Beverly Bass River District Resilience Plan

Beverly, Massachusetts

Final Report

June 30, 2023

prepared by **City of Beverly**

funded by **Commonwealth of Massachusetts**
Executive Office of Energy and Environmental Affairs (EEA)
Municpal Vulnerability Preparedness Grant

in association with
Tetra Tech
Woods Hole Group
Salem Sound Coastwatch

TETRA TECH

WOODS HOLE GROUP FOR EARTH, FROM SPACE
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Salem Sound COASTWATCH

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INTRODUCTION

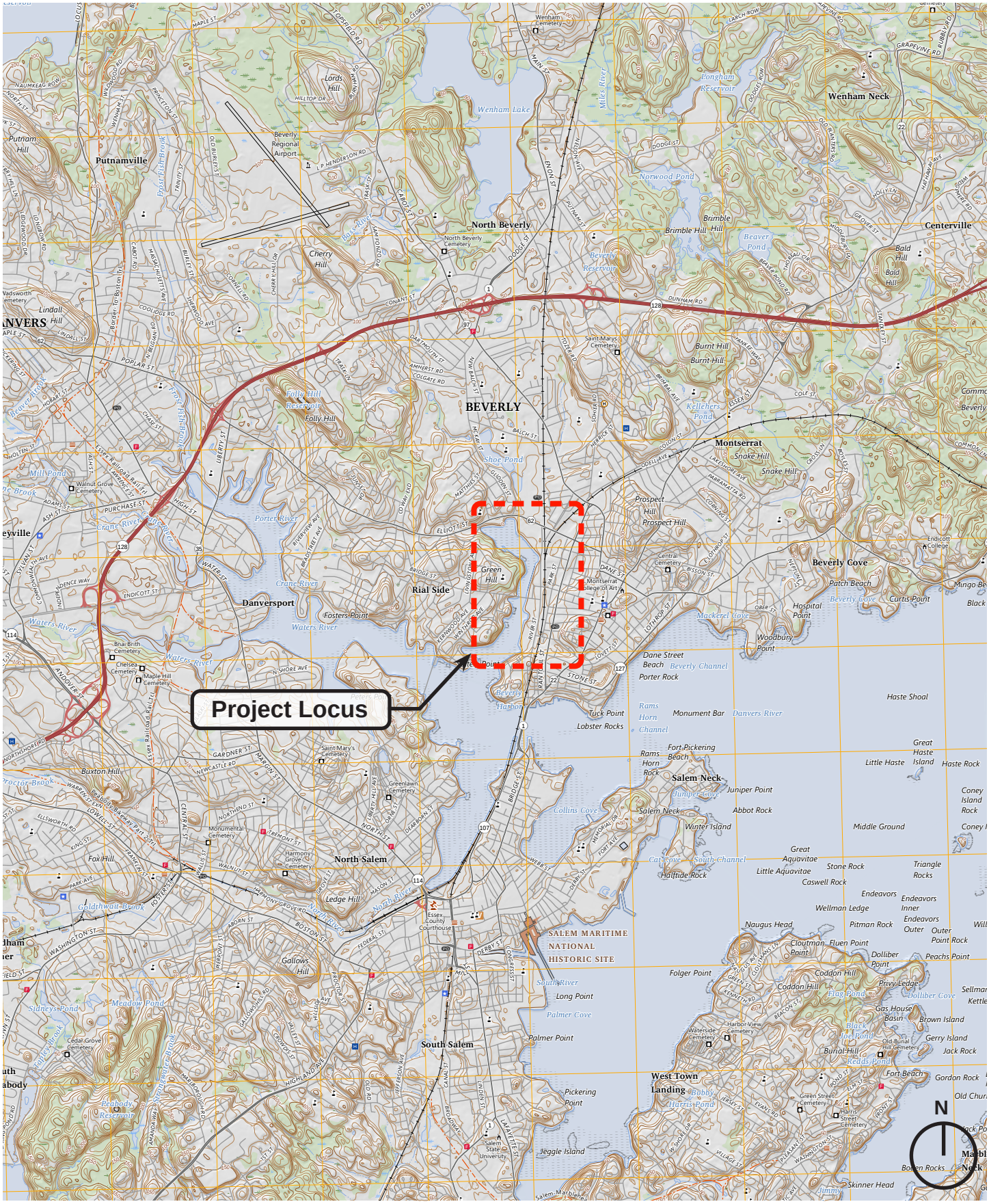
CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

As early as 2002, the City of Beverly identified that the Bass River District (the "District) provided unique opportunities and challenges to the future of the city. A tidal riverfront, the District is lined with commercial and industrial properties with some properties currently in a state of decline. Sea level rise due to climate change will continue to exacerbate flood risk through increased intensity and frequency of coastal storm events across the globe. The City of Beverly and Bass River are no exception to this phenomenon. Being cognizant of this, the City of Beverly sought to build upon its 2017 coastal vulnerability assessment to promote flood resilience in the District. Loosely defined, the District runs along the east bank of the Bass River from Elliott Street/Route 62 in the north, to Webber Avenue in the south, and is bounded on the east by the Massachusetts Bay Transportation Authority (MBTA) Newburyport/Rockport Line rail tracks and Beverly Commuter Rail station.

This Beverly Bass River District Resilience Plan (the "Resilience Plan" or "Plan") focuses on critical utility asset protection, coastal resource area enhancements, the health of marine use facilities, and smart redevelopment practices along the river. The primary objective of this Resilience Plan is to provide City of Beverly staff, utility providers, marine users, landowners, and other stakeholders with strategies to implement flood resilience solutions on a site-level scale appropriate for their land use, as well as conceptual designs for district-scale interventions that can isolate flood pathways, enhance coastal resource areas, and implement nature-based solutions.

By addressing coastal flood risk in the District, this Resilience Plan will help to shape the future of this growing community, reinforce critical utility services in the area, promote marine recreation uses, and protect the vulnerable residents within this floodplain. See Figures 1-1: Locus Map and 1-2: Aerial View of Bass River District below.



Beverly, Massachusetts

Figure 1-1
Locus Map
Source: USGS, 2023

Figure 1-2
Aerial View of Bass River District
Nearmap, 2022

1.2 COASTAL HAZARDS & CLIMATE ADAPTATION

1.2.1 PROJECT AREA DESCRIPTION & CONTEXT

The Bass River District lies on the eastern bank of the Bass River in south Beverly. The District includes waterfront and inland properties along River Street from Elliott Street/Route 62 in the north, to the utility substation site in the south. See Figures 1-1: Locus Map, 1-2: Aerial View of Bass River District, and 1-3, 1-4, and 1-5: Existing Conditions Photographs.

Key assets within the District include the Beverly Depot MBTA Commuter Rail station, a utility substation, Innocenti Park, McPherson Youth Center, a large-scale grocery store, the City of Beverly's Margin Street Stormwater Pump Station, and a significant number of commercial and industrial properties, some of which are underutilized and facing growing redevelopment pressure. The District also includes two boat yards: Bass Haven Yacht Club and Hill's Yacht Yard. Coastal resource areas of the Bass River include pockets of salt marsh near the Bass Haven Yacht Club, tidal flats along the northeastern portion of the river, and coastal banks along the river. In the northern portion of this riverfront area, there are community walking/public access paths along the banks of the Bass River.

Additionally, the District is located entirely within two census block groups which are identified as Environmental Justice (EJ) communities based on Minority, and Minority and Income. Social services within or directly adjacent to the District include the River House homeless shelter located on River Street and the Beverly Bootstraps facility on Park Street. River House provides 34 shelter beds and five units of supportive permanent housing for formerly homeless adults. Beverly Bootstraps serves as a food pantry and thrift shop, and provides other social services programming for the community.

The District is mapped through the Federal Emergency Management Agency (FEMA) with Flood Zone AE at Elevation 10 NAVD88 across properties between River Street and the river. The Massachusetts Coast Flood Risk Model (MC-FRM) projects the Bass River floodplain will expand steadily over the next 50 years and result in increasing flood depths associated with the 100-year coastal storm event (1% storm). Properties between River Street and the river could experience flood depths up to three feet in 2030. Those projections skyrocket to nearly five feet of flood depth in 2050 and could well exceed five feet of flood depth by 2070. These impacts would be catastrophic to the District without careful planning and strategic interventions.

The presence of marine and industrial uses in the District has led to the degradation of its salt marsh areas. Massachusetts GIS ("MassGIS") data reflecting Massachusetts Department of Environmental Protection's (MassDEP's) wetland resource areas indicate sections of land under the ocean and tidal flat in the District, as well as a small area of salt marsh near the Bass Haven Yacht Club. Over many years, uncontrolled stormwater runoff has increased the amount of sedimentation within the Bass River. In addition to impacting

aquatic habitat, the waterway is currently limited as several docks and boats may only be accessible during the higher portion of the tidal cycle.

