APPENDIX

LITERATURE SUMMARIES

NEPONSET RIVER ESTUARY AREA OF CRITICAL ENVIRONMENTAL CONCERN (ACEC) RESOURCE MANAGEMENT PLAN

STATE-APPROVED RESOURCE MANAGEMENT PLAN

ENTITY

The ACEC Program is a Department of Conservation and Recreation (DCR) program. During the designation and Resource Management Plan (RMP) process, it was a Department of Environmental Management (DEM) program. In 2003, DEM merged with the Metropolitan District Commission (MDC) to become DCR.

TIMELINE

Neponset River Estuary ACEC has a designation date of March 1995. Amended on December 1, 1995. This RMP was approved on May 15, 1996.

OVERVIEW

The Neponset River Estuary ACEC is approximately 1,300 acres in size and is located in Boston (435 acres), Milton (355 acres) and Quincy (470 acres). The ACEC boundary is based upon the Wetlands Protection Act Regulations (wetlands resource areas and a 100-foot buffer) plus adjacent public open space and historic districts. The central resource features of the Neponset River Estuary ACEC are the Neponset River and portions of its tributaries, the estuary, salt marshes, , fishery habitat, and diverse wildlife habitat. The predominant ecological and visual features of the ACEC are the Neponset River and the adjacent salt marshes.

The DCR, formerly Metropolitan District Commission) owns over 500 acres within the ACEC, providing a wide variety of public open space and recreational opportunities. Following the ACEC designation in March, 1995, Environmental Affairs Secretary Trudy Coxe directed EOEA agencies to develop a Resource Management Plan for the ACEC to guide the implementation of the ACEC designation. As part of this process, the ACEC was amended on December 1, 1995 to provide for a variety of publicly and environmentally beneficial projects. This final ACEC RMP was approved by the Secretary on May 15, 1996.

AREA OF STUDY

Neponset River Estuary ACEC – approximately 1,300 acres of land in Boston, Quincy, and Milton, Massachusetts.

SUMMARY

The stated purpose of the RMP is "*to guide the implementation of the Neponset River Estuary* ACEC *and coordinate the activities and interests of federal, state, and local agencies and the public and private sectors within the* ACEC. The RMP establishes goals and makes recommendations for managing the ACEC and its resource areas and features including to promote increased coordination and cooperation among the several municipalities, state and federal agencies, nonprofit groups, and citizens in gathering and sharing information, considering future land and water use, reviewing proposed development, and in designing and implementing specific solutions to problems. The RMP clearly identifies historic authorizations for dredging activities and licenses for water-dependent and nonwater-dependent structures and fill within the ACEC and provides guidance for future state agency review of these activities and uses within the ACEC. It

notes that improvement dredging is prohibited except for the sole purpose of fisheries and wildlife enhancement. However, improvement dredging should be limited to specific areas where public projects are undertaken to promote public health, public recreation and environmental quality improvements. Furthermore, some exemptions have been granted from the Chapter 91 prohibitions regarding improvement dredging. It also includes an implementation strategy for proposed projects and initiatives with associated timelines and associated stewardship necessary to maintain the ACEC and revise the RMP going forward. The RMP includes contributions from numerous public and private entities and underwent rigorous public process and community input prior to being approved by the state in 1996.

TOPICS ADDRESSED

Parks and open space, natural resources, coastal structures, dredging, floodplains, stormwater management, etc.

DORCHESTER RELEVANCY

No historic authorizations for dredge activities or record licenses for structures or fill are included in the RMP for the Project study area. Per the RMP, no new or improvement dredging shall be authorized within the ACEC. However, improvement dredging associated with the stormwater outfalls at Tenean and Lawley Streets and Pine Neck Creek, and sediment removal and re-sanding at Tenean Beach have been granted exemptions from the Chapter 91 prohibitions regarding improvement dredging per the RMP.[1]

The RMP also provides only limited exemption for the licensing of new structures or fill below the high tide line in the ACEC as follows:

1) *Shoreline stabilization or rehabilitation of an existing shore protection structure*;
2) *Installation or drainage, ventilation, or utility structures, or placement of minor or incidental fill necessary to accommodate any modification to existing public roadways or railroad track and/or rail bed; or*
3) *Improvement or rehabilitation of existing public roadways or railroad track and/or rail bed, provided that any net encroachment with respect to public roadways is limited to widening by less than a single lane, adding shoulders, and upgrading substandard intersections.*

Per the Chapter 91 Waterways Regulations, the Massachusetts Department of Environmental Protection (MassDEP) may authorize projects that meet the categorical restrictions within an ACEC at 310 CMR 9.32(1)(e):

- *fill or structures for any use on previously filled tidelands*;
- *structures to accommodate public pedestrian access on flowed tidelands, provided that it is not feasible to locate such structures above the high-water mark or within the footprint of existing pile-supported structures or pile fields*;
- *fill or structures to accommodate an Ecological Restoration Project, subject to approval under* 314 CMR 9.00: 401 *Water Quality Certification for Discharge of Dredged or Fill Material, Dredging, and Dredged Material Disposal in Waters of the United States Within the Commonwealth*, 310 CMR 10.00: *Wetlands Protection, and* 310 CMR 40.000: *Massachusetts Contingency Plan if applicable, provided that any fill or dredged material used in an Ecological Restoration Project may not contain a chemical above the RCS-1 concentration, as defined in* 310 CMR 40.000: *Massachusetts Contingency Plan*;
- *publicly owned structures for other water-dependent uses below the high water mark, provided that such structures are designed to minimize encroachment in the water*;
- *and other privately-owned structures for other water-dependent uses.*

Additionally, consideration should be given to general tenets of the RMP, which include, but are not limited to, improving water quality, enhancing public access, restoring salt marshes, and improving of areas of potential habitat in any proposed Project design.

Should proposed uses, activities, and/or other alterations to address growing coastal flood risk due to climate change conflict with state approved RMP, an amendment of the RMP supported by state agencies, local municipalities, and other key stakeholders may be necessary. Per the RMP, the original intention of the RMP process was create a *dynamic plan* that would be revised every 3-5 years under the guidance of the Neponset River Estuary ACEC Stewardship Council and that the plan be *adjusted as new issues arise*.

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[1] It should be noted that the version of the RMP posted on the ACEC Programs site is an incomplete version as page and 69 is not included in the published electronic document. An unofficial copy of the RMP including the missing Page 69 was generously provided by the Neponset River Watershed Association.

CLIMATE CHANGE IMPACTS AND PROJECTIONS FOR THE GREATER BOSTON AREA: FINDINGS OF THE GREATER BOSTON RESEARCH ADVISORY GROUP REPORT

REPORT

CLIENT

The Barr Foundation provided the funding.

TIMELINE

The report was published in 2022.

OVERVIEW

The report "summarizes the most recent (as of late 2021) scientific understanding of climate risk factors pertinent to Greater Boston."

AREA OF STUDY

Relative sea level rise projections are provided for the Boston tide gauge (NOAA Station 8443970).

CONSULTANT TEAM

The study was led by Ellen Douglas and Paul Kirshen of UMass Boston, with support from a large and diverse academic and technical team, as well as a steering committee of public, non-governmental, and private organizations.

SUMMARY

The most relevant component of the Greater Boston Research Advisory Group (GBRAG) report is its updated relative sea level rise projections for Boston. By examining these projections, the City can ascertain the degree to which projections in the original Climate Ready Boston vulnerability assessment and the Massachusetts Coast Flood Risk Model (MC-FRM) are reflective of conservative (extremely unlikely to be exceeded) scenarios based on the most recent and best available science for the region.

The GBRAG report provides updated probabilistic projections for the Boston tide gauge based on the best available science, summarized in Table 4.1 from the report, shown below. Note that the values are in cm. The second row of the table indicates the probability that the values in cells below will be exceeded in each time horizon (0.99 is 99% probability. The inverse of these probabilities would be the degree to which the values below are unlikely to be exceeded (0.17 is 83% or very unlikely to be exceeded, 0.05 is 95% or extremely unlikely to be exceeded).

Table 4.1

Relative sea level probabilities for Boston Harbor relative to a 2000 baseline for three RCP greenhouse gas emissions scenarios.

				Likely range					
		0.99	0.95	0.83	0.5	0.17	0.05	0.01	0.001
RCP8.5	2020	1	5	8	13	17	21	25	31
	2030	4	9	14	20	27	33	40	54
	2050	12	19	27	39	52	65	83	127
	2070	19	31	44	63	85	109	145	239
	2100	28	49	72	105	146	192	273	476
	2200	118	148	184	257	378	550	904	1,690
RCP4.5	2020	3	6	8	12	15	18	21	25
	2030	6	10	14	19	24	28	33	43
	2050	9	16	23	34	44	54	66	95
	2070	13	23	34	50	68	84	105	161
	2100	16	31	48	73	100	129	173	290
	2200	23	54	89	147	230	335	543	1,050
RCP2.6	2020	3	6	9	13	16	19	22	27
	2030	4	8	13	19	25	30	35	44
	2050	4	12	20	32	43	53	64	85
	2070	6	16	27	43	59	73	90	130
	2100	6	20	35	56	78	101	133	214
	2200	41	54	69	97	143	208	341	680

Values are in cm and columns show percentiles. 0.5 represents the 50th percentile (median) estimate, while 0.83 to 0.17 represent the 17th to 83rd percentile "likely range" of possible outcomes. There is a 66% likelihood that sea level will fall within the likely range (light blue columns), while there is a 5% chance that sea level will exceed the 0.05 (95th percentile) value.

The Climate Ready Boston (CBR) vulnerability assessment report centers the City's coastal resilience planning around relative sea level rise projections of about 1.0 ft[1] by 2030, 2.0 ft[2] by 2050, and 3.6 ft[3] by 2070, relative to a 2000 baseline, based on a high emissions scenario (RCP 8.5). These projections were extremely unlikely to be exceeded in 2030 (99% probability) and 2050 (95-99% probability) and unlikely to extremely unlikely to be exceeded in 2070 (83-95%) based on the Boston Research Advisory Group (BRAG) Climate Projections Consensus report (2016) (see Table 1-1 from BRAG 2016 below).

[1] The report indicates about 3 inches of RSLR occurred between 2000 and 2015, and 9 inches are projected between 2016 and 2030.
[2] The report indicates about 3 inches of RSLR occurred between 2000 and 2015, and 21 inches are projected between 2016 and 2030.
[3] The report indicates about 3 inches of RSLR occurred between 2000 and 2015, and originally indicated that 36 inches are projected between 2016 and 2030, though the City later revised its communications to reflect 40 inches. This revision was to align the City's projections more closely with the Boston Harbor Flood Risk Model projections.

Table 1-1. *RSL projections for Boston, MA (in ft, relative to 2000) categorized by exceedance probabilities.*

			Likely range					Maximum
	0.99	0.95	0.833	0.5	0.167	0.05	0.01	0.001
RCP8.5								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.7	1.1	1.5	1.8	2.1	2.4
2070	0.6	1.0	1.5	2.2	3.1	3.7	4.3	4.8
2100	1.6	2.4	3.2	4.9	7.4	8.6	9.5	10.5
2200	18.9	19.9	21.4	26.1	32.8	34.1	35.3	36.9
RCP4.5								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.7	1.0	1.4	1.7	2.0	2.3
2070	0.4	0.9	1.5	1.9	2.6	3.1	3.6	4.1
2100	0.9	1.7	2.4	3.6	5.1	6.1	7.0	8.0
2200	5.5	6.2	7.2	10.9	16.5	18.0	19.3	20.9
RCP2.6								
2030	-0.1	0.1	0.3	0.5	0.7	0.9	1.0	1.2
2050	0.1	0.4	0.6	1.0	1.4	1.7	2.0	2.3
2070	0.3	0.7	1.1	1.7	2.3	2.7	3.1	3.6
2100	0.4	1.2	1.8	2.8	3.8	4.6	5.3	6.2
2200	3.6	4.4	5.2	6.4	7.7	8.8	9.9	11.8

MC-FRM uses the Commonwealth's High scenario[4] relative sea level rise projections for the Boston tide gauge (DeConto and Kopp, 2017). Relative to a 2000 baseline, these equate to approximately 1.4 ft by 2030, 2.6 ft by 2050, and 4.4 ft by 2070. These projections were estimated to be extremely unlikely to be exceeded (99.5% probability, or 0.005 relative to numbers in the second row of Table 1) under a high emissions scenario (RCP 8.5).

