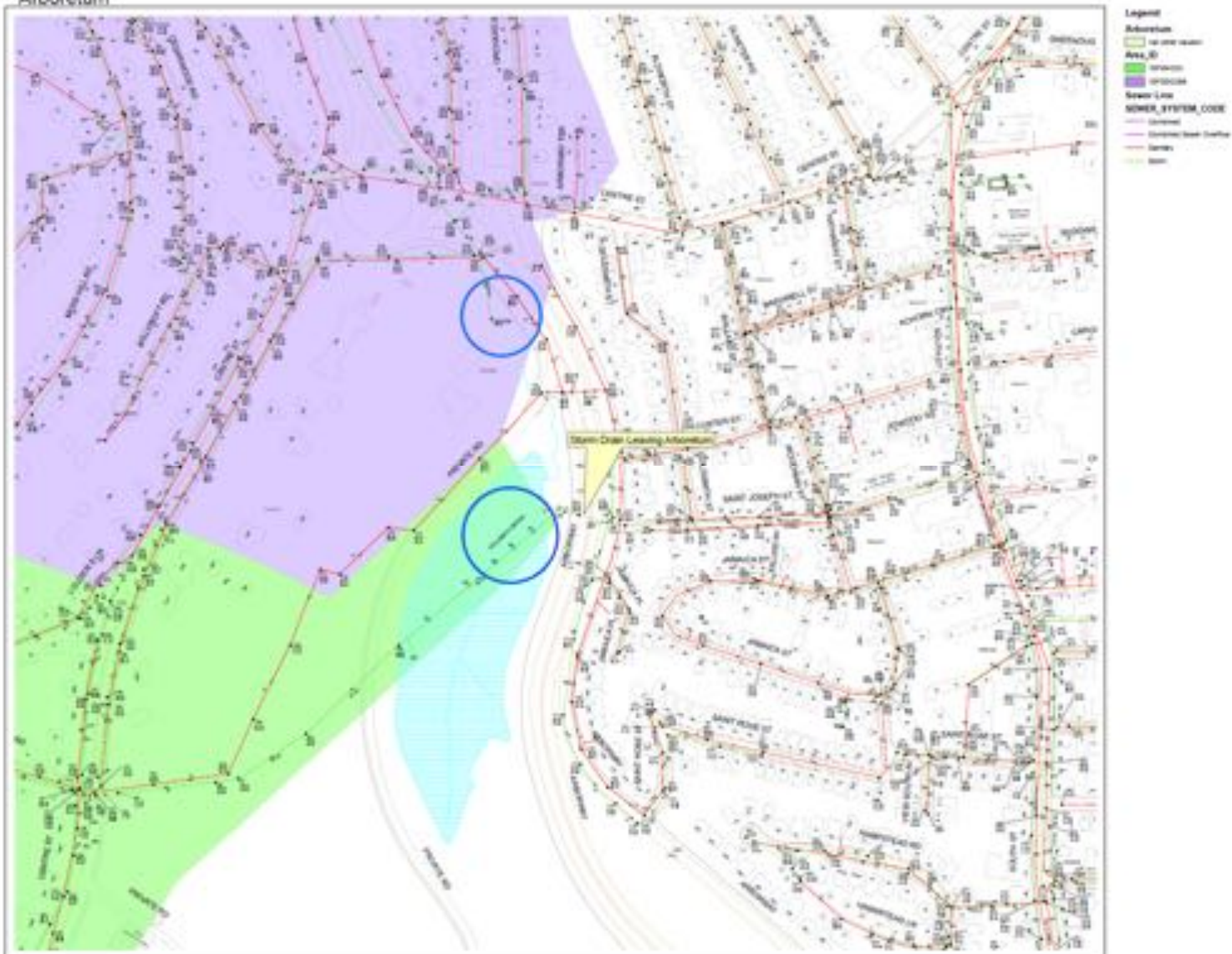
NEW TIDE GATES MT. WASHINGTON AVE

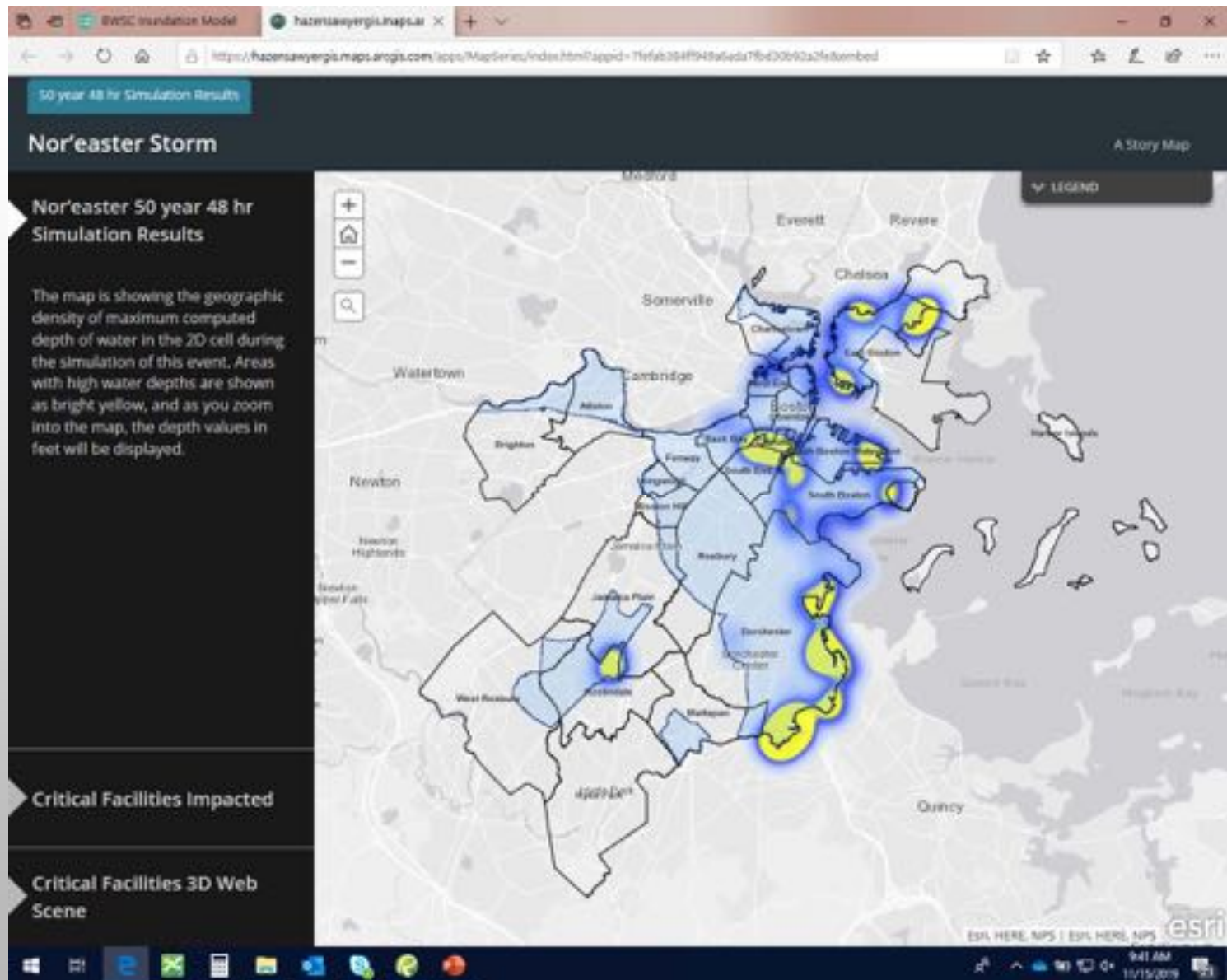


Arboretum - with Inundation - P2060



Arboretum