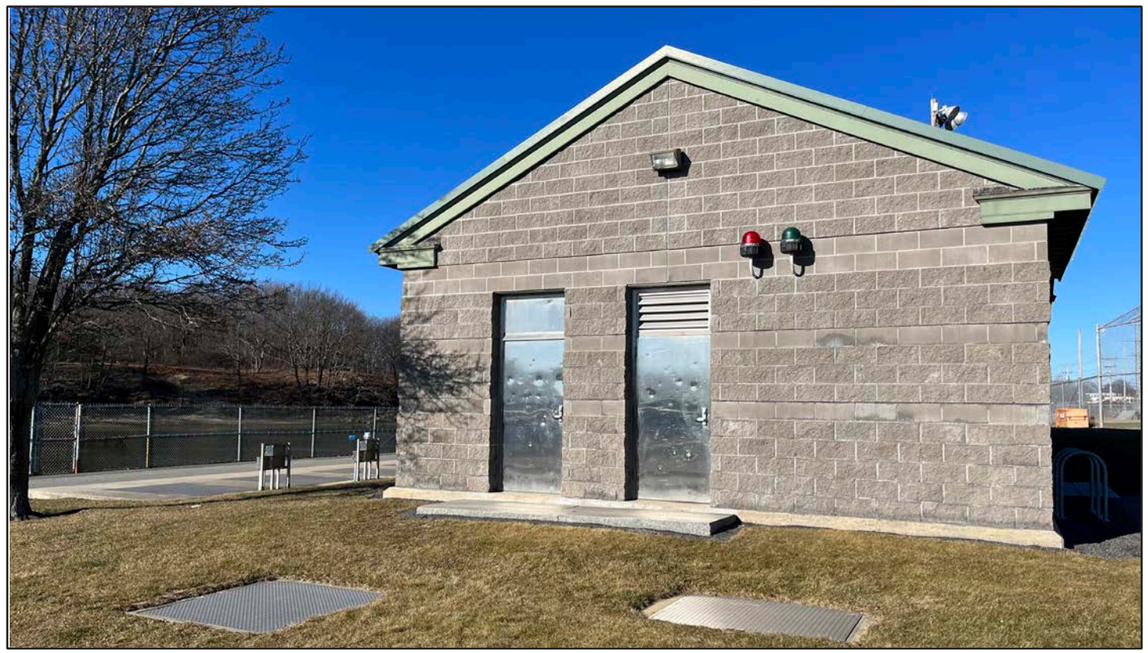


Photo 1: View Looking at Margin Street Pump Station and the Bass River

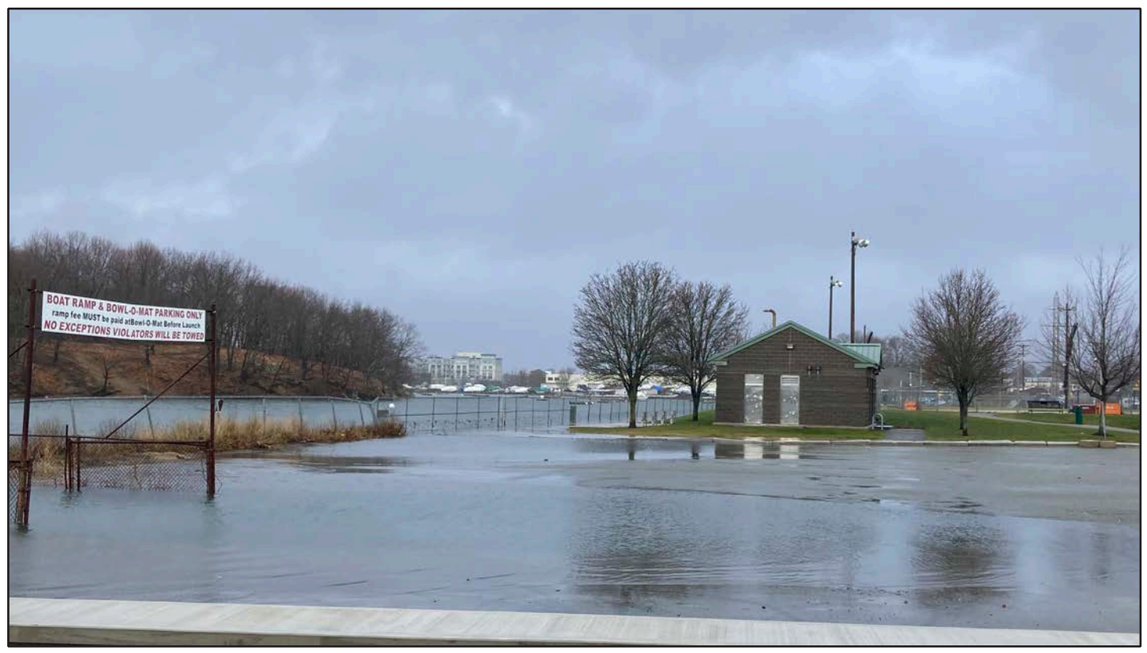


Photo 2: December, 2022 Flood Event, Photo By Todd Callahan

Photo 3: Internal Infrastructure of Margin Street Pump Station

Photo 4: Internal Infastructure of Margin Street Pump Station

Photo 5: McPherson Youth Center proximity to Bass River

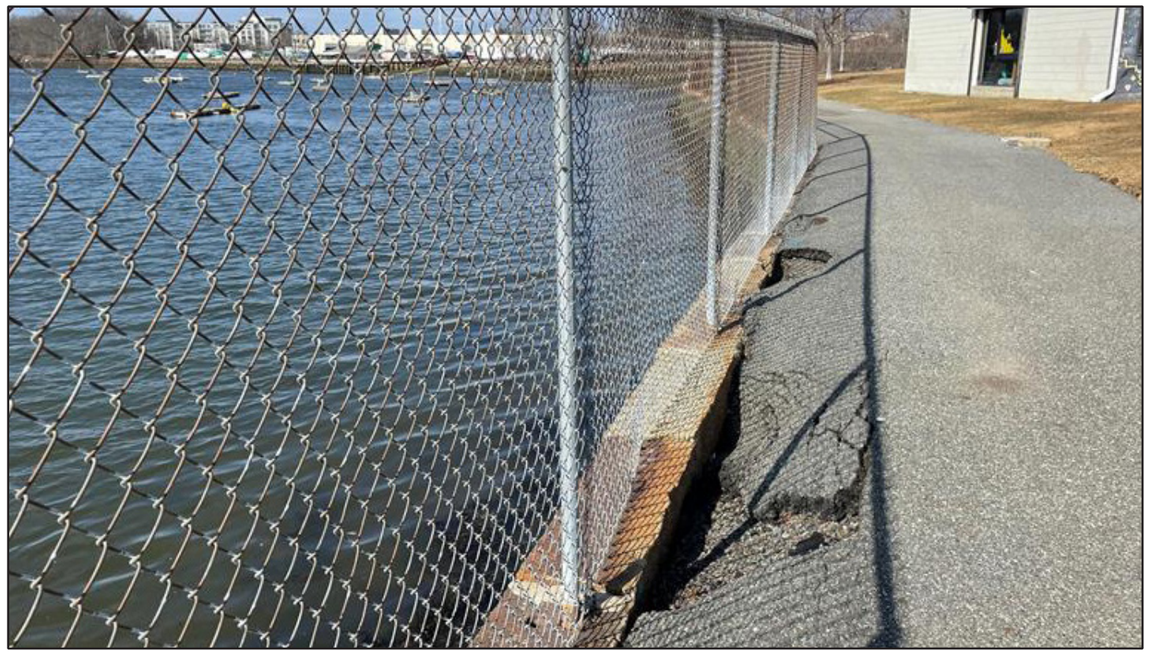


Photo 6: Stormwater damage adjacent to McPherson Youth Center

Photo 7: McPherson Youth Center and parking lot

Photo 8: McPherson Youth Center Skate Park

Figure 1-4
Existing Conditions Photographs
Source: Tetra Tech, 2022

Photo 9: Yacht Club landbased infrastructure

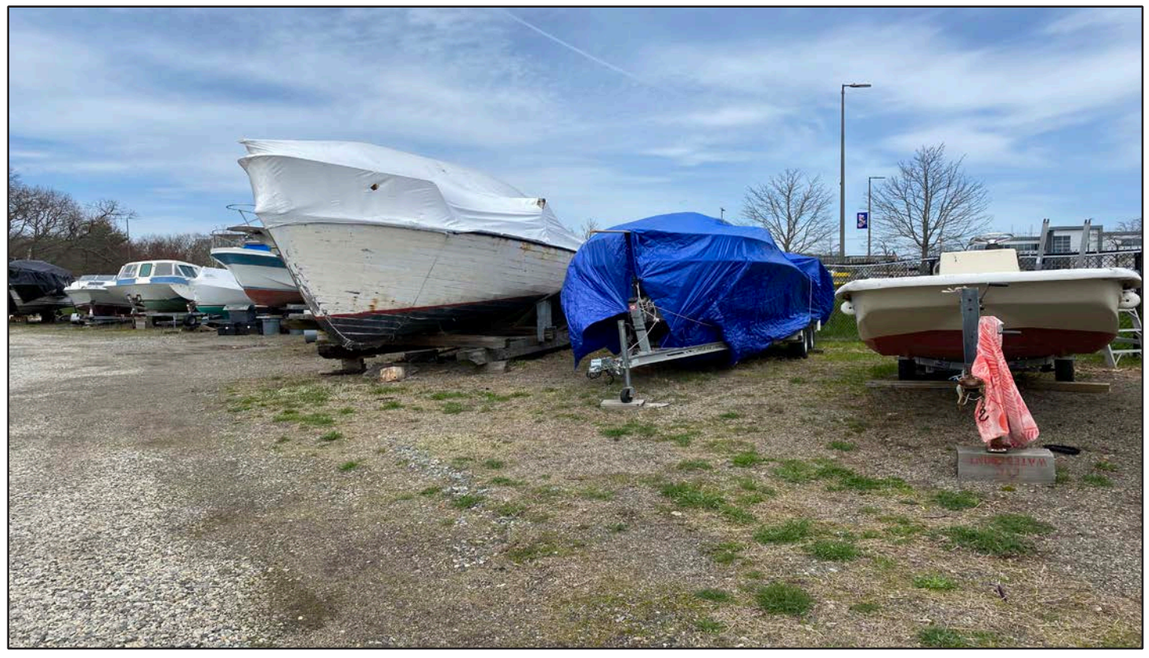


Photo 10: Yacht Club boat storage space

Photo 11: Yacht Club boat ramp/water access

Photo 12: Shoreline existing conditions of the Yacht Club

The utility substation on River Street supplies electricity to the surrounding region. Both underground and overhead transmission lines traverse the District in the River Street corridor. The utility company is currently working on a reliability improvement project focused on replacing aging and/or undersized transmission lines under River Street and McPherson Drive. The City of Beverly's Margin Street Stormwater Pump Station in the District plays a critical role to alleviate inland flooding for areas east of River Street. Major roadways and bridges also frame this District, including Elliott Street/Route 62, the Hall-Whitaker Bridge over the Bass River (currently planned for reconstruction), and other major thoroughfares that connect Beverly to its neighbors in Danvers and Salem, as well as Route 128/Interstate 95. Should these assets be damaged by floodwaters, it would require significant time and resources to resolve these issues that would overwhelm the City of Beverly and distress its residents, business owners, and neighboring communities.

1.2.2 FUTURE DEVELOPMENT CONSIDERATIONS

Furthermore, the Mayor's Office and Planning and Development Department has recently been working to create new zoning for the Bass River Area over the last five years, which would include a sizeable portion of the District south of Innocenti Park. This zoning initiative is a prime opportunity for Beverly, and the region, to help meet the City's housing and economic needs through transit-oriented development and to provide better public access to the Bass River riverfront. The guiding principles of this effort are proximity to the Beverly Commuter Rail station, opening up public access to the river, opportunities for climate resilience mitigation, meeting the City's housing needs, economic development through new investment, knitting together the Bass River with downtown, and creating another great place in Beverly. The new zoning initiative is a strong catalyst for the planning process and final product of the project. The analysis and recommendations from this Plan will directly inform and support a future rezoning effort by the City, in particular its flood resiliency goals and objectives.

For these reasons, as well as the City of Beverly's ongoing commitment to sustainability and resiliency, addressing coastal flooding vulnerabilities in the Bass River District has been identified as a high priority in need of sustainable solutions and long-term planning.

1.3 STUDY DESCRIPTION

This Resilience Plan was funded by an FY23 Municipal Vulnerability Preparedness (MVP) Action Grant from the Massachusetts Executive Office of Energy and Environmental Affairs (EEA). The Plan focuses on the results of assessments of diverse stakeholder outreach and feedback, lived experiences within the District, and coastal resource area analysis along the banks of the Bass River. These assessments were used to propose measures to enhance the long-term health and functionality of the District's resource areas, as well as identify opportunities to incorporate nature-based solutions.

The Plan concentrates on critical utility asset protection, coastal resource area enhancements, the health of marine use facilities, and smart redevelopment practices

along the Bass River. Specifically, the Plan builds on prior work from Coastal Zone Management (CZM) and MVP grants to:

- Develop flood resilience strategies by land use typology and time horizon to allow for near-term adaptations and long-term interventions.
- Consider both environmental resilience of the Bass River ecosystems and social resilience of the residents living in EJ communities in and around the District.
- Conduct coastal resource area assessments to facilitate critical interventions to improve the health of degraded resource areas and identify future adaptations.
- Educate a broad group of stakeholders (residents, landowners, utility providers, marine facilities users, and the public) on flood risk in this District and collaborate with them to plan for a resilient future.