To determine the likelihood that CRB and MC-FRM projections are exceeded based on the updated projections for a high emissions scenario, a modified version of the GBRAG report's Table 4.1 was created and compared with prior projections (see Table 1 below). The results indicate that projections used in CRB's vulnerability assessment (red text in Table 1) are unlikely to extremely unlikely to be exceeded in 2030 and 2050 (83-95% probability) and extremely unlikely to be exceeded in 2070 (95% probability). They also indicate that the MC-FRM projections (yellow cells in Table 1) are extremely unlikely to be exceeded in 2030 (99-99.9%) and 2050 and 2070 (95-99%).

Table 1. Modified excerpt of Table 4.1 - Relative sea level probabilities for Boston Harbor relative to a 2000 baseline for three RCP greenhouse gas emissions scenarios.[5]

				Likely range					
		0.99	0.95	0.83	0.5	0.17	0.05	0.01	0.001
RCP 8.5	2030	0.1	0.3	0.5	0.7	0.9	1.1	1.3	1.8
	2050	0.4	0.6	0.9	1.3	1.7	2.1	2.7	4.2
	2070	0.6	1.0	1.4	2.1	2.8	3.6	4.8	7.8

TOPICS ADDRESSED

[4] https://eea-nescaum-dataservices-assets-prd.s3.us-east-1.amazonaws.com/resources/production/MA%20Statewide%20and%20MajorBasins%20Climate%20Projections_Guidebook%20Supplement_March2018.pdf
[5] Excerpt is limited to RCP 8.5. Modifications are limited to conversion of values from cm to ft and rounding to the tenths decimal place. The red text color indicates the range in which CRB projections fall for each time horizon. The yellow cell color indicate the range in which MC-FRM projections fall for each time horizon.

Climate science, sea level rise, projections, modeling

DORCHESTER RELEVANCY

Based on the findings, the City can confidently expect that relative sea level rise projections included in the MC-FRM are extremely unlikely to be exceeded based on the most recent climate science. There is a higher, but still low probability that CRB projections will be exceeded.

BOSTON PUBLIC WORKS DEPARTMENT CLIMATE RESILIENT DESIGN GUIDELINES & STANDARDS FOR PROTECTING THE PUBLIC RIGHT OF WAY

TYPE

CLIENT

Boston Public Works Department.

TIMELINE

October 17, 2018

OVERVIEW

With the growing number of conceptual solutions to climate resilience and urgency for action, the City has proactively identified that a framework for designing and evaluating climate resilient projects was needed to protect the public right-of-way (ROW).

The City is drafting a new policy to protect the public ROW from acute and chronic flooding due to SLR and storm surge. The Boston Public Works Department (BPWD) has prepared the Climate Resilient Design Standards & Guidelines for engineers and designers as guidance when designing flood barriers to protect the public ROW. The guidelines are intended to provide climate design adjustments and a standardized climate resilient design process for flood barriers. The document is meant to augment existing City and State design standards by considering climate impact and managing segmental shore-based flood protection projects over time.

Four sample barrier types and sample sites within the City were selected to provide example design considerations and real-world context for designing flood protection:

- Vegetated Berm: construct a vegetated earthen berm to serve as a flood barrier, with the goals of creating open space and additional value along Boston's waterfront
- Harborwalk (Seawall barrier: Transform the existing Boston Harborwalk into a flood barrier that maintains pedestrian connectivity to the waterfront
- Raised Roadways: elevate roadways to act as a flood barrier (or as emergency access/evacuation routes)
- Deployable Flood Barriers: Deploy temporary flood barriers as short-term solutions while long-term solutions are designed, permitted and constructed.

AREA OF STUDY

Effective for the City of Boston. There are sample sites for each barrier type, but these simply serve as a limited model of guidelines for city-wide implementation.

CONSULTANT TEAM

Julie Eaton, Project manager and Lead Resiliency Engineer, Weston & Sampson

Dean Groves, Principal-in-Charge, Weston & Sampson

Frank Ricciardi, Technical Review Lead, Weston & Sampson

SUMMARY

The Guidelines and Standards are defined by climate design adjustments for *useful life*. Useful life is defined as generally having longer timeline than design life and represents the extended service life of most infrastructure and should be assessed using professional knowledge, prior useful lifetime frames, and projected future conditions. The useful life estimates will inform the selection of climate adjustments to increase infrastructure resilience.

This is framed through the 2030, 2050, and 2070 time horizons. The 2070 time horizon represents a 50-year useful life and should be the goal for flood barrier design. The 50-year useful life may not be feasible for all projects, so climate design adjustments for 2030 and 2050 time horizons are presented to help designers select an incremental approach.

2030: Through 2040

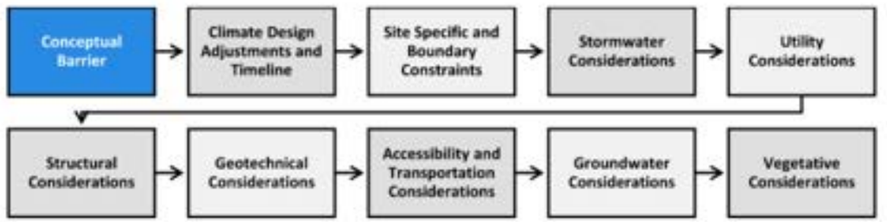
2050: 2041 to 2060

2070: 2061 to 2080

Section 2.0 articulates useful life time horizons for climate design adjustments and associated target projections for Sea Level Rise & Storm Surge, Extreme Precipitation, and Extreme Heat.

- Sea Level Rise & Storm Surge: See Table 1 in Appendix. Note that these were developed through the Boston Harbor Flood Risk Model (BH-FRM). Incremental approach: If 2070 DFE is not feasible to achieve at this point due to available funding and/or site constraints, intermediary DFE presented below should be used to prepare a plan to reach the 2070 DFE elevation incrementally. Temporary, deployable flood barriers may use intermediary DFE (2030 and 2050 time horizons) but are not considered appropriate for long-term flood defense from SLR and storm surge.
- Extreme Precipitation: See Table 2 in Appendix. Note that the Boston Water and Sewer Commission (BWSC) uses NOAA ATLAS 14 POINT PRECIPITTATION FREQUENCY ESTIMATES for design of stormwater collection and management systems. Designers are advised to use available projections and trend from Climate Ready Boston studies. Drainage planning and stormwater management for flood protections structure should assume future precipitation increases behind the barrier as well as on the flood side.
- Extreme Heat: See Table 3 in Appendix.
    - Extreme heat is a concern for protection structures due to several reasons, including but not limited to:
        - Heath and safety impacts
        - Thermal expansion
        - Material degradation from excessive heat
        - Pavement softening
        - Increased failure/reduced efficiency of electrical/mechanical systems (power outages and pumps)
    - Cold temperatures should be accounted and should include, but not limited to:
        - Health and safety impacts
        - Snow and ice ground cover
        - Plowing and snow removal
        - Snow storage on-site or off-site
        - Drainage and infiltration impacts
        - Ice jams

Section 3.0 details design, O&M (operations and maintenance), and cost considerations for the design process:



See appendix for in-depth description of design considerations.

See document for detailed O&M considerations, as well as Cost estimate considerations.

See **Section 4.0** for in-depth description of **Vegetated Barrier** and see Appendix for sample design drawing that implement the standards for protecting the public ROW.

See **Section 5.0** for in-depth description of **Harborwalk** and see Appendix for sample design drawing that implement the standards for protecting the public ROW.

See **Section 6.0** for in-depth description of **Raised Roadway Barrier** and see Appendix for sample design drawing that implement the standards for protecting the public ROW.

See **Section 7.0** for in-depth description of **Deployable Flood Barrier Guidance** and specific products of varying physical attributes and structural attributes.

TOPICS ADDRESSED

Design standards, climate resilience, sea level rise and storm surge, extreme precipitation, extreme heat, climate design adjustments, useful life

DORCHESTER RELEVANCY

These guidelines directly impact the design of the project at Tenean Beach as it articulates standards and considerations for the project flood risk reduction kit of parts:

- Vegetated Berm
- Raised Roadways
- Harborwalk
- Deployables

The guidelines offer a detailed description of considerations engineers and designers should take to develop the resilient strategies to reduce flood risk while also protecting the public ROW. It serves as a helpful tool as the project enters the Schematic Design phase and develops and evaluates the options in further detail.

Table 1. Sea Level Rise Design Adjustments – Reference the BH-FRM for site-specific BFE

End of useful life	Sea Level Rise Adjustment	1% annual flood event elevation (BFE) *BCB	Minimum DFE for non-critical assets *BCB	Minimum DFE for critical assets *BCB
Baseline	N/A	15.7	16.7	17.7
2030	+9 inches	17	18	19
2050	+21 inches	18	19	20
2070	+40 inches	19.5	20.5	21.5

Notes:
2030: Through 2040
2050: 2041 to 2060
2070: 2061 to 2080
1% annual flood event is also known as the 100-year flood event.
Boston City Base (BCB) Datum can be converted to NAVD88 by: NAVD88 = BCB – 6.46 ft.

Table 2. Extreme Precipitation Design Adjustments

Peak Hourly Intensity Rainfall (inch/hour)			
End of useful life	**10% annual design storm (in/hr) (BWSC 2015 (A1FI))**	**2% annual design storm (in/hr)**	**1% annual design storm (in/hr)**
Baseline (NOAA 14)	1.66	2.33	2.62
2035	1.78	*Data not available*	*Data not available*
2060	1.91	*Data not available*	*Data not available*
2100	2.11	*Data not available*	*Data not available*
Total Storm Depth (inches/24 hour)			
End of useful life	**10% annual design storm (in) (BWSC 2015 (A1FI))**	**2% annual design storm (in)**	**1% annual design storm (in) (City of Cambridge 2015)**
Baseline (NOAA 14)	5.25	7.18	8.08
2035	5.60	*Data not available*	10.2
2060	6.03	*Data not available*	*Data not available*
2100	6.65	*Data not available*	11.7

Notes:
10% annual design storm is also known as the 10-year flood event.
2% annual design storm is also known as the 50-year flood event.
1% annual design storm is also known as the 100-year flood event.