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



ACCESSIBLE RAMPS AT KEY LOCATIONS

SHEET PILING TO PREVENT GROUND WATER PENETRATION

OUTFALL WITH TIDEGATE

15.00
40' S.R.
1% STORM

13.50
4' S.R.
1% STORM

17.00 1' PROPOSED
HARBORWALK GRADE

9.00 1' EXISTING
HARBORWALK GRADE

PROPOSED HARBORWALK

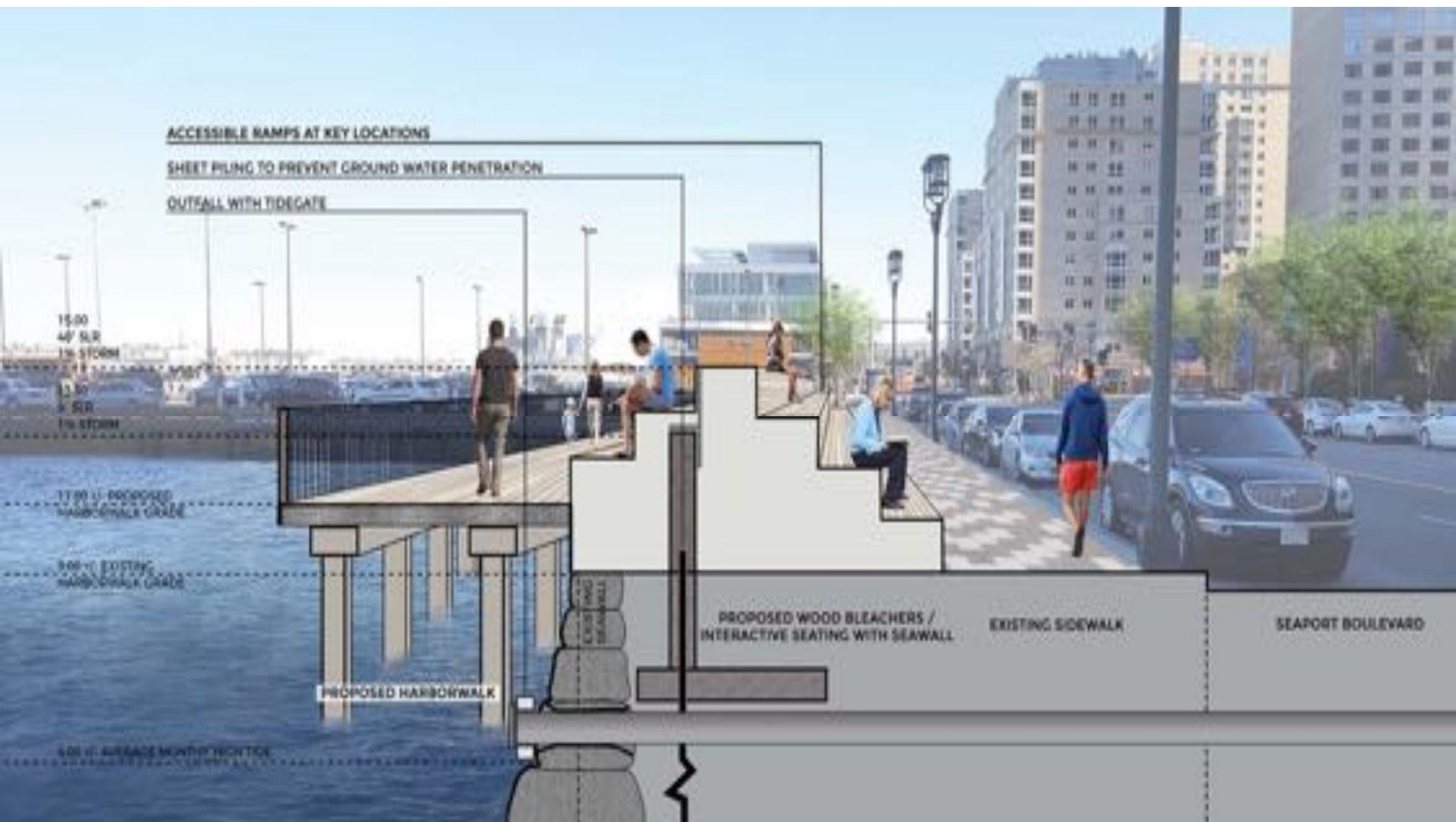
4.00 1' AVERAGE MONTHY HIGH TIDE

EXISTING
SEAWALL