In the first phase of this study, the study team identified a suite of strategies by land use typology to inform and educate the City, the public, and stakeholders on potential approaches for resilient design and retrofits. Land uses within the District were divided into four typologies as follows:

- Coastal Resource Areas
- Commercial/Industrial Use Sites
- Critical Infrastructure & Community Assets
- Marine Uses

In the second half of the study, the team focused on flood interventions that could be developed to a conceptual level for future pursuits. Flood intervention areas concentrated on near-term opportunities for nature-based solutions along the waterfront, long-term approaches to addressing significant projected flood depth risk along the riverfront by the end of the century, enhancement of coastal resource areas, elimination of future flood pathways, and other options. The study team used three time horizons (2030/2050/2070) to inform these strategies and interventions based upon the need to phase flood resilience in the District appropriately to react to redevelopment pressures that present opportunities and challenges to District-wide resilience.

As described further within Chapter 5, public and stakeholder outreach and engagement was a critical aspect of this Plan, including interviews, public meetings, robust public education, hands-on social connections to the community, and engagement with local businesses on infrastructure resilience. As noted earlier, ultimately, this Plan provides recommendations on how to best address critical utility asset protection, coastal resource area enhancements, the health of marine use facilities, and smart redevelopment practices along the river.

1.4 STUDY PARTNERS

Throughout the study, the City of Beverly and Salem Sound Coastwatch (SSCW) partnered to work collaboratively and with the hired consultant team to participate in both

the technical and community engagement aspects of the planning process. The consultant team was led by Tetra Tech and supported by Woods Hole Group (WHG).

The planning process was led by a Core Team that met monthly to establish goals and objectives for the study, review data collection and modeling, evaluate site-level flood resilience strategies, develop district-wide flood intervention approaches, and engage with stakeholders and the public. Members of the Core Team are listed below in Table 1-1: List of Core Team Members.

Table 1-1: List of Core Team Members

Name	Organization
Erina Keefe	Study Manager – City of Beverly Sustainability Office
Lisa Chandler	City of Beverly Engineering Department
Darlene Wynne	City of Beverly Planning & Development Department
Danielle Spang	Beverly Harbor Management Authority
Barbara Warren	Salem Sound Coastwatch
Alison Frye	Salem Sound Coastwatch
Katie Moniz	Consultant Team – Tetra Tech
Erika Frazier	Consultant Team – Tetra Tech
Piper Cole	Consultant Team – Tetra Tech
Bob Parsons	Consultant Team – Tetra Tech
Nasser Brahim	Consultant Team – Woods Hole Group

1.5 PUBLIC BENEFITS & INTERESTS

The recommendations from this Plan will help ensure the public resources of the District, such as the utility substation, Innocenti Park, McPherson Youth Center, and the Margin Street Stormwater Pump Station, are in a strong flood resilience position. The same is true for the significant number of commercial/industrial properties in the District, which provide public benefits to the community through the services and products they offer/provide. Furthermore, and perhaps most importantly, the strategies within this Plan will assist in protecting the people within the District and the surrounding area from physical, monetary, and emotional harm. This includes residents, employees, customers, landowners, and others all of whom rely on the resources in the District for a variety of reasons.

Additionally, the public engagement built into the study's planning process, including community and stakeholder meetings and interviews, broad collaboration with partners and stakeholders, the development of resilient infrastructure-focused documents and materials for public distribution, and community education and outreach, will ensure ongoing support of this Plan and future similar studies throughout the community. This Plan and its public process have raised awareness regarding climate impacts on critical infrastructure and resources, and the opportunities communities have (a) to increase

resilience of existing infrastructure and resources, and (b) to locate new equipment, resources, and structures in appropriate areas.

1.6 ACKNOWLEDGEMENTS

The following individuals and staff have contributed their time to support and develop this work. Their contributions join the numerous comments of stakeholders and members of the public, including nearby property and business owners, who contributed their time and thoughts to develop a more robust study:

- Mayor Michael P. Cahill, City of Beverly
- Darlene Wynne, Director of Planning and Development, City of Beverly
- Lisa Chandler, City Engineer, City of Beverly
- Erina Keefe, Sustainability Director, City of Beverly
- Brad Pillen, Sustainability & Resilience Project Manager, City of Beverly (former)
- Barbara Warren, Executive Director, Salem Sound Coastwatch
- Alison Frye, Associate Director, Salem Sound Coastwatch
- Danielle Spang, Vice Chair, Beverly Harbor Management Authority
- Michelle Rowden, Municipal Vulnerability Preparedness Program Regional Coordinator, Massachusetts Executive Office of Energy and Environmental Affairs

Finally, we would like to sincerely thank the Massachusetts Executive Office of Energy and Environmental Affairs for understanding the importance of preparing resilient municipalities in Massachusetts for climate change impacts and providing thoughtful feedback, support, and funding necessary in the form of an MVP grant throughout this study.

Chapter 2

DATA COLLECTION & METHODOLODY

CHAPTER 2: DATA COLLECTION & METHODOLOGY

2.1 METHODOLOGY

The study team worked with the City of Beverly to collect relevant data on the District and its assets to inform the evaluation of near- and long-term resiliency measures.

Data collection activities included:

1. Performing a coastal resource assessment including a physical inspection of existing conditions and a wetlands delineation;

2. Providing updated coastal flood exposure maps and data derived from the Massachusetts Coast Flood Risk Model (MC-FRM) for Present, 2030, 2050, and 2070 time horizons;

3. Reviewing critical assets within the District, which were previously identified in the Beverly Coastal Vulnerability Assessment in 2017 and the City of Beverly Hazard Mitigation Plan Update in 2018;

4. Collecting and reviewing relevant geospatial data sets, reports, studies, permitting documents, and engineering record drawings associated with the Margin Street Stormwater Pump Station (the "Pump Station") and other utility infrastructure in the District; and

5. Visually inspecting the Pump Station infrastructure.

This chapter provides additional detail on the scope of this data collection and research and the methodology for collecting and producing data through visual inspections, wetlands delineations, coastal flood modeling, and other methods.

2.2 COASTAL RESOURCE ASSESSMENT

WHG performed a wetlands delineation survey on February 27, 2023, as part of the coastal resource assessment needed to support the development of resilience strategies for protecting coastal resource areas from risks associated with sea level rise and the potential for expanded nature-based flood interventions in the District. The delineation was performed by a Professional Wetland Scientist and Coastal Scientist in conformance with the Massachusetts Wetlands Protection Act (WPA) and associated regulations and guidelines. There are five wetland resource areas that are regulated under the WPA, including Coastal Bank, Salt Marsh, Rocky Intertidal Shore, Coastal Beach, and Land Subject to Coastal Storm Flowage (LSCSF). See Figure 2-1: Coastal Resource Areas and Appendix A, Coastal Resource Areas Technical Memorandum prepared in May 2023.

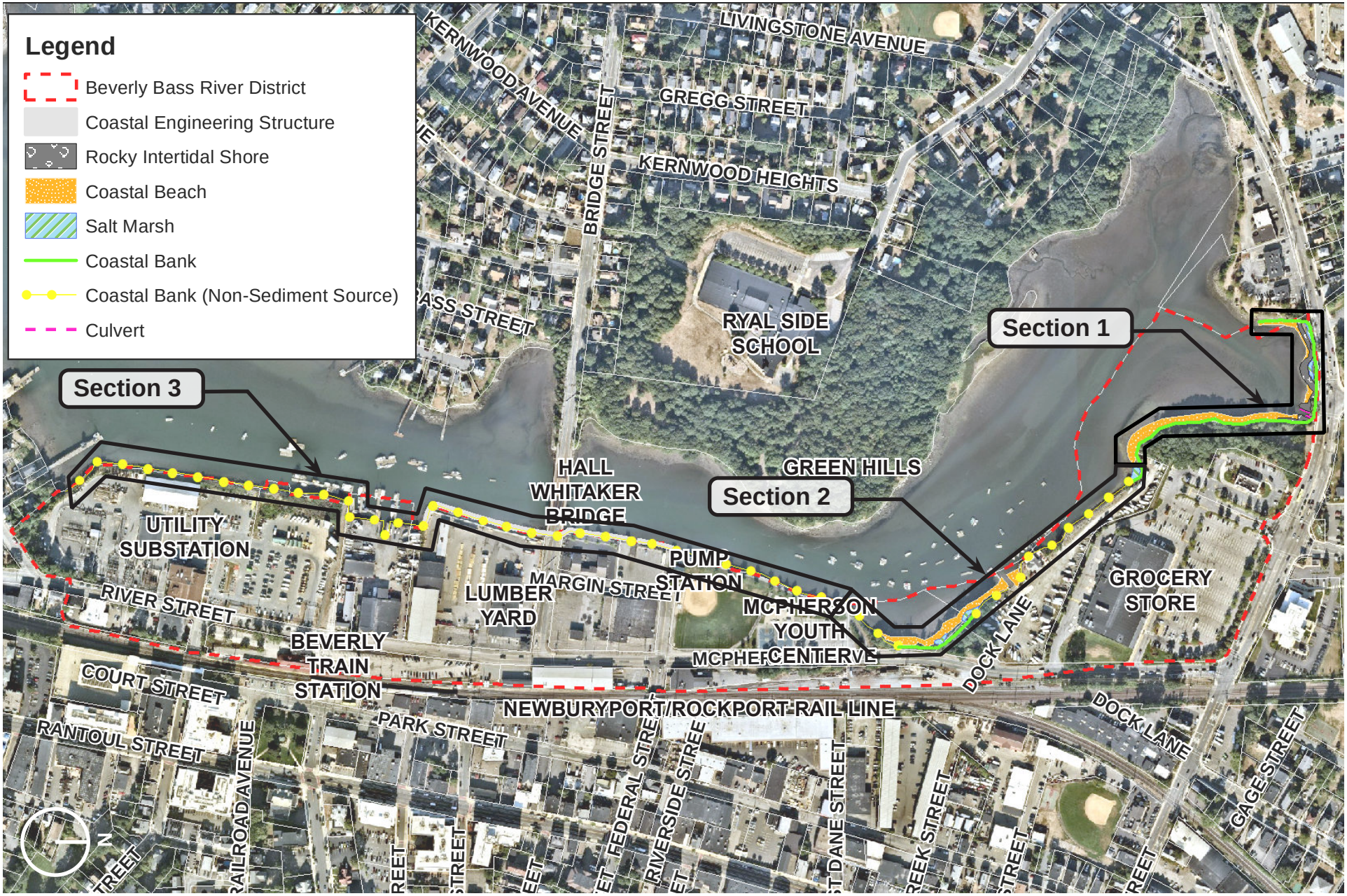


Figure 2-1
Coastal Resource Areas
Source: Woods Hole Group, Tetra Tech, 2023

The delineation along with the technical memorandum provided in Appendix A can be used in future permitting applications.

The following narrative describes the vegetation types and characteristics of each coastal resource area in the District. The coastal resource area delineation extended 5,347 linear feet (LF) from Elliott Street/Route 62 at the northern edge of the District, along the eastern banks of the Bass River, and down to the southern edge of the existing utility substation site along River Street.