Table 3: Extreme Heat Design Adjustments

Extreme Heat Events		
End of useful life	**# days above 90°F (Rossi et all, 2015)**	**Average Summer Temperature (°F) (Houser et al, 2015)**
Baseline	11	69
2030	20-40	69-73
2070	25-90	Up to 84 by 2100

Notes:
Baseline: 1971 through 2000
2030: Through 2040
2070: 2061 to 2080

DESIGN CONSIDERATIONS

Refer to **Appendix B – General Design Considerations** for detailed general design considerations and guidance

Climate Design Adjustments and Timeline	► Refer to Section 2.0 for climate design adjustment for useful life. Evaluate a risk-based approach for identifying design parameters based on exposure, sensitivity, adaptive capacity, and consequence of flooding. ► Sea Level Rise & Storm Surge Climate Adjustments. ▲ Evaluate if the site is within the Boston Planning and Development Agency "SLR-BFE" zone via the zoning viewer. ▲ Identify if the site is within a major flood pathway that will impact the right-of-way. ▲ Identify if the site should be designed for the 1%, 0.2%, or 0.1% annual flood event. ▲ Boston Harbor Flood Risk Model (BH-FRM) Design Details: Probability of flooding, flood depth, duration of flood, flood pathways, wave impacts, wind velocity. ► Extreme Precipitation. ▲ Select design storm events for analysis (10%, 4%, 2%, or 1% annual storm). ▲ Estimate the drainage area contained by new barrier. ► Extreme Temperature. ▲ Evaluate heatwave, annual maximum temperature, and winter storm impacts. ► Incremental Climate Adjustments. ▲ If 50-year useful life climate design adjustment is not feasible, identify approach to reach climate design adjustment over time.
Boundary Constraints and Site Considerations	► Identify the extent of the barrier (current and future, if proposed incremental approach). ► Identify related zoning regulations and requirements. ► Evaluate available open space. ▲ What is needed for construction, operations, and maintenance? ▲ What are the downstream encroachment considerations? ► Identify opportunities to maintain the public right-of-way and access to waterfront. Livability, walkability, connectivity, and social and neighborhood context are essential. ► Coordinate with private properties and abutters. ▲ Existing or new easements must be established. ► Consider existing operational capacity to maintain barrier. ▲ What is the ease of access to site for maintenance vehicles and equipment? ► Conduct a Phase I Environmental Site Assessment to assess if the potential exists for Recognized Environmental Conditions including soil and/or groundwater impacts. ► Identify off-site impacts resulting from barrier – both sites adjacent to barrier and inland. ▲ Will neighboring sites have stormwater redirected or stored on them? ► Consider Climate Ready Boston Evaluation Criteria (social impact, equity, value creation). ► Estimate incremental impacts to boundary and site constraints.
Stormwater Considerations	► Identify Green Infrastructure (GI) opportunities and challenges. ▲ Consider Low Impact Design (LID), Extreme temperatures (drought, frozen ground). Refer to vegetative considerations. ► Assess volume capture and control. ▲ What are opportunities to resist, delay, store, and/or discharge stormwater?

Stormwater Considerations (continued)	► Identify possible off-site flooding impacts. ► Consider water quality. ▲ Polluted stormwater runoff is commonly transported through municipal separate storm sewer systems (MS4 pollutants). ► Evaluate watershed approach for stormwater management. ▲ Assess inland opportunities to delay, divert, store in off-site areas. ► Consider incremental and adaptive management approach, and possible current or future land use changes. ► Establish inspection, debris and sediment removal, and maintenance processes essential to system performance.
Utility Considerations	► Coordinate with local utility providers to identify gas, electric, communications, and other utilities that may be located within the project area. Consider engaging a professional subsurface utility engineering firm to identify utilities. ► Eliminate perpendicular barrier crossing of utilities. If elimination is not feasible, consider placing the conduit within a watertight sleeve to protect the barrier and the utility from movement. ► Estimate additional loads on existing utilities resulting from raised grades and higher groundwater levels. ► Identify existing connections to surrounding infrastructure and buildings. ► Water utilities considerations. ▲ What are impacts to fire hydrants and emergency access? ► Sewer utilities considerations. ▲ Look for opportunities to implement backflow valves and seal manholes. ► Combined Sewer Overflow (CSO) and Outfalls considerations. ▲ Off-site flooding may back up CSOs behind barrier. Study the extent of the stormwater system to the critical nodes and identify preliminary vulnerability of these locations. ▲ Implement tide gates and establish operations and maintenance protocols. ► Stormwater utilities considerations. ▲ Future pump stations may need to be constructed in the vicinity to manage stormwater behind barrier. ▲ Design for pump redundancy, over-design of wet-well capacity (future flow volumes), pump approaches, trash accumulation and removal, on-site generators and power supply (emergency systems also). ► Consider relocation of infrastructure to maintain access to utilities.
Structural Considerations	► Estimate anticipated loads. ▲ American Society of Civil Engineers (ASCE) guidance provided in ASCE 7-16, earth pressures with raised grades, live loads, etc. with climate adjustments. ► Assess condition of nearby existing structures. ▲ Perform field inspection and data review. ► Wall considerations. ▲ Floodwalls should be designed in accordance with United States Army Corps of Engineers (USACOE) guidance provided in EM-1110-2-2502, Retaining and Flood Walls. ► Material considerations.

Structural Considerations (continued)	▲ Consider impact of increased extreme temperatures and sensitive materials. ► Connection considerations. ▲ Analyze shear, tensile, breakout, pullout, blowout, splitting, etc. ► Durability considerations. ▲ Prioritize "Safe-to-Fail" design. ▲ Identify repair considerations. ► Identify possible failure mechanisms and the likelihood of progressive failure. ► Constructability considerations. ► Incremental considerations may include lengthening barrier vertically and/or laterally. Design for final loading conditions. ► Establish annual inspections and maintenance protocols.
Geotechnical Considerations	► Conduct subsurface explorations to evaluate overall subsurface conditions, seepage conditions, bearing capacity, and potential for settlement. ► Identify impact to existing structures. ▲ Raised grades may result in a surcharge on the underlying utilities or adjacent structures located within the "zone-of-influence" of the barrier. ► Perform stability analysis. ▲ Earthen flood barriers should be designed in accordance with USACOE guidance provided in EM 1110-2-1913, Design and Construction of Levees. ▲ Slopes of 3H:1V (Horizontal:Vertical) are recommended for stability and ease of maintenance. ► Perform settlement analysis. ► Assess seepage. ▲ Prevent sediment transport. ▲ Cutoff walls or trenches; if used, consider area groundwater hydrology and its effects on area foundations. ► Erosion and scour protection considerations. ▲ Place riprap in areas with high erosional forces. ▲ Materials and vegetation must be able to withstand wave action and saltwater. ► Foundation considerations. ▲ Overdesign foundation to support future loads. (i.e. if grades or walls are planned to be raised over time). ▲ Incorporate foundations for future floodwalls as needed into the embankment. ► Establish annual monitoring and maintenance program for embankment structures.
Transportation & Accessibility Considerations	► Maintain ADA accessibility and connection to inland area (existing buildings, sidewalks, roadways) and waterfront. ► It is unacceptable to raise a roadway four to six feet and leave existing sidewalks and entries at grade if there is less than 14 feet between the back of the existing sidewalk and a building; clearance greater than 14 feet may be required for public health and safety. ► Accessible routes shall not exceed 5% slope. Changes in slope for connections to side streets, driveways, and parking lots shall not exceed 15%, so vehicles do not bottom out. ► The minimum width of access paths shall be 12 feet so that a maintenance vehicle can bypass a wheelchair without impeding movement. ► Bridges and underpasses within 500 feet of a barrier should be analyzed for clearance.

Transportation & Accessibility Considerations (continued)	► Raising roadways will impact the public and stakeholders beyond the immediate streetscape. Coordinate with property owners and stakeholders, including but not limited to the City, MassDOT, Massachusetts Bay Transportation Authority (MBTA), community organizations, and private property owners. ► Construction materials should consider increases in heat as well as freezing temperatures. ► Evaluate parking needs. ► Create maintenance accessibility (vehicle or tracked equipment). ► Develop snow, ice, and stormwater management tasks that are critical for proper maintenance. ► Incremental considerations include access to surrounding infrastructure and redevelopment of roadways and property over time. ► Streetscapes should consider emergency vehicle access (police, fire, EMS), and meet City Standards for Boston Complete Streets and the BPWD Roadway Design Standards.
Groundwater Considerations	► Higher tides may increase groundwater levels and may result in reduced stormwater infiltration and affect stormwater drainage systems. ► Barriers must be designed to prevent excessive hydraulic gradients, internal erosion and loss of material (piping), and sand boils caused by underseepage. ► Uplift pressure may impact underground structures. ► Freshwater-Saltwater interface may impact: ▲ Coastal ecosystems ▲ Water treatment ▲ Corrosion of buried structures ► Higher groundwater may increase the risk of contaminant transport. ► Groundwater intrusion risks in below grade structures, including steam infrastructure.
Vegetative Considerations	► Current USACOE setbacks and easements do not allow for trees to be within 15 feet of dams or levees. ► Identify native or naturalized salt tolerant vegetation and non-invasive plant materials appropriate to the surrounding microclimate and ecosystem and complement passive recreational activities. ► Evaluate aesthetic considerations to create value. ► Promote open space opportunities. ► Select plants with erosion control qualities for embankments and steep slopes. Woody vegetation and brush can also prevent observation of deficiencies forming that increase the risk of failure. ► Consider plants that are "low maintenance" such as grasses and groundcovers that may also provide habitat that are tolerant of urban pollutants (emissions, oils, etc.). ► Consider plant heights as they relate to view-sheds and corridors towards the water and also the inland side.

Trees are not permitted on flood barriers because of their root systems. If trees are uprooted during a storm event, the barrier may result in a breach. Tree root systems also pose a risk as a flood pathway; roots rot over time and can provide pathways for animals to burrow. If trees are desired, a root barrier system may be designed for the inland side of the barrier (waterfront side is a higher risk of breaching the structure). A structural wall may be designed in the embankment to reduce the impact of a breach. The wall should consider groundwater, geotechnical, and structural considerations.

CLIMATE RESILIENT DESIGN STANDARDS AND GUIDELINES FOR PROTECTION OF PUBLIC RIGHTS-OF-WAY

B.1 VEGETATED BERM BARRIER

Refer to Climate Resilient Design Standards and Guidelines for notes and guidance.

DOWNLOADABLE FILES:

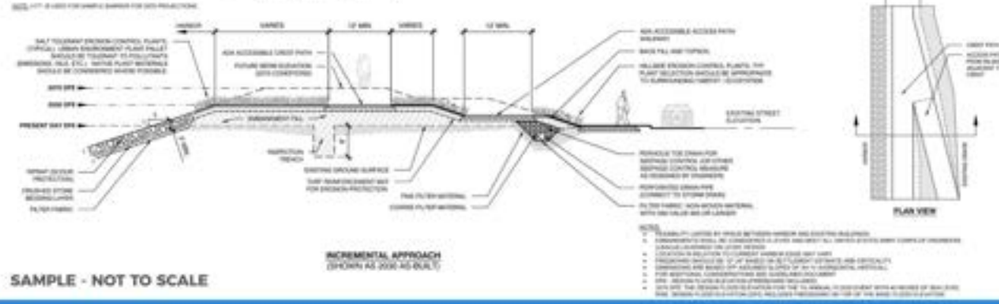
Standard PWD Details for reference and download can be found here

B.1. SAMPLE VEGETATED BERM BARRIER

CAD

PDF

SAMPLE



INCREMENTAL APPROACH (SHOWN AS 2030 AS-BUILT)

SAMPLE - NOT TO SCALE

1 CITY HALL SQUARE
ROOM 714
BOSTON, MA 02201-2024

PUBLIC WORKS DEPARTMENT
(T): 617 635 4900
(E): publicworks@boston.gov

CLIMATE RESILIENT DESIGN STANDARDS AND GUIDELINES FOR PROTECTION OF PUBLIC RIGHTS-OF-WAY

B.2 HARBORWALK AS FLOOD BARRIER (RAISED SEAWALL)

Refer to Climate Resilient Design Standards and Guidelines for notes and guidance.

DOWNLOADABLE FILES:

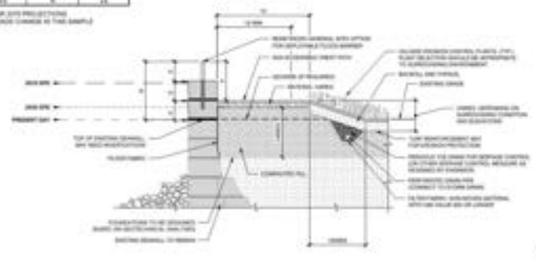
Standard PWD Details for reference and download can be found here

B.2 SAMPLE HARBORWALK AS FLOOD BARRIER (RAISED SEAWALL)

CAD

PDF

SAMPLE



SAMPLE - NOT TO SCALE

1 CITY HALL SQUARE
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CLIMATE RESILIENT DESIGN STANDARDS AND GUIDELINES FOR PROTECTION OF PUBLIC RIGHTS-OF-WAY

B.3 RAISED ROADWAY - OPTION 1 NO BUILT PROPERTY WITHIN AT LEAST 14 FEET OF EXISTING RIGHT OF WAY

Refer to Climate Resilient Design Standards and Guidelines for notes and guidance.