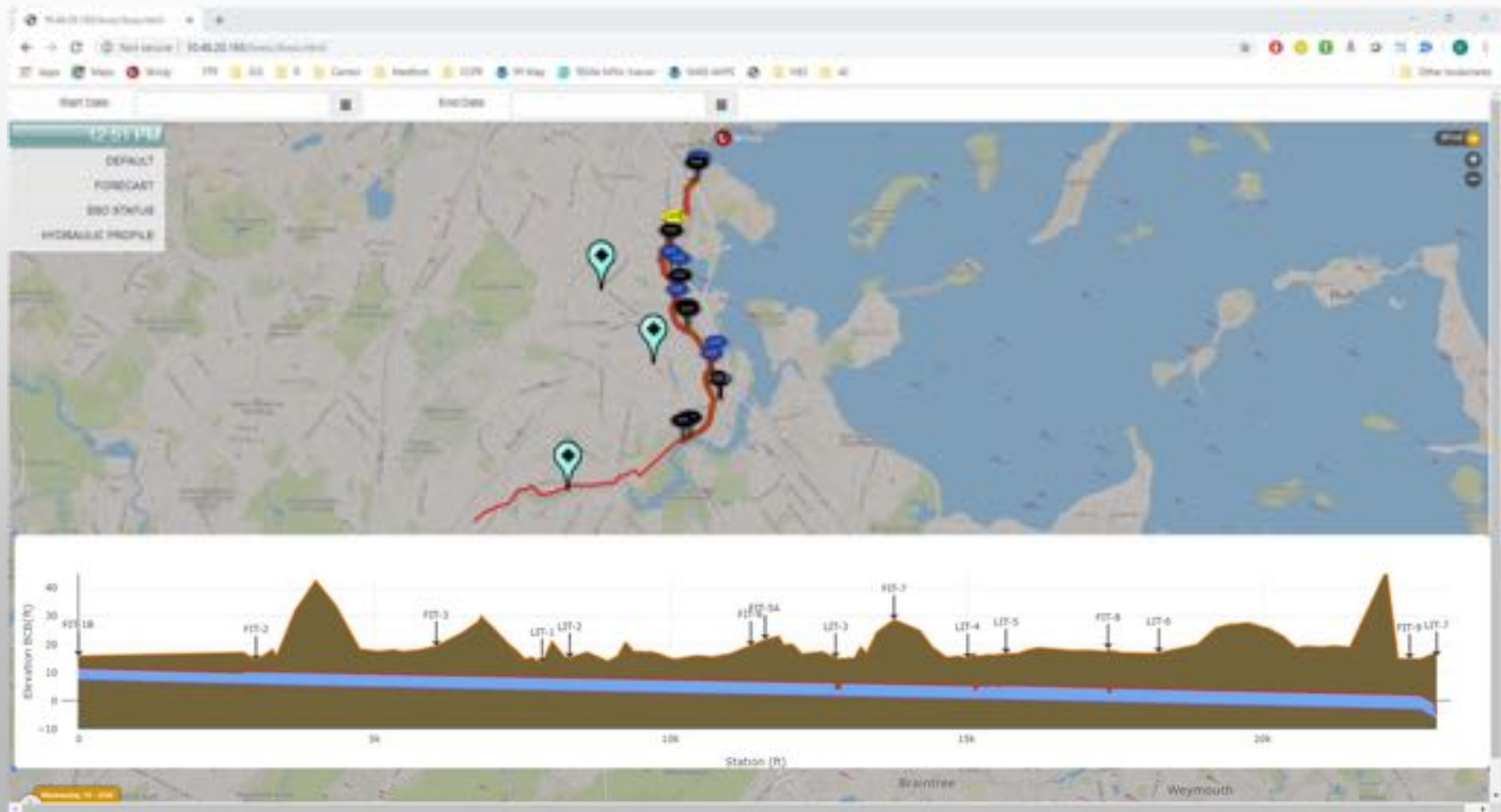
PROPOSED WOOD BLEACHERS /
INTERACTIVE SEATING WITH SEAWALL

EXISTING SIDEWALK

SEAPORT BOULEVARD



Smart Sewers



Questions

JewellC@bwsc.org