The delineation was divided into three sections:

- Section 1, Upstream Basin: Elliott Street/Route 62 to the southern edge of the grocery store property;
- Section 2, Boatyard: Grocery store property to the McPherson Youth Center; and
- Section 3, River Street: McPherson Youth Center to the southern edge of the utility substation.

Coastal Bank

The Section 1 coastal bank resource area was comprised of industrial fill, brick, concrete waste, and some fine-grained sands and silts, which conveyed to the adjacent coastal beach and mudflat located seaward of the bank. Given the poor quality of the coastal bank substrate around the upstream basin, only limited amounts of native and invasive vegetation were observed growing on the landform. Species observed along this section of shoreline included native black cherry (*P. serrotina*), eastern red cedar (*J. virginiana*), black oak (*Q. velutina*), high tide bush (*B. halimifolia*), poison ivy (*T. radicans*), invasive Asiatic bittersweet (*C. orbiculatus*), and black locust (*R. pseudoacacia*). Only sparse grasses and perennial species were observed.

Section 2 of the shoreline included both sediment source (actively eroding) and non-sediment source (armored) coastal bank. A sloping rock revetment and bulkhead armored the landform immediately seaward of Section 2. Vegetation was observed along the unarmored section of shoreline which corresponded with Section 1.

The Section 3 coastal bank resource area is heavily developed and armored with a combination of sloping rock revetments, vertical bulkheads, sheeting, bridge abutments, and seawalls.

Salt Marsh

Section 1 contained fringing peat salt marsh immediately landward of the coastal bank resource area along Elliott Street/Route 62. The seaward face of the salt marsh platforms were armored with 1 to 3 feet of riprap, forming a manmade sill. The fringing salt marshes were vegetated with smooth cordgrass (*S. alterniflora*), which dominated low marsh areas,

and salt marsh hay (*S. patens*), which dominated high marsh areas. A narrow strand of high tide bush (*B. halimifolia*) occupied the narrow strand along the landward edge of the salt marsh and the toe of the coastal bank.

Salt marsh was delineated at the north end of Section 2, which contained corresponding vegetation with Section 1 and vegetation downstream of the concrete boat ramp in Section 2. Salt marsh located downstream showed the most severe evidence of dieback, degradation, and active erosion with large, unvegetated sections eroding onto the beach.

Rocky Intertidal Shore

The rocky intertidal shore resource area extended from the northern shoreline of Section 1 where intermittent boulders were filled seaward of the coastal bank and fringing salt marsh resource areas. Within the rocky intertidal shore, cobbles exceeding a 1 foot diameter were subject to daily tidal inundation and were occupied by various species of macroalgae. The CZM Coastal Manual states that while human-made coastal engineering structures sometimes meet the definition for rocky intertidal shore, they are not able to meet the performance standards of the resource area and therefore, are not delineated as such. Only boulder strewn areas with stable cobble seaward of the human-made structures were mapped as rocky intertidal shore. There were no additional rocky intertidal shore resource areas located south of Section 1.

Coastal Beach

Around the entire tidally influenced shoreline of Section 1, a narrow coastal beach was delineated between the coastal bank, salt marsh, and/or rocky intertidal shore and the edge of the mudflat. Coastal beach along the northern, terminal end of Section 1 consisted of fine sediments mixed with gravel and industrial fill, overlaid with mud. Along the eastern shoreline downstream of Section 1, the landward edge of coastal beach was comprised of coarser sand, gravel, and fill, becoming muddier along the seaward edge. There was no evidence of vegetation within the coastal beach resource area, which could be attributed to the poor quality of sedimentation.

Coastal beach delineated within Section 2 consisted of more gravel than areas located further upstream. However, coastal beach still became muddy along the seaward edge, where mudflat was omnipresent. There was no evidence of a coastal beach resource area along the heavily armored Section 3 shoreline.

Land Subject to Coastal Storm Flowage

The majority of the District is located within the FEMA Flood Zone AE, which is classified as an area subject to the 1% annual chance flood (100-year flood), where Base Flood Elevation (BFE) has been determined. The BFE in the District is Elevation 10 NAVD88, as reflected in the current version of the FEMA Flood Insurance Rate Map (FIRM) Community Panel 25009C0417G (effective July 16, 2014). See Figure 2-2: FEMA FIRM

25009C0417G below. As a result, LSCSF also encompasses all the resource areas that were observed.

Estimated and Priority Habitat for Rare and Endangered Wildlife

There are no Estimated or Priority Habitat for Rare or Endangered Species identified within the District, as determined by the Massachusetts Natural Heritage and Endangered Species Program. However, a significant portion of the District was identified as spawning and settlement habitat for soft-shell clam (*Mya arenaria*). There were no live shellfish observed within the District, however shell fragments were observed along the coastal beach resource areas.

2.3 MC-FRM COASTAL FLOOD MODELING

The MC-FRM is a high-resolution, probabilistic flood risk model created specifically to assess physics-based, coastal forced, flooding conditions under present and future climate conditions for the entire coast of Massachusetts. The model uses a two-way coupled version of the Advanced Circulation (ADCIRC) and Unstructured Simulating Waves Nearshore (UnSWAN) models to fully simulate a variety of storm conditions (e.g., tropical and extra-tropical cyclones). The MC-FRM incorporates the ”High” relative sea level rise (RSLR) projections for 2030, 2050, and 2070 developed by the Commonwealth and made publicly available on the Resilient MA website (ResilientMA.org). Storm intensification due to climate change is also incorporated within the MC-FRM 2050 and 2070 time horizons. The model has been, and is currently being, used for numerous coastal planning and design projects throughout Massachusetts and is recommended by the Commonwealth of Massachusetts Climate Resilience Design Standards as the basis for resilient coastal design.

The MC-FRM provides a probabilistic distribution of water levels for locations throughout Massachusetts based on thousands of storms. From these thousands of storm events, individual storms corresponding closely to specific return-periods water surface elevations can be selected to evaluate the performance of flood resiliency projects. For this modeling effort, three representative storms, under three different climate horizons were simulated for existing conditions (existing elevations) and proposed conditions (with the proposed development constructed) within the MC-FRM framework. See Appendix B, Flood Intervention Performance Modeling Memorandum.

Beverly, Massachusetts

Figure 2-2
FEMA FIRM 25009C0417G
Source: FEMA, 2023

WHG provided updated coastal flood exposure maps and coastal hazard data derived from the MC-FRM for the District, including:

- Tidal benchmark map for the District showing the location of the mean higher high water (MHHW) line in the present, 2030, 2050, and 2070 time horizons. See Figure 2-3: Tidal Benchmarks below
- Tidal benchmark elevations (Mean Lower Low Water (MLLW), Mean Low Water (MLW), Mean Tide Level (MTL), Mean High Water (MHW), and Mean Higher-High Water (MHHW)) for the present, 2030, 2050, and 2070 time horizons.
- Coastal flood maps for the District showing the extent, probability, and 1% annual chance depth of flooding in the present, 2030, 2050, and 2070 time horizons, including from the District into inland neighborhoods. See Appendix C, Coastal Flood Maps.
- Water surface elevations in the 2050 and 2070 time horizons of the 1% annual exceedance probability (AEP). See Appendix D, Water Surface Elevations and Max Wave Crest Elevations.
- Maximum wave crest elevations for the District in the 2050 and 2070 time horizons, at the 1% annual probability of exceedance including still water surface elevations and maximum wave crest heights. See Appendix D.

Relative Sea Level Rise Projections

The MC-FRM incorporates the state's most recent RSLR projections and dynamically models the impact across the Massachusetts coast, producing the best available data statewide. The project utilized tidal benchmark elevations generated by the MC-FRM specifically for the Bass River (Figure 2-3, Table 2-2) to understand the local risks from future high tide flooding and inform resiliency recommendations.

The Commonwealth developed probabilistic projections for relative mean sea level elevation at the Boston tide gage under "Intermediate," "Intermediate High," "High," and "Extreme" RSLR scenarios (DeConto et al., 2016; DeConto et al., 2017). As summarized in Table 2-1, these scenarios account for a range of assumptions regarding how much global greenhouse gas concentration, ocean thermal expansion, and melting of glaciers and ice sheets will occur and when. All four scenarios anticipate continued acceleration of RSLR.

The MC-FRM incorporates the "High" scenario projections, outlined in dark red in Table 2-1. The "High" SLR scenario was recommended by CZM and chosen by Massachusetts Department of Transportation for the MC-FRM because of the critical infrastructure at stake and the interest in planning for inundation risk probabilities that were unlikely to be exceeded (there is a 99.5% confidence level that the "High" scenario chosen will not be exceeded if there are very high greenhouse gas emissions through end of century). These same considerations make the "High" sea level rise scenario appropriate to inform the City

of Beverly's resiliency planning and design. As the MC-FRM is the state standard tool for resilient coastal design, adoption of this scenario is best practice and ensures consistency.