DOWNLOADABLE FILES:

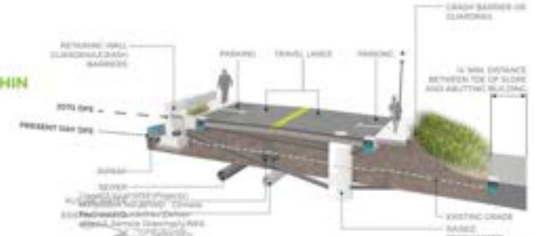
Standard PWD Details for reference and download can be found here

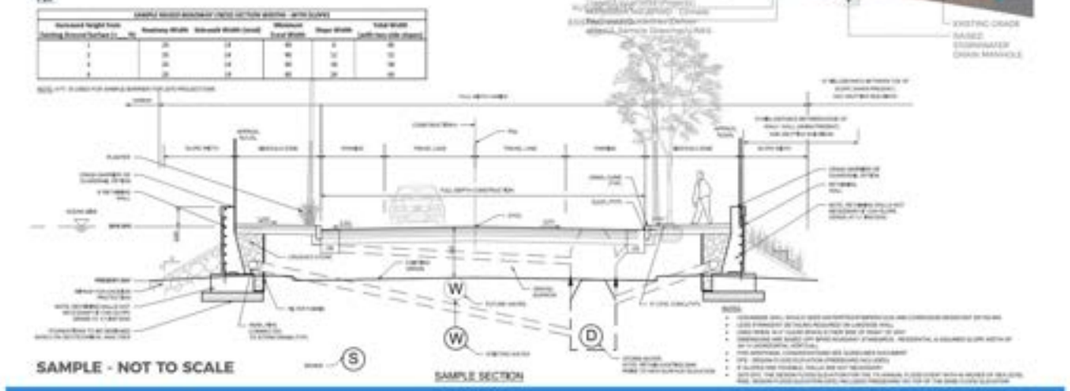
B.3 SAMPLE RAISED ROADWAY - OPTION 1

CAD

PDF

SAMPLE





SAMPLE - NOT TO SCALE

1 CITY HALL SQUARE
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BOSTON, MA 02201-2024

PUBLIC WORKS DEPARTMENT
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CLIMATE RESILIENT DESIGN STANDARDS AND GUIDELINES FOR PROTECTION OF PUBLIC RIGHTS-OF-WAY

B.4 RAISED ROADWAY - OPTION 2 RAISED ROADWAY & SIDEWALKS WITH NEW DEVELOPMENT

Refer to Climate Resilient Design Standards and Guidelines for notes and guidance.

DOWNLOADABLE FILES:

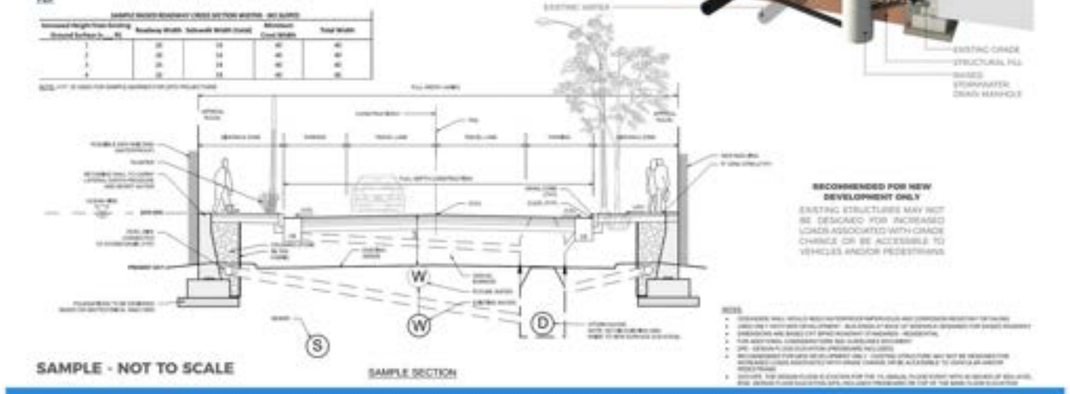
Standard PWD Details for reference and download can be found here

B.4 SAMPLE RAISED ROADWAY - OPTION 2

CAD

PDF

SAMPLE



RECOMMENDED FOR NEW DEVELOPMENT ONLY

EXISTING STRUCTURES MAY NOT BE DESIGNED FOR INCREASED LOADS ASSOCIATED WITH GRADE CHANGE OR BE ACCESSIBLE TO VEHICLES AND/OR PEDESTRIANS

SAMPLE - NOT TO SCALE

1 CITY HALL SQUARE
ROOM 714
BOSTON, MA 02201-2024

PUBLIC WORKS DEPARTMENT
(T): 617 635 4900
(E): publicworks@boston.gov

310 CMR 10.00 MASSACHUSETTS WETLANDS PROTECTION ACT (WPA)

STATE ENVIRONMENTAL REGULATIONS

ENTITY

The Massachusetts Department of Environmental Protection (MassDEP)

TIMELINE

Current WPA regulations became effective as of October 23, 2014.

OVERVIEW

310 CMR 10.00, the Massachusetts Wetlands Protection Act (WPA) regulations for all inland and coastal wetlands, is promulgated by the Commissioner of the Massachusetts Department of Environmental Protection pursuant to the authority granted under The Wetlands Protection Act, M.G.L. c. 131, § 40. The WPA protects wetlands and the public interests they serve, including flood control, prevention of pollution and storm damage, and protection of public and private water supplies, groundwater supply, fisheries, land containing shellfish, and wildlife habitat. The law protects not only wetlands, but other resource areas, such as land subject to flooding (100-year floodplains), the riverfront area (added by the Rivers Protection Act), and land under water bodies, waterways, salt ponds, fish runs, and the ocean.

AREA OF STUDY

Water-related lands such as inland and coastal wetlands, floodplains, riverfront areas, etc. in the Commonwealth of MA.

SUMMARY

The WPA regulations describe how each type of resource area provides one or more of the public interests and address the type and extent of work allowed in resource areas. Proposed work must meet these WPA performance standards for each impacted resource area. The law regulates many types of work in resource areas, including vegetation removal, regrading, and construction of structures, and work within 100 feet of a wetland resource area (the buffer zone).

Proposed work that will alter any coastal or inland resource area requires the filing of a Notice of Intent (NOI) and associated application fee to the local conservation commission and to MassDEP. The NOI requires a plan describing the details of the proposed project, location of wetland resource areas and buffer zones, and measures to be taken to protect these regulated resource areas. Following a public hearing, the local conservation commission will issue an Order of Conditions that either approve the project -- with special conditions that will protect the public interests -- or denies the project if impacts to resource areas cannot be avoided or mitigated. The applicant, landowner, any aggrieved person, abutter, group of 10 citizens, or MassDEP may appeal the local commission's decision to MassDEP.

TOPICS ADDRESSED

Wetlands, floodplains, riverfront areas, natural resources, coastal resilience, and stormwater management.

DORCHESTER RELEVANCY

The Project study area includes multiple wetlands resource areas that are regulated under the WPA, including, but not limited to, Land under the Ocean, Land Containing Shellfish, Coastal Beaches, Coastal Banks, Rocky Intertidal Shores, Salt Marshes, Land Subject to Coastal Storm Flowage, and Riverfront Area. All resource areas should be delineated clearly on project plans and all project design concepts should be reviewed to understand the area and nature of

proposed impacts to resources areas.

BOSTON HEAT RESILIENCE PLAN

STUDY & CITY-WIDE PLAN

CLIENT

City of Boston Department of the Environment

TIMELINE

April 2021 to March 2022. Published: April 2022

OVERVIEW

Heat Resilience Solutions for Boston presents a roadmap for navigating extreme heat. By building on the legacy of previous resilience plans, including 2016's Climate Ready Boston report, it prepares the City to tackle the heat impacts of climate change. The study centers people and recognizes the challenges extreme heat poses to residents' quality of life.

AREA OF STUDY

Citywide strategies; focus on the environmental justice neighborhoods of Chinatown, Dorchester, East Boston, Mattapan, and Roxbury.

CONSULTANT TEAM

Sasaki, Klimaat, All Aces, WSP

SUMMARY

Heat Resilience Solutions for Boston (the Heat Plan) presents the City's action plan to prepare for the near-term and long-term impacts of extreme heat in a changing climate. As a product of the Climate Ready Boston initiative, the City's ongoing program to prepare Boston for the effects of climate change, this plan provides an in-depth analysis of extreme summer temperatures during a recent heat wave and an all-of-government framework for strategies to reduce the risks of extreme heat. The plan helps accelerate Boston's progress toward increased climate resilience, charting our course for protecting residents from the effects of extreme heat.

To build resilience to heat, Boston must address three factors of heat risk: exposure to extreme heat, the adaptive capacity to access cooling, and the sensitivity to changes in temperature due to underlying factors like health or age that may influence vulnerability to heat. This report presents a comprehensive framework of strategies to address these core factors of heat risk–and to prepare Boston for extreme heat, both today and under future climate conditions.

TOPICS ADDRESSED

Keywords for topics addressed by the document (examples include: coastal resilience, stormwater management, parks and open space, education, community strengthening, etc.)

1. **Heat Vulnerability and health:** Extreme heat disproportionally affects some people and communities more than others. There are three main factors that affect heat vulnerability:
    A. Exposure: People with elevated heat exposure include those with jobs, living situations, or hobbies in outdoor or indoor environments without adequate shade to block direct sunlight or ventilation to circulate cool air flow.
    B. Sensitivity: People with elevated heat sensitivity include those with chronic health conditions (especially respiratory conditions), children, and older adults.

C. Adaptive capacity: A person's ability to adapt to extreme heat by taking measures to cool themselves also affects their heat vulnerability. The ability to access cooling resources is a critical factor of adaptive capacity.

2. **Boston's Risk from Extreme Heat**

   A. Extreme heat affects all of Boston today.
   B. Extreme heat impacts cause significant health risks.
   C. Extreme heat is already a daily stressor for many Bostonians during hot weather.
   D. Green infrastructure to reduce stormwater flooding could also reduce temperatures.

3. **Heat Experience Factors**

   A. **Personal Health and Cooling Access:** Chronic health conditions and age can increase vulnerability to heat risk.
   B. **Physical Environment (Built and Natural):** Trees and parks help cool off neighborhoods, while denser neighborhoods and large amounts of pavement make them heat up more and stay hot longer.
   C. **Air Flow:** The dynamic nature of air shapes how individuals and neighborhoods experience heat.
   D. **History And Structural Inequity:** Environmental injustices and systemic racism are drivers of differences in heat experiences for both places and people. A history of discriminatory planning actions, such as redlining, has lasting effects on health and heat vulnerability today.

4. **Infrastructure Vulnerabilities: Transportation and Energy.**

   A. **Transportation Infrastructure**. Thermal expansion causes impacts to roads and the subway/trolley system that affect the ability of residents, workers, and visitors to move around the city.
   B. **Energy Infrastructure**. Extreme heat can lead to increased peak summertime energy consumption, reduced transmission capacity, and decreased efficiency of solar panels.

5. **Extreme Heat Risk in Boston:**

   A. **Heat trends and projections:** In Massachusetts, due to climate change, temperatures have increased by 3.5°F since the beginning of the 20th century. The number of hot days and hot nights is expected to increase in both low and high carbon emissions scenarios through the end of the century.

      i. In a scenario where emissions trends continue at the current rate (RCP 8.5), climate projections estimate that the number of very hot days (over 90°F) will most likely (17th to 83rd percentile) increase from a range of 17 to 26 days by the 2030s, to 25 to 42 days by the 2050s, and 33 to 62 days by the 2070s. In an extreme case, the number of very hot days (over 90°F) could reach up to 87 days by the 2080s.

      ii. If aggressive action is taken to reduce emissions (RCP 4.5), the number of very hot days (over 90°F) by the 2070s will be about half (20 to 38 days) what we might see in the previous high emissions scenario.

   B. **City wide Analysis:** Some places experience disproportionately greater heat risk, with higher temperatures and extended heat wave conditions. Boston is very hot during the day and is also hot at night.
      i. Dark, paved, and impervious surfaces, such as asphalt roads and buildings with black roofs, contribute to the urban heat island effect. These surfaces absorb more heat than vegetated or light colored surfaces, and they release this heat back into the surrounding environment.
      ii. Areas with less trees, grass, and other vegetation tend to feel hotter when there is little shade or evapotranspiration to help reduce high air temperatures.

      iii. Tall buildings and dense development also impact heat within a city. Building form and orientation can change how ventilating wind flows through corridors, how readily radiated heat can disperse, and how much sun or shade hits the surface.

   C. **Extreme heat response:** In Boston, a heat advisory is issued if there is a heat wave—a period of three or more consecutive days above 90°F. A heat emergency is declared if there is a period of two or more consecutive days above 95°F, and the overnight temperature does not fall below 75°F.

      i. When a heat emergency is declared, public facilities like designated Boston Centers for Youth and Families (BCYF) community centers are activated to serve as cooling centers within Boston neighborhoods.

      ii. The City of Boston has also implemented short-term cooling strategies, such as the distribution of cooling appliances to older adult residents and residents with disabilities or chronic illnesses.

   D. **Heat experiences:** Bostonians shared that their highest priorities for heat resilience include increasing shade and trees, reducing dark surfaces and pavements, increasing comfort in densely developed areas, addressing the impacts of pollution on health and wellbeing, and increasing the accessibility and affordability of places to cool off.

   E. **Heat analysis relined neighborhoods:** Redlined areas are 7.5°F hotter in the day, 3.6°F hotter at night, and have 20% less parkland and 40% less tree canopy than areas designated as A: Best.

6. **Focus Neighborhoods:** The planning process and strategy development for the Heat Plan included additional detailed study of solutions within five of the hottest environmental justice neighborhoods in Boston: Chinatown, **Dorchester**, East Boston, Mattapan, and Roxbury.

7. **Citywide Heat Resilience Strategies:**

   A. **Goals:** Reduce heat vulnerability for Bostonians and recognize the challenges that heat can bring to their quality of life, including negative health outcomes and physical or mental stress.

      i. **Reduce Heat Exposure:** Reduce indoor and outdoor urban heat exposure, intensity, and duration by enhancing the capacity of the built environment to recover from daytime heat.

      ii. **Adapt to Heat:** Expand choices for staying cool during heat waves and improve awareness of actions residents can take to stay safe and cool.

      iii. **Reduce Sensitivity and Foster Healthy, Connected Communities:** Create healthier, more connected neighborhoods that help reduce underlying social determinants of health that increase heat risk.

   B. **Heat Resilience Strategies.** The Heat Plan includes a wide range of strategies for the City of Boston to take action and address the risks of extreme heat in a changing climate.

      i. **Relief during heat waves**

         1. OPERATIONS AND COMMUNICATIONS
            a. BOSTON EXTREME TEMPERATURES RESPONSE TASK FORCE
            b. PRE-HEAT WAVE RESOURCES MOBILIZATION
            c. HEAT SENSOR NETWORKS
         2. COOLING DURING HEAT WAVES
            a. POP-UP HEAT RELIEF
            b. ENHANCED AND EXPANDED CITY-RUN COOLING CENTERS
            c. CITYWIDE COOLING NETWORK

3. LOOKING OUT FOR NEIGHBORS
    a. EXPANDED COMMUNITY CLIMATE
    b. EXTREME TEMPERATURE PLANS FOR OUTDOOR WORKERS
4. AWARENESS, EDUCATION, AND TRAINING
    a. HEAT RESILIENCE PUBLIC EDUCATION CAMPAIGN
    b. HEAT SURVEY
    c. EXPANSION OF GREEN WORKFORCE DEVELOPMENT FOR HEAT RESILIENCE

ii. **COOLER COMMUNITIES**

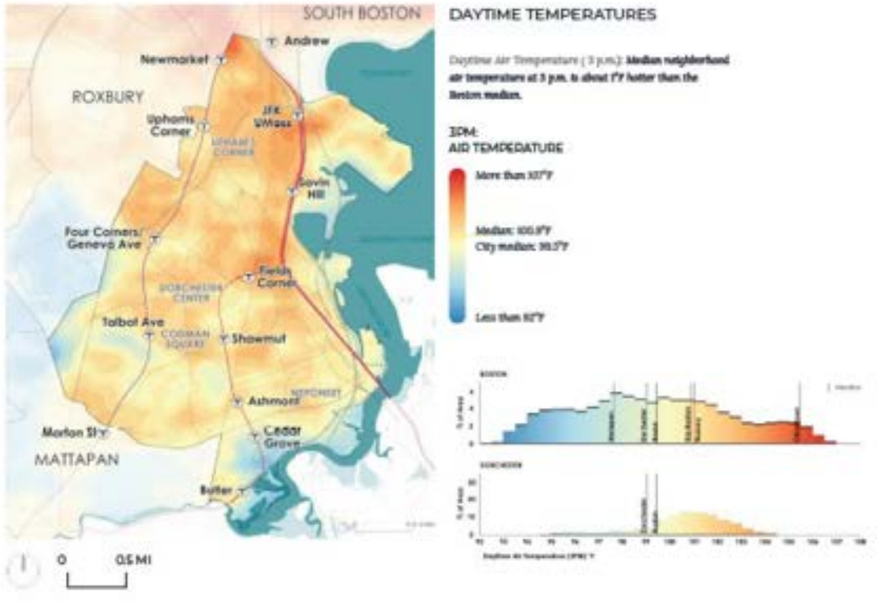
1. BUILDINGS
    a. HOME COOLING RESOURCES DISTRIBUTION
    b. COOL ROOFS PROGRAM
    c. HOME ENERGY RETROFITS
    d. AFFORDABLE HOUSING RESOURCES AND RETROFITS
    e. COOL SCHOOLS
2. PARKS, TREES, AND OUTDOOR SPACES
    a. ENHANCED COOLING IN POCKET GREEN SPACES AND STREET-TO-GREEN CONVERSIONS
    b. INCREASED SHADE ON MUNICIPAL SITES
    c. EXPANDED DRINKING FOUNTAIN NETWORK
    d. PLANNING FOR FUTURE PARKS
3. TRANSPORTATION AND INFRASTRUCTURE
    a. COOL COMMUTES
    b. ENERGY RESILIENCE UPGRADES AND MICROGRIDS
    c. COOL MAIN STREETS
4. PLANNING, ZONING, AND PERMITTING
    a. UPDATED CLIMATE RESILIENCY CHECKLIST
    b. HEAT RESILIENCE BEST PRACTICE GUIDELINES
    c. ZONING REVISIONS TO SUPPORT COOLER NEIGHBORHOODS

DORCHESTER RELEVANCY

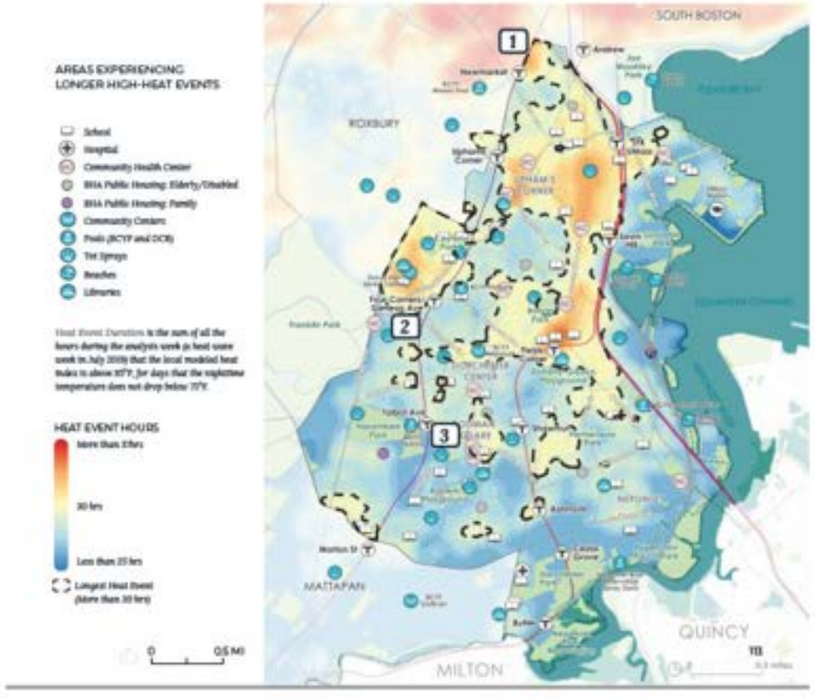
Dorchester was selected for the neighborhood-level analysis. The purpose of the neighborhood-level analysis was to evaluate how current day heat impacts vary across the city, identify temperature hot spots within environmental justice neighborhoods, and assess how racism, inequality, historic urban planning decisions, and other policies have influenced existing heat exposure and vulnerability.

1. **Dorchester's Heat Story:** As a large neighborhood, Dorchester has some areas that are hotter (Fields Corner, JFK/UMass MBTA station, and Newmarket and South Bay areas) and some areas that are cooler (around parks or adjacent to the waterfront).
    A. Contributing factors to hotter areas are unshaded pavement, parking lots, and dark roofs.

B. Areas of Dorchester experience temperatures that exceed Boston's median temperatures.
C. Dorchester's hotter microclimates are a result of several factors, including less green space, building characteristics, and impermeable surfaces.
D. Even as parks and waterfront areas are cooler, the experience along roadways and pathways accessing those areas is very hot.



2. **Dorchester Community Cooling ideas.** Dorchester residents suggested cooling strategies that expand access to cooling at home and in the neighborhood and increase cool outdoor spaces.
    A. **Cool Accessible Parks:** Additional shade elements and hydration stations in parks paired with digital wayfinding tools to help identify nearby open spaces.
    B. **Public Cooling Centers:** Opportunities to integrate public art and community engagement at Cool Spots and cooling centers.
    C. **Affordable Ways to Stay Cool at Home:** Opportunities to expand awareness about energy and utilities assistance programs to overcome challenges of staying cool at home and the cost of using air conditioning.



URBAN FOREST PLAN

PLAN

CLIENT

City of Boston

TIMELINE

September 2022

OVERVIEW

The Urban Forest Plan (UFP) is a long-term citywide strategic plan to create a sustainable and equitable urban forest in Boston. It sets a vision not only for the care, management, and expansion of the urban forest but also for how the Boston community works together to plan for its future.

Goals:

- **Goal #1: Equity First:** Focus investments and improvements in under-canopied, historically excluded and socially vulnerable areas
- **Goal #2: Proactive Care and Preservation:** Ensure trees/tree canopy are proactively cared for
- **Goal #3: Community-Led:** Ensure community priorities drive urban forest decisions and management
- **Goal #4: Prioritize and Value Trees:** Increase awareness and buy-in regarding the importance of trees in Boston, across the public and private sectors

AREA OF STUDY

City-wide

CONSULTANT TEAM

- Stoss Landscape Urbanism
- Urban Canopy Works
- Star-Luna Consulting
- American Forests
- Nitsch Engineering

SUMMARY

The Urban Forest Plan (UFP) is a long-term citywide strategic plan to create a sustainable and equitable urban forest in Boston. It sets a vision not only for the care, management, and expansion of the urban forest but also for how the Boston community works together to plan for its future.