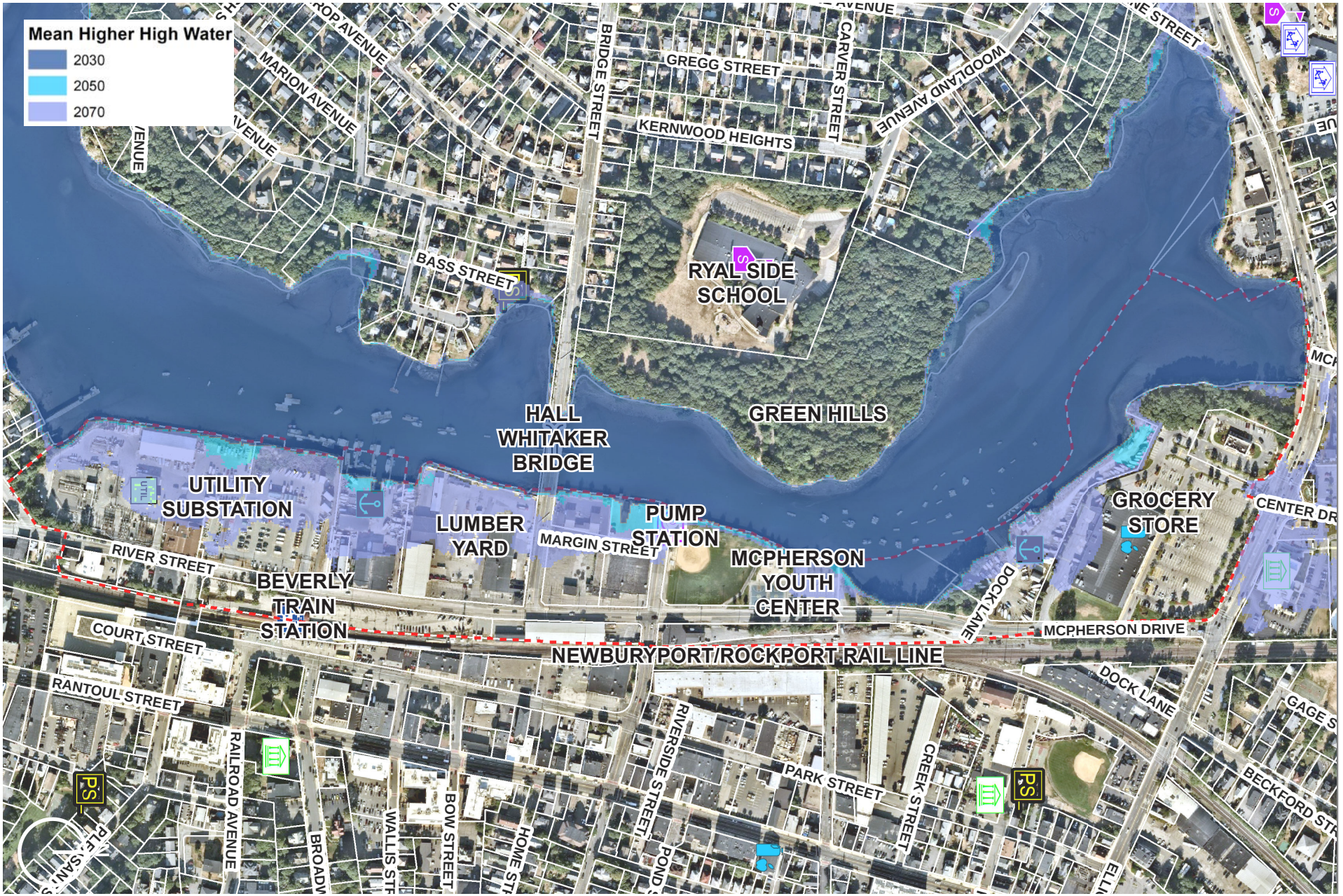


Figure 2-3
Tidal Benchmarks
Source: Woods Hole Group, Tetra Tech, 2023

Table 2-1: Relative Mean Sea Level (ft-NAVD88) Projections for Boston, MA

Scenario	Cross-Walked Probabilistic Projections	2030	2050	2070	2100
Intermediate	Unlikely to exceed (83%) under RCP 8.5[1]	0.7	1.4	2.3	4.0
	• Extremely unlikely to exceed (95%) under RCP 4.5 • About as likely as not to exceed (50%) under RCP 4.5 when accounting for possible ice sheet instabilities				
Intermediate-High	Extremely unlikely to exceed (95%) under RCP 8.5	0.8	1.7	2.9	5.0
	• Unlikely to exceed (83%) under RCP 4.5 when accounting for possible ice sheet instabilities • About as likely as not to exceed (50%) under RCP 8.5 when accounting for possible ice sheet instabilities				
High	Extremely unlikely to exceed (99.5%) under RCP 8.5	1.2	2.4	4.2	7.6
	• Unlikely to exceed (83%) under RCP 8.5 when accounting for possible ice sheet instabilities • Extremely unlikely to exceed (95%) under RCP 4.5 when accounting for possible ice sheet instabilities				
Extreme (Maximum physically plausible)	Exceptionally unlikely to exceed (99.9%) under RCP 8.5	1.4	3.1	5.4	10.2
	• Extremely unlikely to exceed (95%) under RCP8.5 when accounting for possible ice sheet instabilities				

Note: 2008 (1999-2017 epoch) mean sea level at Boston tide gage was -0.09 feet (NAVD88)

[1] Representative Concentration Pathways (RCPs) describe different 21st century pathways of greenhouse gas (GHG) emissions and atmospheric concentrations, air pollutant emissions and land use. RCP 4.5 represents a scenario with an intermediate level of GHG mitigation and RCP 8.5 represents a scenario with very high GHG emissions.

Selecting the "High" scenario reduces the risk of under-preparing and under-designing for the future, while providing flexibility to move the timeline for adaptation actions further into the future if observed RSLR follows lower trajectories. As highlighted in Table 2-1 color coding, the "High" results in 2030 are similar to "Intermediate" results in 2050 (blue), the "High" results in 2050 are similar to the "Intermediate" results in 2070 (dark teal), and the "High" results in 2070 are similar to the "Intermediate" results in 2100 (bright red).

Note that the values in Table 2-1 are elevations of the projected mean sea level in future years relative to a vertical datum of NAVD88, not the magnitude of change in elevation. For comparison, the baseline (i.e., year 2008) mean sea level elevation, is -0.09 feet (NAVD88). The projected change in mean sea level is the difference between the year 2008 (present) and 2030, 2050, 2070 and 2100, respectively. These projections were used to supply sea level rise information to MC-FRM and are consistent with the approach being used across the entire state of Massachusetts.

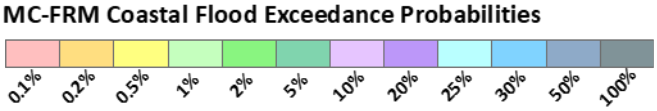
Projected Tidal Datum and Exposure to Daily Tidal Flooding

Tidal Datum maps provide the MHHW projections based upon projected sea level rise as modeled by MC-FRM. These maps show tidal benchmark elevations for the 2030, 2050, and 2070 time horizons. See Table 2-2, Tidal Benchmark Elevations.

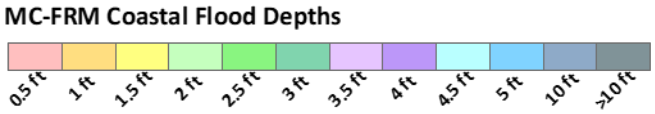
Table 2-2: Tidal Benchmark Elevations

Tidal Benchmark	2030 (Ft, NAVD88)	2050 (Ft, NAVD88)	2070 (Ft, NAVD88)
MHHW	6.3	7.6	9.4
MHW	5.9	7.2	9.1
MTL	1.4	2.5	4.3
MLW	-3.2	-2.3	-0.6
MLLW	-3.5	-2.6	-0.9

Coastal Flood Exceedance Probability (CFEP): CFEP maps provide the annual chance of inundation from coastal storm surge across the landscape. These maps show interpolated results of the MC-FRM nodal calculations and can be used as a screening/planning tool and to inform engineering design criteria since they provide the probability of an event occurring in this changing regime, such as the "new" 1 in 100 year flood event (1% probability). Inundation probabilities are represented as follows:



Coastal Flood Depth: Depth maps indicate the scale of inundation above the land surface produced by a given probability level event. These maps are developed by subtracting the land surface elevation from the water surface elevation at each model node and interpolating the results of these MC-FRM intra-nodal elevation comparisons. Depth maps are also useful as a screening/planning tool and to inform engineering design criteria since they provide an indication of the severity of flooding under various conditions. For this study, Coastal Flood Depth maps were produced for the 1% (100-year return period) CFEP levels. Inundation depths are represented as follows:



MC-FRM coastal flood maps, including both flood exceedance probabilities and flood depths, are included in Appendix D.

Projected Coastal Flood Exceedance Probabilities and Elevations

MC-FRM provides water surface elevations for the full distribution of annual probability levels, from 100% (annual recurrence) to 0.1% (1,000-year recurrence) for Present, 2030, 2050, and 2070. These data are reported in CFEP tables. These water surface elevations account for sea level rise, tides, storm surge, wave setup, and other physical factors, but they do not account for additional height added by wave runup and overtopping.

2.4 REVIEW OF CRITICAL ASSETS IN DISTRICT

As identified in the 2017 Coastal Resiliency Plan and 2018 Hazard Mitigation Plan Update, the District contains private and publicly owned critical municipal assets, including stormwater infrastructure, marinas, utility substations, roadways, and rail lines and stations. The existing conditions and impacts to these assets were evaluated. See Table 2-3: District Critical Assets.

Table 2-3: District Critical Assets

Facility Name	Type of Asset	Type of Ownership	Water Surface Elevation at 1% CFEP in 2050 (ft)	Maximum Wave Crest Elevation at 1% CFEP in 2050 (ft)	Water Surface Elevation at 1% CFEP in 2070 (ft)	Maximum Wave Crest Elevation at 1% CFEP in 2070 (ft)
Bass Haven Yacht Club	Marina	Private	11.6	14.3	13.4	16.2
Grocery Store	Supermarket	Private	11.6	12.8	13.4	14.4
Utility Substation	Utility	Private	11.8	14.3	13.5	16.2
McPherson Youth Center	Community Center	Public	11.6	13.4	13.4	15.8
Innocenti Park	Park	Public	11.6	13.2	13.4	15.8
Beverly Commuter Rail Station	Train Station	Public	N/A	N/A	N/A	N/A
Newburyport/Rockport MBTA Commuter Rail Line	Train Tracks	Public	11.6	11.6	13.5	14.3
Margin Street Pump Station	Stormwater Pump Station	Public	11.6	14.3	13.5	16.2
Elliott Street/Route 62 from Bass River to Rail Crossing	Roadway	Public	N/A	N/A	13.4	13.5

Facility Name	Type of Asset	Type of Ownership	Water Surface Elevation at 1% CFEP in 2050 (ft)	Maximum Wave Crest Elevation at 1% CFEP in 2050 (ft)	Water Surface Elevation at 1% CFEP in 2070 (ft)	Maximum Wave Crest Elevation at 1% CFEP in 2070 (ft)
McPherson Drive from Elliott Street/Route 62 to Federal Street	Roadway	Public	11.6	12.1	13.4	14.1
McPherson Drive at Federal Street	Underpass	Public	11.6	11.6	13.5	14.3
Federal Street from Margin Street to Rail Crossing	Roadway	Public	11.6	11.6	13.5	14.3
Bridge Street Bridge	Roadway	Public	11.6	14.6	13.5	16.5

2.4.1 CRITICAL ASSET EXISTING CHAPTER 91 LICENSES

The District consists of filled (formerly flowed) tidelands and flowed tidelands on private and Commonwealth tidelands. See Figure 2-4: Chapter 91 Jurisdiction. The Chapter 91 presumptive line is based on the MassGIS data and the high water mark from historic survey plans.

Authorizations for fill and structures within Chapter 91 jurisdiction were researched using a database from the MassDEP and the websites at the Essex County Registry of Deeds. Authorizations were found for fill and the existing structures, including wharfs and decks, filling, dredging, and stormwater structures. See Table 2-4: Historic Authorizations.