Social equity and environmental justice are key to long-term resilience and therefore at the heart of the Urban Forest Plan. From the start, the planning process has recognized that access to the urban forest and the benefits its canopy provides are not equitably distributed, and that this lack of equity is reflective of historic and ongoing physical, political,

and social barriers. Many important voices and concerns have historically been excluded from formal decision-making processes. Specifically, communities of color, linguistically isolated communities, socio-economically disadvantaged populations, and others are too often left outside formal public input and planning processes.

Together the community and City leadership are working to eliminate these barriers and change practices that perpetuate them. Through these efforts and the recommended actions included in this plan, we can work towards long-term resilience, protect and grow our urban forest, establish management practices that support a diverse, healthy climate-adapted urban forest, and ensure these critical resources are available for the enjoyment and benefit of all of Boston's residents for years to come.

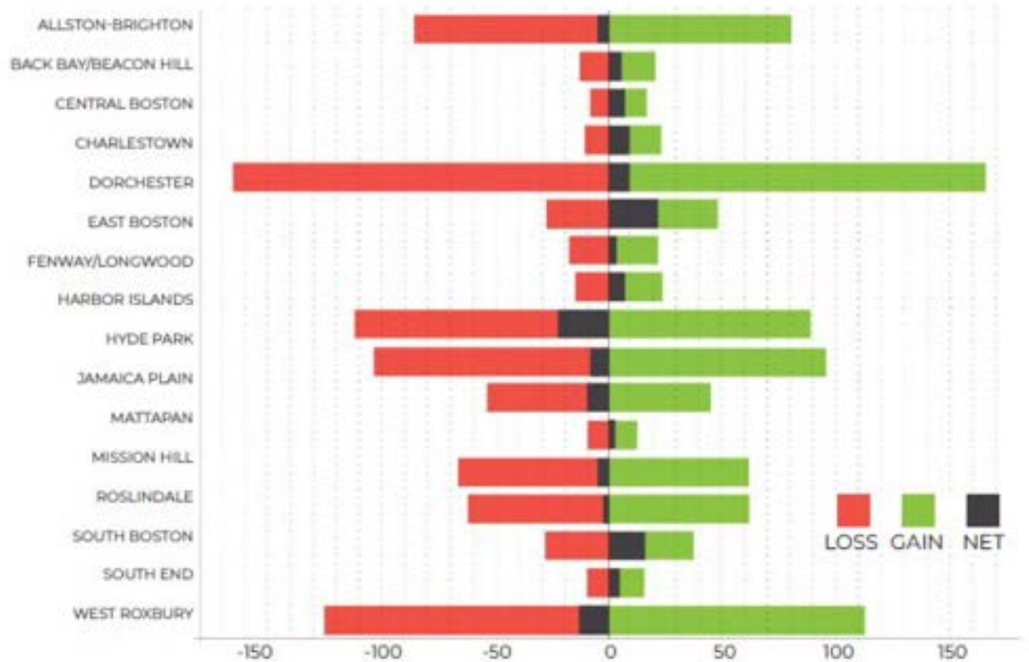
TOPICS ADDRESSED

- A Vision for Boston's Urban Forest
- State of Boston's Urban Forest Today
- Strategies and Recommendations
    - Strategy #1: Expand and Reorganize Urban Forestry Management
        - Recommendation 1.1 - Establish an urban forest leadership position within the City
        - Recommendation 1.2 - Increase and sustain operational staffing resources for Parks Department urban forest management
        - Recommendation 1.3 - Improve collaboration between the City and community partners
        - Recommendation 1.4 - Promote the formation of formal networking and advocacy bodies
    - Strategy #2: Proactively Protect and Care for Existing Trees
        - Recommendation 2.1 - Develop and implement a proactive work plan for trees on public land
        - Recommendation 2.2 - Perform plant health care and integrated pest management
        - Recommendation 2.3 - Prioritize proactive tree care in areas of highest need
        - Recommendation 2.4 - Protect and better manage trees with clear policies
        - Recommendation 2.5 - Increase interdepartmental support of urban forestry efforts
        - Recommendation 2.6 - Consider new programs and changes in code to protect mature trees and enhance the urban forest
    - Strategy #3: Strategically and Equitably Expand Tree Canopy
        - Recommendation 3.1 - Set up a process for neighborhood planting strategy implementation
        - Recommendation 3.2 - Expand canopy with resilience in mind
        - Recommendation 3.3 - Expand canopy through street tree planting
        - Recommendation 3.4 - Expand canopy in open spaces
        - Recommendation 3.5 - Expand canopy on residential land
    - Strategy #4: Make Space and Improve Conditions for Trees
        - Recommendation 4.1 - Recognize trees as critical infrastructure to be prioritized in right-of-way projects, and equivalent to utilities, sidewalks, bikeways and travel lanes

        - Recommendation 4.2 - Balance parking and room for planting
        - Recommendation 4.3 - Explore adding tree canopy to underutilized/vacant lands
        - Recommendation 4.4 - Implement updated planting standards
        - Recommendation 4.5 - Minimize above-grade conflicts
    - Strategy #5: Improve Communications - Both Process and Content
        - Recommendation 5.1 - Improve avenues of City communications
        - Recommendation 5.2 - Promote awareness of the role of trees in Boston
    - Strategy #6: Improve Information Collection and Sharing
        - Recommendation 6.1: Complete and sustain data sets on the entire urban forest
        - Recommendation 6.2: Regularly assess canopy change patterns and causes
        - Recommendation 6.3: Improve access to tree data for all residents
    - Strategy #7: Build and Support a Local Tree Workforce
        - Recommendation 7.1 - Support existing and emerging workforce development opportunities
        - Recommendation 7.2 - Establish an urban forestry career pathway program
        - Recommendation 7.3 - Create and support forest-related entrepreneurial opportunities
- A Roadmap for Implementation
- Appendices
    - Appendix A: Trees and Tree Canopy Benefits
    - Appendix B: Glossary
    - Appendix C: Species Guide
    - Appendix D: UFP Assessment Framework and Extended Findings

DORCHESTER RELEVANCY

1. **Resilience:** The urban forest can help us to live more comfortably with the impacts of climate change. However, these changes not only create more stressful city environments for humans, but also for the urban forest. Trees experiencing hotter temperatures and heat stress are more susceptible to pest and disease infestations, severe weather can cause more damage and loss of trees, and a warming climate inflicts greater pressures from invasive plant species outcompeting natives. Flooding also has negative impacts on trees, especially coastal flooding, as saline inundation can be deadly to trees.
2. A number of neighborhoods with Environmental Justice populations have low canopy cover, including **Dorchester**. Parts of Dorchester with higher canopy are now losing canopy at a rapid rate. Dorchester is also one of the Boston neighborhoods anticipated to be most impacted by increased stormwater. Tree planting and species selection at Tenean Beach should pay careful attention to Recommendation 3.2 - Expand canopy with resilience in mind. Considerations will include contributing to tree diversity in Dorchester specifically; selecting plants that can tolerate saltwater inundation; and ensuring that climate-ready implementation projects contribute to tree canopy expansion.
3. Reference Appendix C: **Species guide** during SD plant selection, which includes the known climate response of trees when known.



Canopy Coverage Change between 2014 - 2019

KOSCIUSKO CIRCLE / WILLIAM T. MORRISSEY BOULEVARD CORRIDOR STUDY

TRANSPORTATION PLANNING STUDY

CLIENT

MassDOT Office of Transportation Planning (OTP) is the client, but the project is managed by an inter-agency group including MassDOT, City of Boston & BPDA, and DCR. There will also be a steering committee established by Governor Baker, but members are not yet identified.

TIMELINE

The study began in 2022 and is ongoing.

OVERVIEW

The goal of the planning study is ultimately "to develop and analyze alternatives for the corridor to improve the public realm, mobility, connectivity, safety, and climate resiliency throughout the area for the City and other communities in the surrounding region." The scope includes existing and future conditions analysis, goal setting, public involvement, alternatives development and analysis, and near-schematic design.

AREA OF STUDY

The study area includes the Morrissey Blvd corridor from Neponset Circle to Kosciusko Circle.

CONSULTANT TEAM

AECOM is the prime consultant, and Woods Hole Group is one of several subconsultants.

SUMMARY

The most relevant element of the project is its coastal resiliency strategy and design criteria and how it interfaces with the Tenean Beach/Conley Street flood pathway mitigation design. Through iterative meetings and communications between the agencies and the consultant team, the agencies agreed to proceed with the following resiliency recommendations for the Morrissey Blvd corridor:

1. That coastal flood risk mitigation to protect Morrissey Blvd should be implemented at the shoreline (advancing strategies identified in Climate Ready Dorchester, including Tenean Beach/Conley St).
2. That coastal flood risk mitigation strategies to protect Morrissey Blvd should be designed to the MC-FRM 2070 1% annual chance coastal flooding hazards, including water surface elevation and maximum or significant wave heights, with no freeboard.

The alternatives development, analysis, and design efforts for coastal resiliency included in the Morrissey Blvd project will therefore focus on the central area of the corridor, from south of Beades Bridge at the I-93 overpass, to north of the UMass Boston entrance at Bianculli Blvd. This is the portion of the corridor where the right-of-way coincides with the shoreline and associated coastal resilience strategies identified in Climate Ready Dorchester. Morrissey Blvd redesign projects will therefore depend on implementation of shoreline/flood pathway mitigation strategies, including Tenean

Beach/Conley St, to achieve the corridor's resilient design objectives.

The Morrissey Blvd project will not develop alternatives or initial designs to improve conditions on intersecting roadways, like Conley St.

TOPICS ADDRESSED

Design criteria, coastal resilience, transportation, connectivity

DORCHESTER RELEVANCY

Interagency/Property Owner Cooperation: As the Morrissey Blvd project agency team members are key property owners at the Tenean Beach/Conley Street site - DCR (Tenean Beach), MassDOT (I-93 overpass), and City of Boston (Conley St) - their agreement to pursue a shoreline/flood pathways focused coastal resiliency strategy for Morrissey Blvd implies that they have a common interest and commitment to a positive outcome for the Tenean Beach/Conley St project. Further engagement is required to elucidate each agencies responsibilities and address concerns through design.

Design Criteria: The Tenean Beach/Conley Street project's near-term design should at a minimum be adaptable to the specific design criteria that the Morrissey Blvd project team has agreed to for long-term coastal flood resiliency measures. At best, it should be designed to meet the long-term design criteria in a single implementation phase.

Independent Effectiveness: The long-term effectiveness of the Tenean Beach/Conley St project for coastal flood mitigation will depend on other efforts to address a secondary/longer-term flood pathway into Dorchester at the I-93 overpass south of Beades Bridge. This secondary flood pathway and its floodplain join with the Tenean Beach/Conley St flood pathway and floodplain in future time horizons. The Morrissey Blvd project will include alternatives and initial design to address the secondary flood pathway.

Conley Street Improvements: Climate Ready Dorchester calls out the need for improvements on Conley St to improve connectivity and waterfront access to the Tenean Beach site from the broader Dorchester community. DCR's plans for the Neponset Greenway connector may include some improvements to Conley St that advance that objective. However, the Morrissey Blvd project will not. If improvements to Conley St (e.g., complete streets improvements) are developed as part of the Tenean Beach/Conley St project, they should be coordinated with the Morrissey Blvd and Neponset Greenway projects.

Implementation Funding: It is possible that future implementation of Morrissey Blvd improvements may be linked, as a design/construction/funding package, with Tenean Beach/Conley Street coastal flood mitigation implementation. This has not been discussed or agreed to by the Morrissey Blvd project agency partners. If that linkage occurs, it is likely that the hypothetical Morrissey Blvd project would seek to implement a long-term coastal flood mitigation strategy at Tenean Beach/Conley Street, rather than a near-term strategy that depends on further incremental adaptation in the future. This may make Tenean Beach/Conley Street design efforts focused on a near-term, incremental implementation strategy obsolete.