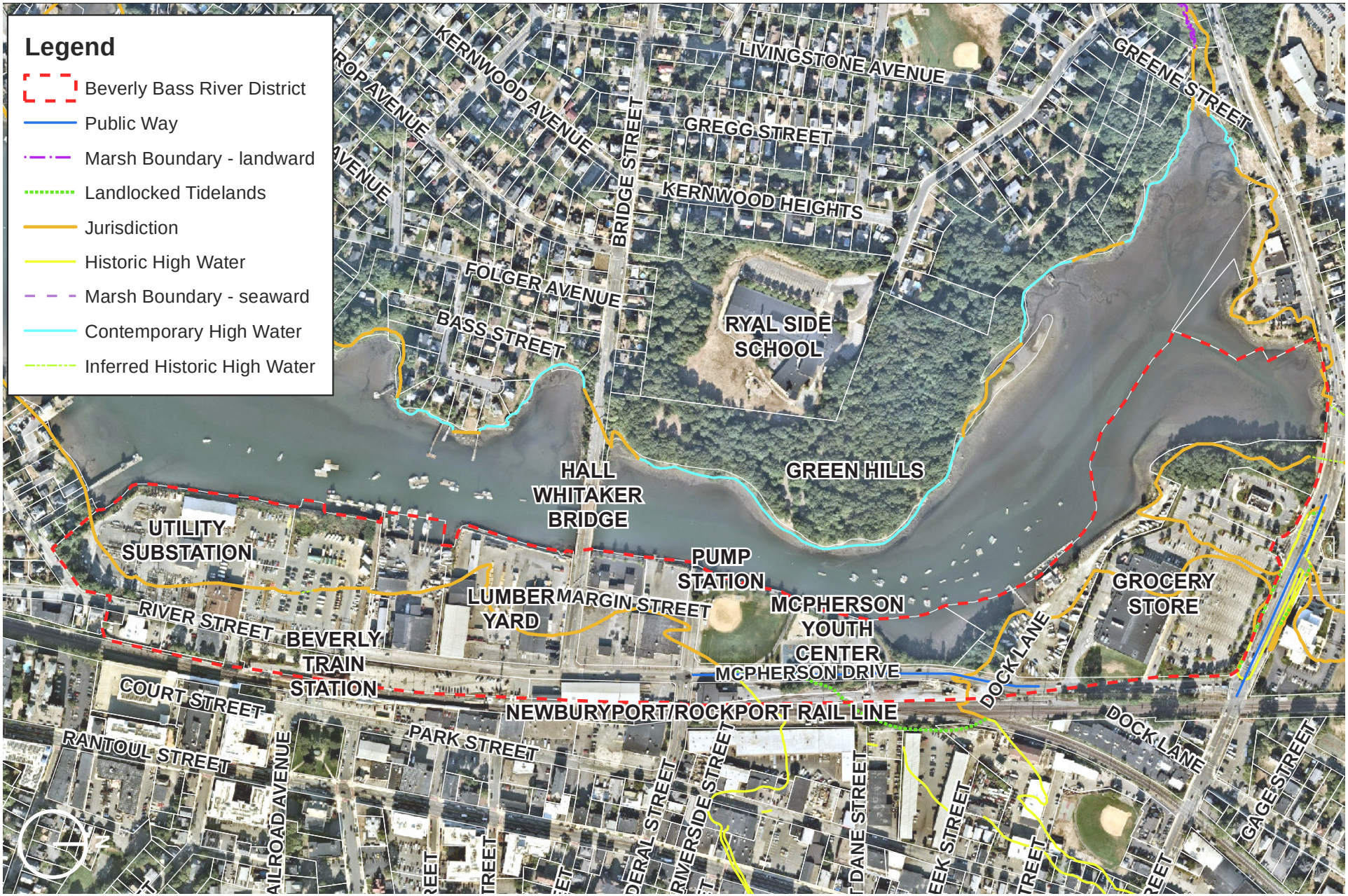


Figure 2-4
Chapter 91 Jurisdiction
Source: MassDEP, 2011; Tetra Tech, 2023

Table 2-4: Historic Authorizations

License No.	Date Issued	Licensee	Authorization
871	5/16/1885	BEVERLY GAS & LT CO	Extend wharf and fill
2902	1/1/1904	BEVERLY GAS LIGHT CO	Pipeline
2828	1/1/1904	BEVERLY GAS & ELEC CO	Bulkhead, Fill
2858	1/1/1904	BEVERLY GAS & ELEC CO	Bulkhead, Fill
3108	1/1/1906	BEVERLY GAS & ELEC CO	Dolphins
3660	1/1/1912	BEVERLY GAS ELEC CO	Bulkhead, Fill
3702	1/1/1913	BEVERLY GAS ELEC CO	Bulkhead, Fill
3729	1/1/1913	CITY OF BEVERLY	Other-water main
3868	1/1/1914	CITY OF BEVERLY	Pier
4084	1/1/1916	CITY OF BEVERLY	Float(s)
17	1/1/1920	CITY OF BEVERLY	Culvert
63	1/1/1920	BOSTON MAINE RR	Bridge
395	1/1/1924	CITY OF BEVERLY	Fill
920	1/1/1928	CITY OF BEVERLY	Seawall
1873	1/1/1937	BEVERLY GAS & ELEC CO	Cables
3688	1/1/1955	ESSEX COUNTY ELEC CO	Dike
516	12/12/1978	CITY OF BEVERLY	Construct rip-rap retaining wall
0	2/12/1996	NATIONAL DEVELOPMENT OF N.E.	Removal
8417	7/13/1999	CITY OF BEVERLY	Construct discharge pipe and Stormwater Pump Station
8489	7/18/2000	BASS HAVEN YACHT CLUB	Replace an existing wooden bulkhead with stone revetment and install a float extension
10167	6/15/2004	MASSACHUSETTS ELECTRIC CO	Dredging
13294	2/21/2012	CITY OF BEVERLY	
3702	1/1/2013	BEVERLY GAS ELEC CO	Bulkhead, Fill
14739	1/10/2017	BOSTON GAS CO D/B/A NATIONAL GRID	Consolidation License

The historic authorizations along the Bass River consist largely of coastal, transportation, and utility infrastructure. The maintenance and eventual replacement of this infrastructure is key to maintaining the stabilized banks of the Bass River over time and adapting to rising sea levels due to climate change. Future Chapter 91 authorizations are anticipated as declining commercial and industrial properties are redeveloped, which is likely to lead to increased public access to the riverfront, further setback of development from the river's edge, and additional state, local, and public input on this evolving District.

2.5 UTILITY RESEARCH AND PLAN REVIEW

The following sections describe the existing private and public utilities within the District. See Appendix E, Utility Infrastructure Maps for wastewater, water, and stormwater infrastructure.

2.5.1 WASTEWATER INFRASTRUCTURE

Based on existing records, there are two municipal sewer lines that converge at a sanitary sewer manhole in the intersection of Bridge and River Streets. An 8-inch main from Bridge Street also converges at this location. A single 42-inch sewer main then runs down River Street through the utility substation at 44-46 River Street and ultimately to the triple barrel South Essex Sewerage District (SESD) sewer system running beneath Goat Hill to the Water Street sewer pump station. Wastewater infrastructure within the District is predominantly subsurface and is at low risk from coastal flooding. However, the risk of infiltration of rising groundwater and coastal floodwater into the underground wastewater system may occur at unsecured frames/covers/joints of sewer manholes and pipe joints.

2.5.2 WATER INFRASTRUCTURE

The District is served by municipal water distribution piping owned and maintained by the City of Beverly. On River Street, there is a 12-inch ductile iron water main starting from the Federal Street intersection and running to the Pleasant Street intersection, and an 8-inch cast iron water main from the Pleasant Street intersection to the Webber Avenue intersection.

Bridge Street is served by a 12-inch cast iron water main starting from River Street to the Hall-Whitaker Bridge, which serves Margin Street and the lumber yard. Elliott Street/Route 62 and McPherson Drive are served by a 12-inch diameter cast iron water main that serves 8-inch ductile water mains at the grocery store at 224 Elliott Street/Route 62. Water infrastructure within the District is predominantly subsurface and is at low risk from coastal flooding.

2.5.3 STORMWATER INFRASTRUCTURE

The District has several public and privately owned catch basins. There are six stormwater outfalls, located at the utility substation, the Hall-Whitaker Bridge, the Pump Station, McPherson Youth Center, Bass River Yacht Haven, McPherson Drive, and Elliott Street/Route 62. The outfall at Elliott Street/Route 62 is served by a 96-inch reinforced concrete pipe for the Shoe Pond Conduit.

2.5.4 MARGIN STREET STORMWATER PUMP STATION

The Pump Station is located on the east side of the Bass River, north of Bridge Street. The Pump Station was constructed between 1999 and 2001 to alleviate stormwater flooding from adjacent commercial and residential neighborhoods, and to protect the critical facilities.

The study team members joined City of Beverly Engineering Department staff on February 8, 2023, for a site survey to observe and document existing conditions at the Pump Station and its surroundings. Staff from Tetra Tech and the City observed, discussed, and documented Pump Station conditions, site history, operations (including under coastal storm and wet weather conditions), and potential flood entry points into the Pump Station and other site MC-FRM Flood Modeling. See Appendix F, Margin Street Pump Station Technical Memorandum for additional information.

CFEP water surface elevations were compared with the Pump Station's critical elevations, identified from record information provided by the City. Critical elevations are thresholds at which flooding would enter the Pump Station and cause damage or otherwise impact access or critical equipment and infrastructure on site. The Pump Station's critical infrastructure that is vulnerable to damage from flooding includes the electrical panel and switches, an emergency generator, and other electrical equipment, including transformers and wiring. Table 2-5 identifies the critical elevations against future flood elevations.

Table 2-5: Pump Station Critical Flood Elevation

Critical Feature Description	Feature Elevation in ft[1] (NAVD88)	Present Flood Elevation[2] (NAVD88)	2050 Flood Elevation[3] (NAVD88)	2070 Flood Elevation[3] (NAVD88)
Door Threshold	9.15	10.0	11.9	13.7
Louver Sill	9.80	10.0	11.9	13.7
Bottom of Emergency Generator	9.50	10.0	11.9	13.7

Critical Feature Description	Feature Elevation in ft[1] (NAVD88)	Present Flood Elevation[2] (NAVD88)	2050 Flood Elevation[3] (NAVD88)	2070 Flood Elevation[3] (NAVD88)
Bottom of Electrical Panel	9.50	10.0	11.9	13.7
Top of Force Main Valve Chamber (exterior)	7.65	10.0	11.9	13.7
Bottom of Exterior Transformer	8.85	10.0	11.9	13.7

[1] Elevations provided on City records are referenced in BCB, where MSL=-5.53. The elevations presented in Table 4 are converted to NAVD88;
[2] Current FEMA BFE;
[3] Projected 1% Annual Chance Flood Extent with Sea Level Rise;

2.5.5 ELECTRICAL INFRASTRUCTURE

The District contains a utility substation at 44-46 River Street. The City of Beverly's electric service is provided by National Grid. There are overhead and below grade electric lines and below grade gas mains throughout the District. National Grid has indicated in publicly available permitting materials that flood mitigation walls around the new substation assets will be constructed during upcoming infrastructure buildout for the River Street Substation, which includes the new N192 line. The timeframe anticipated for these flood resiliency measures is upon completion of substation infrastructure buildout completion or approximately 2027.

2.5.6 OTHER UTILITY INFRASTRUCTURE

Cable service to the District is generally provided through Comcast, Crown Castle, Verizon, and AT&T. There are overhead telephone and cable lines in the District. Third party telecommunication providers may exist within the corridor.

Chapter 3

SITE-LEVEL FLOOD RESILIENCE STRATEGIES

CHAPTER 3: SITE-LEVEL FLOOD RESILIENCE STRATEGIES

3.1 INTRODUCTION

Prior climate resilience and hazard mitigation planning in Beverly has established several essential assets to the community which are within the flood prone Bass River District. This chapter examines the development of conceptual strategies to strengthen resilience of critical infrastructure sites, coastal resource areas, potential redevelopment areas, and marine industrial sites within the District based on typology and timing of implementation. Flood resilience strategies range from elevated landforms, floodproofing measures, resilient public open space, and resilient building design strategies.

3.2 COASTAL RESOURCE AREAS

3.2.1 ASSETS IN THE DISTRICT

Key coastal resource areas in the District include the following wetland resource areas: Salt Marsh, Rocky Intertidal, and Coastal Beach. These resource areas are all defined in 310 Code of Massachusetts Regulations (CMR) 10, the Massachusetts Wetlands Protection Act (WPA). In order to collect the necessary data on these coastal resources with the District, WHG performed a wetlands delineation survey on February 27, 2023. This was conducted as part of the coastal resource assessment needed to support the development of resilience strategies for protecting coastal resource areas from risks associated with sea level rise and the potential for expanded nature-based flood interventions in the District. As noted earlier, the delineation was performed by a Professional Wetland Scientist and Coastal Scientist in conformance with the Massachusetts WPA and associated regulations and guidelines. See Figure 2-1: Coastal Resource Areas in Chapter 2 which identifies the locations of these resource areas within the District and the following Table 3-1: Coastal Resource Areas Summary for additional context.

Table 3-1: Coastal Resource Areas Summary

Type of Coastal Resource Area	Location of Coastal Resource Area	Approximate Size of Resource Area
Coastal Bank	Elliott Street/Route 62 southward to the northern end of Innocenti Park	5,310LF

Type of Coastal Resource Area	Location of Coastal Resource Area	Approximate Size of Resource Area
Coastal Bank (Non-Sediment)	Along the Bass River throughout the majority of District	3,840 LF
Salt Marsh	Near Bass Haven Yacht Club	3,920 SF
Coastal Beach/Tidal Flat	Elliott Street/Route 62 southward to the northern end of the Bass Haven Yacht Club and from the Bass Haven Yacht Club boat ramp southward to the northern end of Innocenti Park	31,640 SF
Rocky Intertidal Shore	Along Elliott Street/Route 62, from the northern end of the Bass Haven Yacht Club southward to the boat ramp, and in the area just north of Innocenti Park	6,600 SF

3.2.2 DESIGN CONSIDERATIONS

Before great strides are taken to preserve and enhance these coastal resource areas, several factors need to be considered. These areas have been fairly degraded by urbanization and active uses at the adjacent properties over the years. These resource areas have limited existing widths due to the existing high tide line along the river and how the uses along much of this stretch of the river extend to the edge of the bank. Significant work and resources may be needed to enhance and expand these resource areas to increase their viability over time as sea level rises and further jeopardizes this coastal resource areas.

Existing coastal resources stretch just under half the length of the Bass River shoreline in the District, from the Elliott Street/Route 62/McKay Street intersection southward, terminating at the northern end of Innocenti Park at the existing seawall. Opportunities to restore coastal resource areas include considerations to reshape embankment areas adjacent to McPherson Drive near rail tracks and Elliott Street near drainage outfalls. Opportunities to expand coastal resource areas exist along the Bass Haven Yacht Club property where low-lying areas are already prone to flooding. Expansion of coastal resource areas on this property could provide additional flood protection and protect some of the last remaining pockets of salt marsh along the Bass River.

3.2.3 NEXT STEPS

For these coastal resource areas, a number of actions could be undertaken to enhance the flood resiliency of these resources to benefit the properties adjacent to the Bass River and the District as a whole. Ongoing investment in environmental stewardship, including trash/debris removal, natural slope stabilization, and vegetation maintenance will serve to improve the health of the existing coastal resource areas. However, more significant enhancement and expansion is needed to retain these coastal resource areas over time.

Potential enhancement and expansion activities for these resources includes:

- *Introducing more/new native plantings where appropriate*. For example, in the salt marsh areas, this would include adding vegetation such salt meadow cord grass (*Spartina patens*) and/or salt marsh cord grass (*Spartina alterniflora*) and may also include spike grass (*Distichlis spicata*), high-tide bush (*Iva frutescens*), or other species. Additions such as these plantings would assist in making these resource areas more robust and healthier.

- *Restoring/Addressing areas of erosion along coastal banks.* To combat this effect, the addition of new plantings to bind the soil, installing rip rap or other non-biodegradable measure, or the construction of berms or revetments would all assist in stabilizing the banks of the river.

- *Creating space for coastal resource areas to migrate/expand over time.* While using existing upland areas to expand the resource areas (or provide them with the ability to grow over time) would infringe upon the usable space of properties which abut the Bass River, the benefits to those properties and the overall District by expanding these coastal areas would be significant. As highlighted in Chapter 4: District-wide Flood Interventions, the most significant opportunities to expand coastal resource areas north of the bridge include the embankment areas adjacent to McPherson Drive near rail tracks and along the Bass Haven Yacht Club property where low-lying areas are already prone to flooding.

- *Limiting and treating stormwater runoff from adjacent urban areas into these coastal resource areas*. In order to do this, existing properties in the District would need to implement Best Management Practices (BMPs) to allow more or all of the stormwater on each property to infiltrate on site. Reducing stormwater runoff from properties within the District would help to minimize sedimentation deposits into the river, reduce water pollution, and assist in maintaining existing water levels in the area. The City is currently updating its stormwater ordinance to enhance stormwater management standards to promote compliance with the federal and state standards for Municipal Separate Storm Sewer Systems (MS4). As properties within the District are redeveloped or significantly renovated over time, these stormwater standards will serve to facilitate the implementation of BMPs throughout the District.

Note that local, state, and/or federal environmental permitting will be required to alter the current ground cover and elevations of delineated wetland resource areas, including existing floodplain extents and associated buffer zones.

Some of these action items call for improvements to the existing makeup of the coastal resource areas within their existing footprint. However, other actions call for the possible size expansion of these areas or adjustments in operational practices at the properties which abut these coastal resource areas. This is a prime example which highlights how flood resilient strategies need accommodation and investment by all parties and stakeholders within the District to be successful in creating an improved resiliency for the area.

3.3 COMMERCIAL/INDUSTRIAL USE SITES

3.3.1 ASSETS IN THE DISTRICT

There are a significant number of commercial and industrial assets in the District. These resources include a custom copper work business, auto body clinic, auto parts business, the Beverly Depot restaurant, a lumber business, car wash, plumbing supply company, bicycle building shop, fast food establishment, and a large-scale grocery store. The District's proximity to the Beverly Commuter Rail station for the Newburyport/Rockport Line rail service to Boston and the recent *Multi-Family Zoning Requirement for MBTA Communities* under Section 3A of MGL c. 40A of state law has led to some redevelopment pressure from multi-family residential developers. Table 3-2 provides more information about these commercial and industrial use sites, including their identifier numbers for their geographic references in Figure 3-1 below.

Table 3-2: Commercial/Industrial Use Sites Summary

Address	Business	Figure 3.1 Identifier #s
27 River Street	E.W. Packard Custom Copper Work	1
29 River Street	Auto Body Clinic	2
64 Pleasant Street	Autopart International	3
10 Park Street	The Beverly Depot Restaurant	4
82 River Street	Moynihan Lumber	5
2 Margin Street	Beverly Car Wash	6
97 River Street	Salem Plumbing Supply	7
69 Federal Street	Parlee Cycles	8
230 Elliott Street	McDonald's	9
224 Elliott Street	Stop & Shop	0

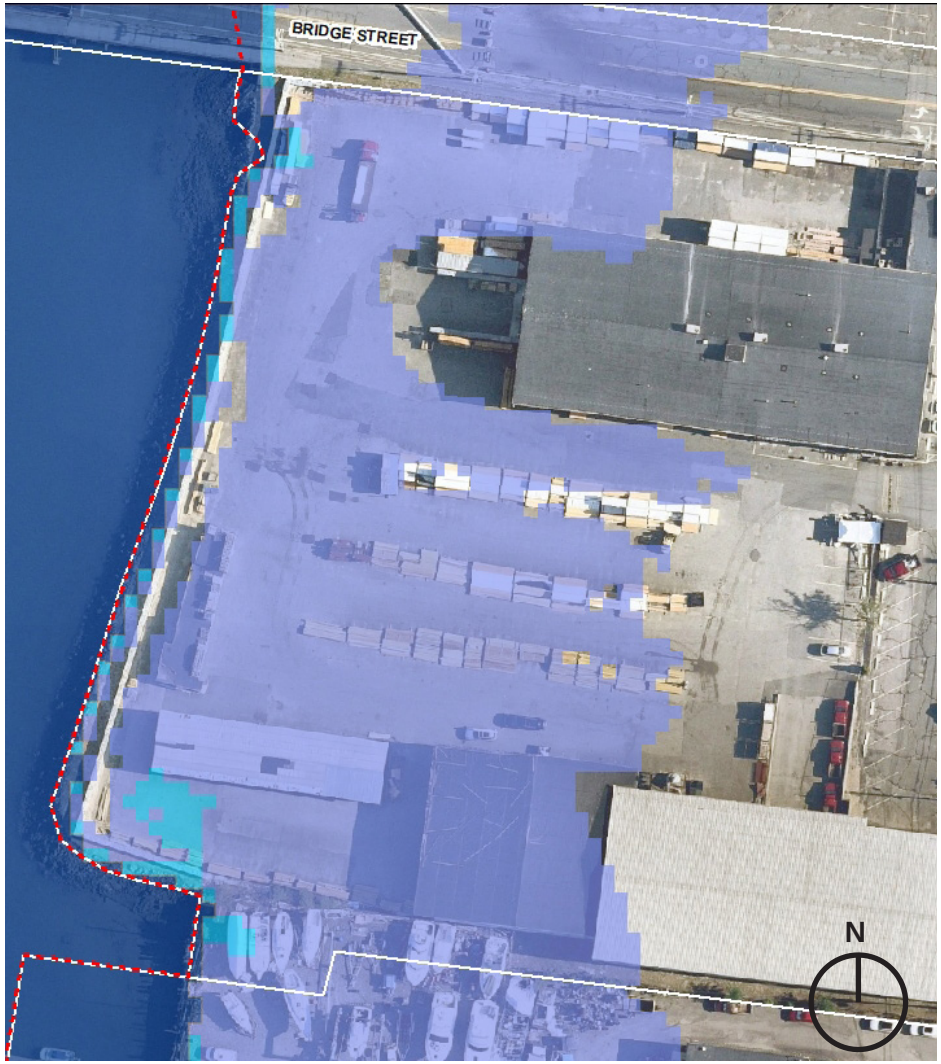
Figure 3-1
Commercial/Industrial Use Sites
Source: Tetra Tech, 2023