A MASTER PLAN FOR THE LOWER NEPONSET RIVER RESERVATION

OPEN SPACE PLAN

ENTITY

Metropolitan District Commission (MDC), which was merged with Department of Environmental Management (DEM) to form the Massachusetts Department of Conservation and Recreation (DCR) in 2003 under Governor Mitt Romney.

TIMELINE

Published in December 1996.

OVERVIEW

This master plan presents a program for improving the Lower Neponset River Reservation, including the development of three new parks totaling 125 acres and a three mile-long multi-use trail. The plan focuses on preserving and enhancing the natural qualities of the river system, while increasing public access in appropriate locations, including between Tenean Beach and Victory Park. Phase 1 of this plan successfully created new parkland along the Neponset River and remediated the sites of former landfills, industrial sites, and other nuisance uses that plagued the riverfront for many years.

AREA OF STUDY

The lower four miles of the Neponset River between the City of Boston's Mattapan and Dorchester neighborhoods.

SUMMARY

The master plan presents an overview of open space planning for additional community parks, enhancement and extension of the Neponset River Trail, and stewardship of the Neponset River Reservation. The master plan includes specific project considerations related to funding, phasing, maintenance, and permitting for proposed amenities, as well as other key features such as increased lighting, visibility, and other public safety enhancements needed to improve community enjoyment of the Lower Neponset River Reservation. The major goals of the master plan are as follows:

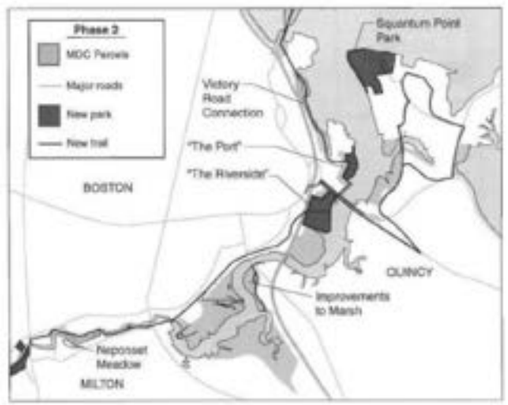
- *Preserve, restore, and enhance the natural qualities of the river system.*
- *Increase views and public access to the river and reservation in appropriate ways and locations.*
- *Create a corridor plan which responds to the variety of recreational needs of the many communities in the area.*
- *Create opportunities along the corridor for people to learn about the river, local history, and culture of the area.*
- *Connect the Lower Neponset River Reservation with the larger Metropolitan Park System.*
- *Ensure that the highest possible emphasis is given to public safety along the corridor.*
- *Incorporate maintenance standards and life-cycle cost effectiveness in the preparation of park and trail designs.*

TOPICS ADDRESSED

Parks and open space, trails and connectivity, natural resources, habitat, and public access and education.

DORCHESTER RELEVANCY

Phase 2 of the master plan includes direct reference to making a physical connection described as the "Victory Road Boardwalk to Tenean Beach" between Tenean Beach and Victory Park along the eastern edge of the Southeast Expressway. Approximate costs for this work were estimated at $1.4M plus 25% design and contingency. The master plan also includes an estimate of 10,500 square feet of wetlands impacts, including Land Under Ocean, Land Containing Shellfish, Land Subject to Coastal Storm Flowage, Coastal Beach, and associated buffer zones, inside the ACEC associated with a physical connection between Victory Road and Tenean Beach.



Phase 2 (Three to five years)

PHASE II

		range	
The Port			
Port Norfolk Site Remediation	$ 400,000		$ 515,000
PJP II Park Development at Port Norfolk	$ 2,350,000		$ 2,350,000
The Riverside			
Drive-In Site Remediation	$ 2,800,000		$ 5,300,000
PJP II Park at Neponset Drive-In	$ 5,150,000		$ 5,150,000
Squantum Point Park	$ 1,700,000		$ 1,700,000
Victory Road Boardwalk to Tenean Beach	$ 1,400,000		$ 1,400,000
Neponset Marsh Reserve Improvements	$ 115,000		$ 115,000
Granite Railway Trail	$ 26,000		$ 26,000
Neponset Meadow	$ 28,000		$ 50,000
Phase II Total	$13,969,000		$16,586,000
25% Design and Contingency	$ 3,485,250		$ 4,146,500
Total	$17,461,250		$20,732,500

MBTA RED LINE CLIMATE CHANGE VULNERABILITY ASSESSMENT

STUDY

CLIENT

MBTA

TIMELINE

August 2021

OVERVIEW

The Massachusetts Bay Transportation Authority (MBTA) conducted a systemwide climate change vulnerability assessment (CCVA) to better understand which of its assets are most vulnerable to climate stressors and to identify adaptation measures that can be implemented to improve the system's resilience to the changing climate. This report focuses on the Red Line rapid transit line, which includes the Mattapan high-speed line. Prior to COVID, 243,000 passengers road the Red Line daily.

AREA OF STUDY

Red Line Corridor in Boston (and Cambridge and Somerville to the North, and Quincy and Braintree to the South)

CONSULTANT TEAM

AECOM

SUMMARY

The Massachusetts Bay Transportation Authority (MBTA) conducted a systemwide climate change vulnerability assessment (CCVA) to better understand which of its assets are most vulnerable to climate stressors and to identify adaptation measures that can be implemented to improve the system's resilience to the changing climate. This report focuses on the Red Line rapid transit line, which includes the Mattapan high-speed line.

The CCVA followed the methodology of the Federal Highway Administration's (FHWA's) Vulnerability Assessment Scoring Tool (VAST), which uses exposure, sensitivity, and adaptive capacity to create a holistic view of vulnerability to future climate change.

The Study was focused on three phases: Information Gathering and Climate Science Review (including inventory of assets); stakeholders with the communities; and site visits (the site visits were more detailed analysis of specific assets in sub-chapters, including a sub-chapter for Tenean Yard, adjacent to Tenean Beach). Vulnerability profiles were developed for the stations, maintenance facilities/yards, and segments of guideway. Tenean Yard has a high degree of vulnerability due to its exposure to SLR and Winter Weather impacts (as an outdoor maintenance yard/facility, subject to snow/ice accumulation). If Tenean Yard is unavailable, that segment of guideway is inaccessible.

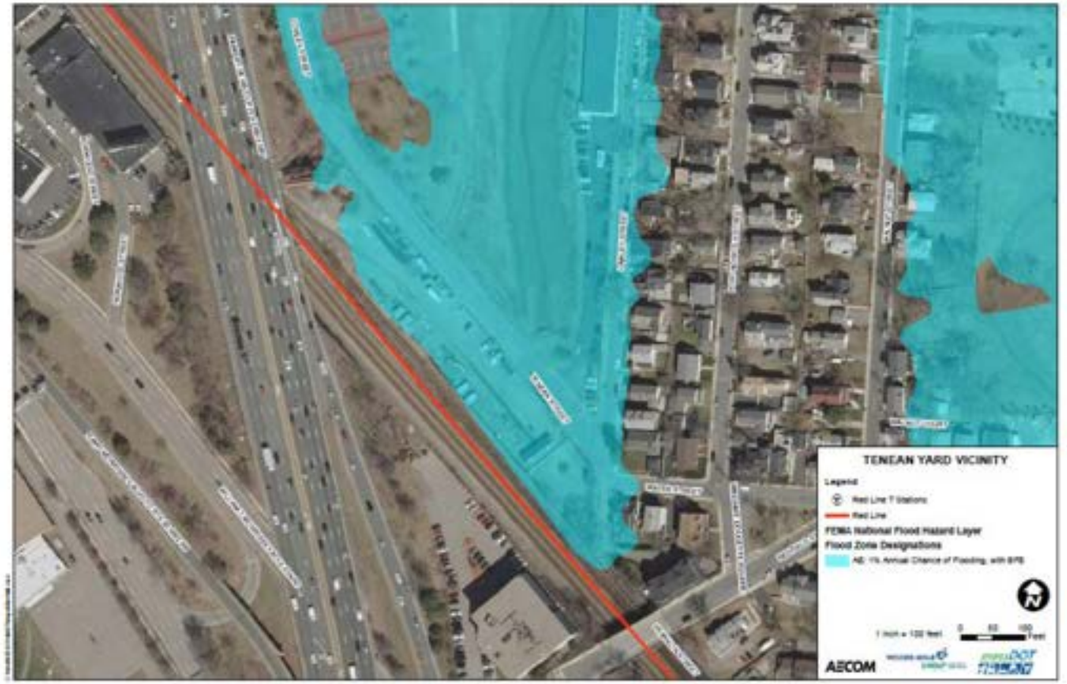
Adapting to Climate Change: To address the vulnerabilities identified in the Red Line CCVA, a menu of 42 adaptation measures was developed to consider both asset-specific and area-wide protection from the five climate stressors being evaluated for the Red Line CCVA. The measures focus on infrastructure, policy, management, and operations.

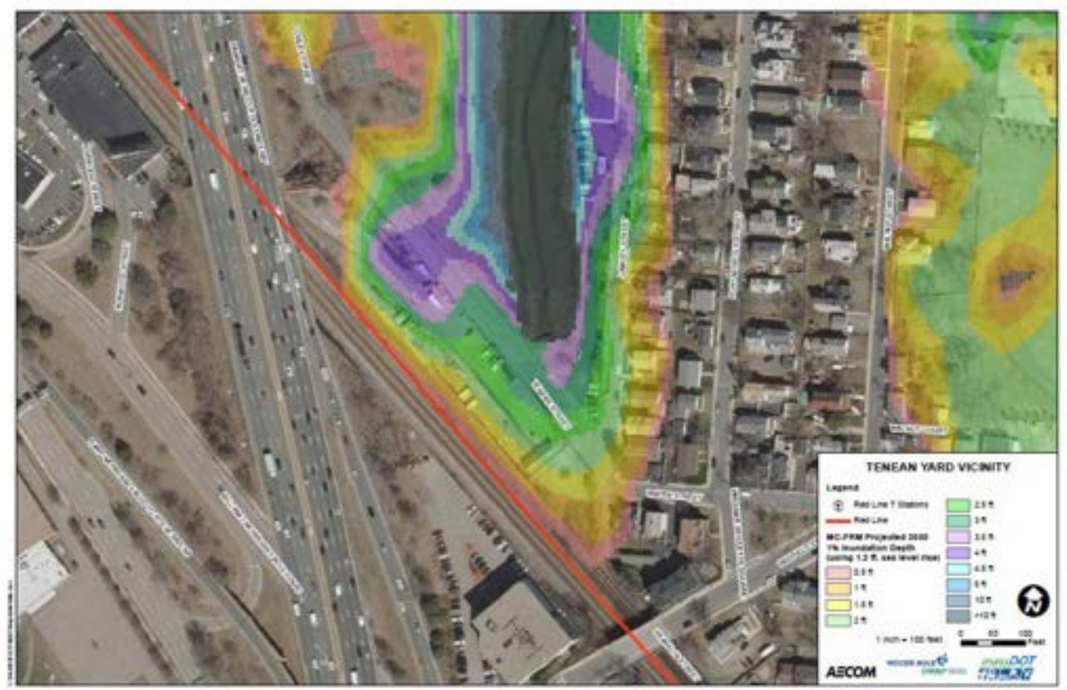
TOPICS ADDRESSED

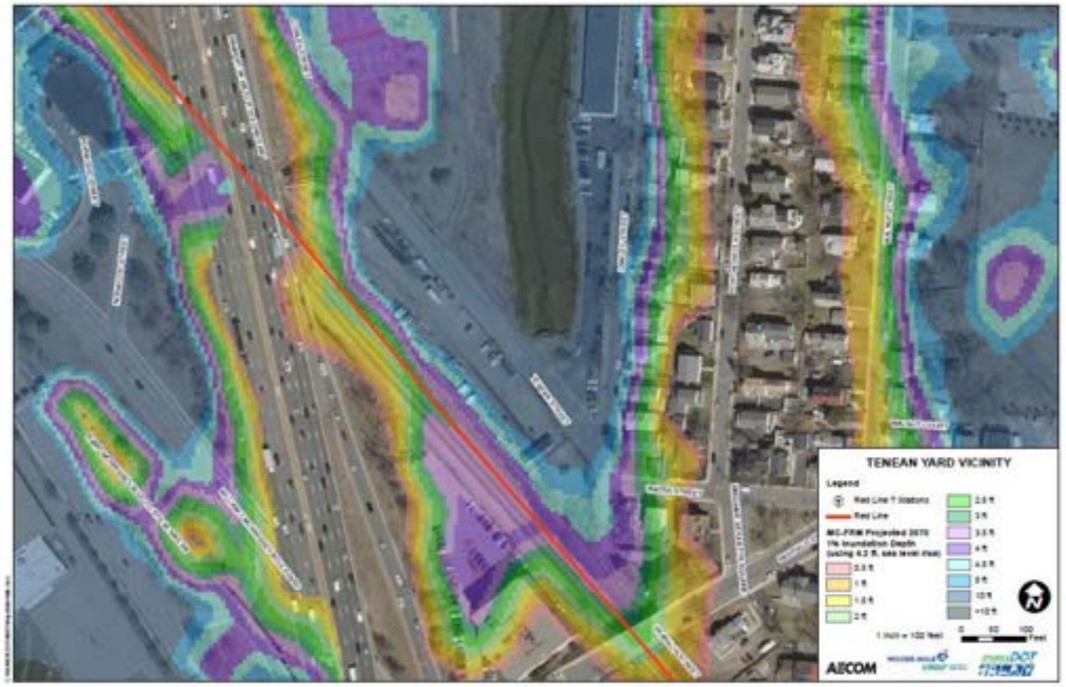
Infrastructure climate vulnerability and adaptation.

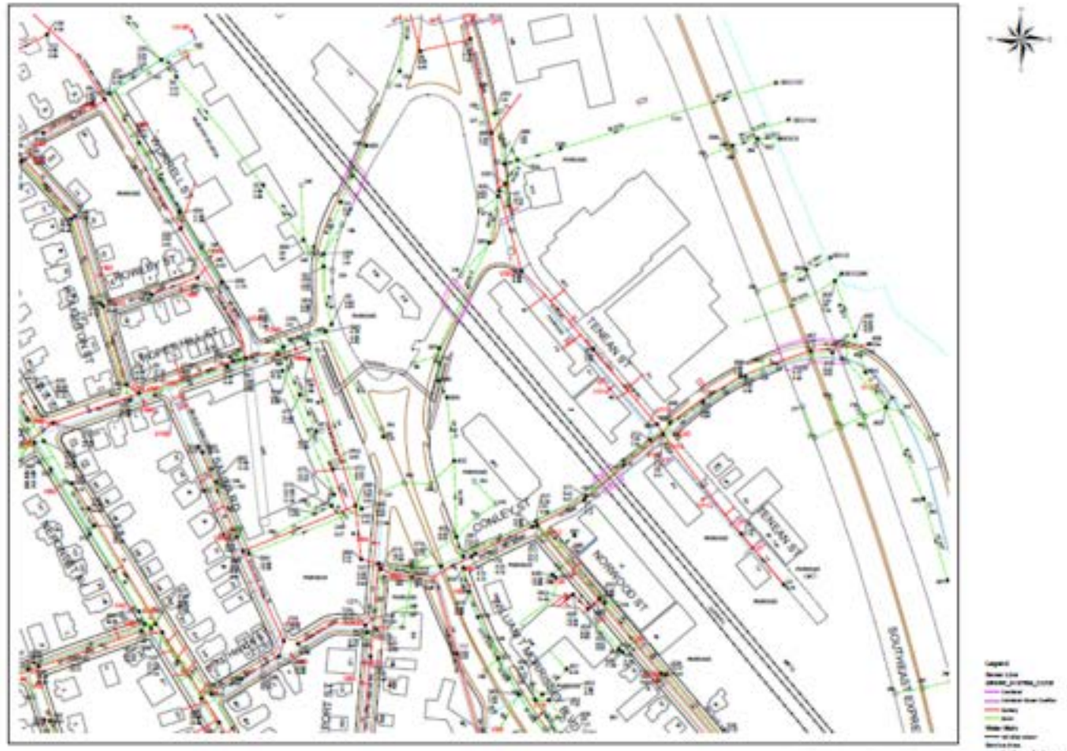
DORCHESTER RELEVANCY

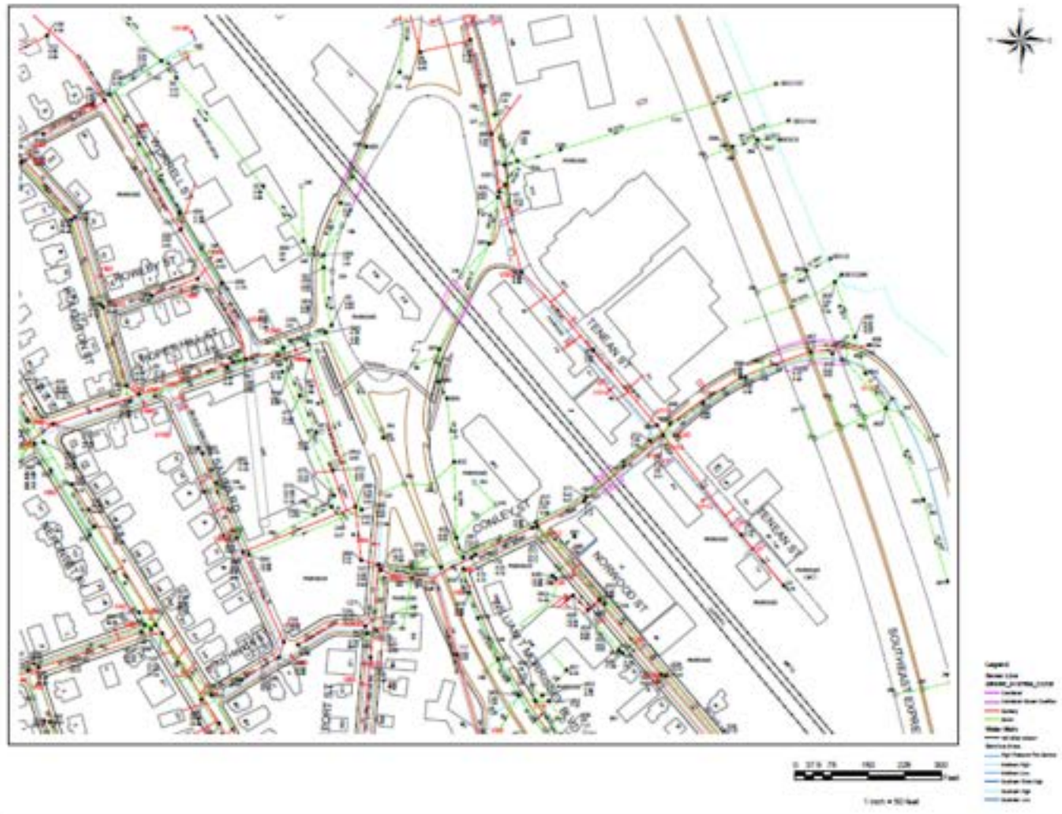
- Tenean Yard has a high degree of vulnerability, the second highest on the Red Line system next to Cabot Yard, due to past incidents at the Yard and its exposure to SLR, Precipitation, and Winter Weather impacts (as an outdoor maintenance yard/facility, subject to snow/ice accumulation). If Tenean Yard is unavailable, that segment of guideway is inaccessible.
- The JFK to Braintree, Tenean Yard Grade segment of guideway similarly has the highest degree of vulnerability, due to its collective exposure to multiple climate stressors: SLR, Precipitation, Wind, and Winter Weather.
- While Tenean Yard has a high degree of exposure and vulnerability in the quantitative assessment, it is not deemed as high an asset because it does not have major infrastructure costs associated with critical assets (such as a below-grade stations, elevators, escalators, tunnels, bridges, or MEP/HVAC systems). Tenean Yard only has the Tracks & Roadbed, Switches & Switch Heaters.
- Additional public health and social equity analysis exists in the report, with data from 2016 through 2018, pulled from the Boston Region Metropolitan Planning Organization's Central Transportation Planning Staff (CTPS) conducted an MBTA Systemwide Passage Survey (Boston Region MPO, 2018), but this data is more broadly for census tracts in all of Dorchester utilizing the Red Line and around specific stations, so not specific to the area directly adjacent to Tenean Beach.
- Tenean Yard is included in Appendix E, with a detailed site visit and mapping, on page 318 (this is consolidated with Mattapan Station, Mattapan Yard, and the Ashmont-Mattapan High-speed Line). From **Section 2.3, Tenean Yard**:
  Tenean Yard is a small maintenance facility located in Dorchester that provides an entry point for specialized equipment to access the Red Line (high rail vehicles, etc.). There is limited infrastructure and fixed assets at the yard. It was noted there is a staging area where ties and ballast were stored. The yard is located across the street from an inlet of the Neponset River, and the site has flooded in the past. As shown in the maps at the end of this Memo, Tenean Yard is located within a currently mapped FEMA flood hazard zone (AE) and is predicted to be inundated by the 1% (100-year) annual exceedance probability coastal flooding event by 2030 according MC-FRM results. The MC-FRM results reflect a projected 1.2 feet of sea level rise for 2030.
- Appendix G includes maps of the BWSC Culverts and utility data, including spot grades of utilities around Tenean Beach, with two plans attached.






TENEAN YARD VICINITY
Legend
AECOM


TENEAN ST
NORWOOD ST
CONLEY ST
SOUTHBAY EXPRESS



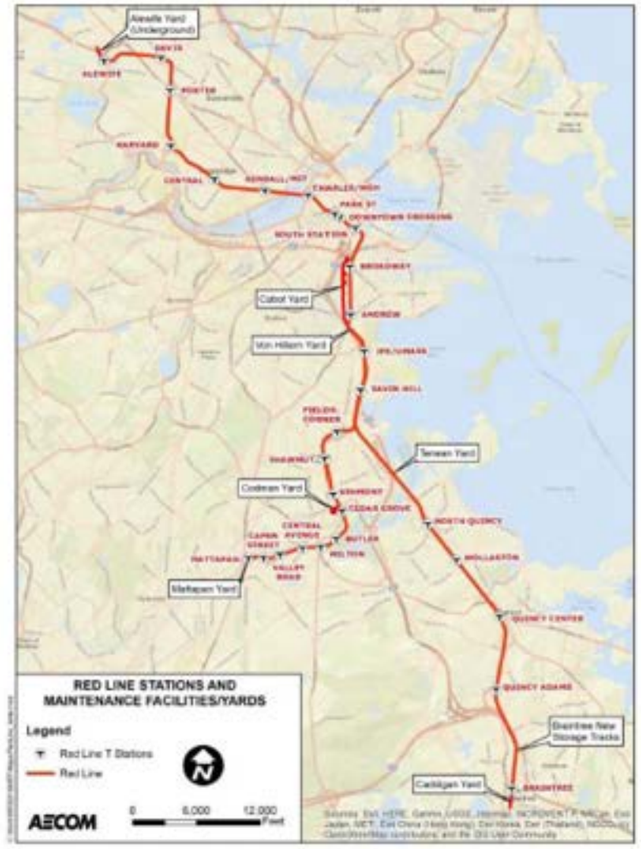


Figure 1-1: Red Line Stations and Maintenance Facilities/Yards