3.3.2 DESIGN CONSIDERATIONS

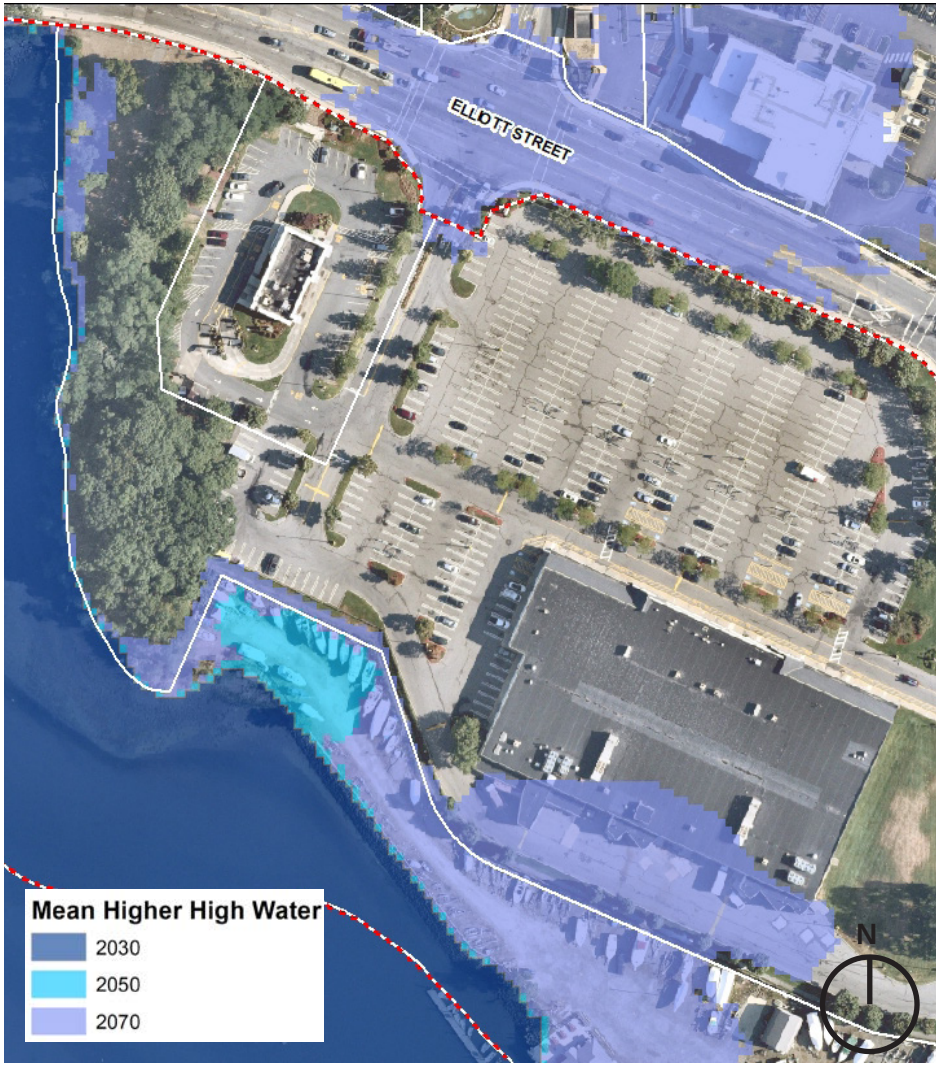
The commercial and industrial uses within the District occupy sites with their buildings and active use areas, as well as passive use areas for accessory activities, such as parking and storage. While some buildings on commercial and industrial properties might have some resiliency to future storm events, other buildings are already being impacted by current flooding events (the car wash business. for example). As future flood data projections are examined, the Mean Higher High Water (MHHW) in 2070 will bring more significant impacts to the commercial and industrial properties in the District. By that time, a portion of the grocery store property and half of the lumber business property will be under the MHHW mark. Other storm events would completely inundate these properties with flooding with over five feet of water in some spots. This would put not just the buildings themselves in harm's way but could also jeopardize the customer and employee parking areas and any materials stored at these sites.

As part of the Plan's outreach and data collection process, District businesses and property owners were interviewed. These stakeholders had varying roles at their business – owner of a multi-generation business, manager of a City-owned property, working for a non-profit, and employees. They were introduced to the study and the future flood risk projections. This information was new to all, and they were very interested in having access to these projected flood maps and understanding their future flood risk. Although they all knew that the area floods, each had their own experiences and concerns. Some businesses had not experienced significant flooding since 1978, while others were recently flooded in the December 23, 2022 storm. Properties that flood currently seemed to take it in stride, moving material or vehicles out of danger. Overall, stakeholders were unaware of how future flood conditions would impact their business and generally unconcerned with today's nuisance flooding.

It appears from the interviews that businesses are not currently planning to prepare for more flooding. The threat of River Street or McPherson Drive being impassable was their gravest concern because this would reduce or eliminate access by their customers, employees, and delivery vehicles. River Street and McPherson Drive are main arteries to the businesses in the District. They were asked if they had suggestions to reduce flooding at their business or in the District. This led to discussion of interventions, such as controlling stormwater flow from upland areas, elevating buildings, moving back from the river, and creating a floodable buffer. Many stakeholders were interested in learning more about these strategies to protect their property from flooding and when these strategies would need to be implemented.



Lumber Yard



Grocery Store

Figure 3-2
Tidal Considerations for Commercial/Industrial Use Sites
Source: Woods Hole Group, 2023; Tetra Tech, 2023

3.3.3 NEXT STEPS

For these commercial and industrial assets in the Bass River District, this Plan recommends that property owners invest in the following site-specific activities which can help to minimize or even prevent future damaging flood events:

- *Investing in flood hardening measures such as flood walls/panels.* This includes implementing new technology, installing new equipment, constructing protective barriers, or changing communications/information technology at the property.

- *Raising/Terracing portions of a site to create a natural barrier to coastal flooding*. Changing elevations of various portions of a property will assist in protecting the other sections of the same property from flooding. These barriers might include earthen berms, embankments, and other non-constructed landscape elements or grading.

- *Setting new occupied building spaces on elevated podiums.* This involves constructing a building's base floor at an elevation above the ground level. The actual height of this would vary for different properties and structures, but often times the space underneath the building's base floor can then be used to benefit of the operations on the premises.

- *Considering a future managed retreat away from the Bass River coastline.* A coordinated effort to relocate existing (and future) buildings and operations a greater distance from the banks of the river would be a significant undertaking but could yield substantial results for the entire District. Outreach, communication, and long-term time investment would be needed to advance this initiative.

See Appendix D: Water Surface Elevations and Design Flood Elevations for additional information on projected flood elevations to be considered for the protection of assets within the District. Note that local, state, and/or federal environmental permitting will be required to alter the current ground cover and elevations of delineated wetland resource areas, including existing floodplain extents and riverfront area, and associated buffer zones.

Most of the riverfront properties are privately owned, there needs to be a coordinated joint effort with business owners to come together to implement a mutually agreed upon combination of site resilience measures and a district-wide flood resilience plan for the future.

3.4 CRITICAL INFRASTRUCTURE AND COMMUNITY ASSETS

3.4.1 ASSETS IN THE DISTRICT

The critical infrastructure and community assets in the District are the McPherson Youth Center, Innocenti Park, the Margin Street Stormwater Pump Station, and the utility substation facility. These assets comprise almost half the land area in the entire District. See Figure 3-3: Locations of Critical Infrastructure and Community Assets and Table 3-3: Critical Infrastructure and Community Assets Summary below.

Table 3-3: Critical Infrastructure and Community Assets Summary

Address	Asset	Resources
4 McPherson Drive	McPherson Youth Center	Drop-in style center for boys and girls, ages 11-18. Offers a safe and fun place to gather, billiards, computer lab, video games, air hockey, fitness programs, leagues, and more
4 McPherson Drive	Innocenti Park	Softball field, skate park, basketball courts, riverwalk, park space, and surface parking
Margin Street	Margin Street Stormwater Pump Station	Station electronics, electrical infrastructure, a natural gas generator, upstream alarms, and other sensitive Pump Station infrastructure
44-46 River Street	Utility Substation	Three large buildings, substation infrastructure, smaller outbuildings, and sizeable private parking

3.4.1 DESIGN CONSIDERATIONS

The location of these assets, directly abutting the Bass River, their large amount of land area, and their critical importance to the District, city, and region, make the proposed flood resilience measures for them even more pertinent. The Margin Street Stormwater Pump Station contains station electronics, electrical infrastructure, a natural gas generator, upstream alarms, and other sensitive Pump Station infrastructure. Furthermore, the utility substation is a critical piece of infrastructure at a regional scale which needs to be in continuous operation. Flooding at the McPherson Youth Center and Innocenti Park would eliminate the ability to use the building, softball field, basketball courts, skate park, and parking area.

Figure 3-3
Locations of Critical Infrastructure and Community Assets
Source: Tetra Tech, 2023

In terms of tidal considerations, the entire McPherson Youth Center, Margin Street Stormwater Pump Station, and most of the Innocenti Park parking area will be under the MHHW mark by 2070. Additionally, just over half of the utility substation will be under the MHHW mark by 2070, and even a small area of the site would be under by 2050. By 2070, all four of these assets are projected to experience storm events that flood their entire properties with at least one foot of water. However, in most areas of each asset site, storm events are projected to produce more than four feet of flooding.

The McPherson Youth Center already experiences water at its door during high tides and they use sandbags to keep water from entering the building. However, sometimes flooding of the building does occur when heavy snow storms overlap with high tides. The seawall in this location is aging and needs maintenance to assist in flood prevention. The Executive Director of the Youth Center indicated the City of Beverly has plans to build a new youth center, further setback from the river, perhaps within the next few years. The Design Flood Elevations (DFEs) provided in the Plan will inform the ongoing design of this new community facility. See Appendix D: Water Surface Elevations and Design Flood Elevations for additional information on projected flood elevations to be considered for the protection of assets within the District.

The Margin Street Stormwater Pump station currently has operational challenges during high tides, would be costly to relocate, and has increasing demands due to higher intensity and volume storm events. The utility substation would also be costly to relocate and has had recent significant investments in high voltage transmission lines. The utility company has already started to examine implementing flood hardening measures for this location.

3.4.2 NEXT STEPS

For these critical infrastructure and community assets, several actions could be undertaken to improve the flood resiliency of these resources.

- *Investing in flood hardening measures for each particular asset.* This would include measures such as installing deployable flood panels and barriers, replacing features with flood resistant materials where possible, and elevating vulnerable utility infrastructure and systems.

- *Creating partnerships and seeking grant funding for large-scale District wide resiliency measures.* Storm events which cause flooding may seem like a private property issue, but they are a much broader reaching concern. As such, facilitating property owner collaborations would yield the best solutions for the District and there are numerous state and federal funding opportunities to support these initiatives.

- *Considering relocation of these assets in capital planning efforts moving forward.* The simplest form of protecting any asset is to physically relocate it away any potential sources of harm. In the District, this would involve moving these assets

further inland. This type of an initiative would require extensive community coordination, outreach, time, and funding, but the benefits from this undertaking would be immense and be the most fruitful protection measure of these assets.

3.5 MARINE USES

3.5.1 ASSETS IN THE DISTRICT

The primary marine uses within the District are the Bass Haven Yacht Club, Hill's Yacht Yard, and the boat ramp off of Margin Street. Each of these assets provides access to the Bass River and, from the river, to the Atlantic Ocean through Beverly Harbor. Please see Figure 3-4: Locations of Marine Use Assets and Table 3-4: Summary of Marine Uses below which identifies these resources within the District.

Table 3-4: Summary of Marine Uses

Address	Marine Use	Resources
2 Dock Lane / 10 McPherson Drive	Bass Haven Yacht Club	Boat ramp, yard storage, electrical equipment, a pier with seven attached floats, pressure washing pad, electricity and fresh water hook up, and a 1,100 square foot waterfront clubhouse with a kitchen and restrooms
Margin Street	Boat Ramp off Margin Street	Boat ramp and surface parking
60 R River Street	Hill's Yacht Yard	5,000 square feet of indoor storage, outdoor yard storage, boat repair and maintenance equipment, electrical equipment, and a gantry crane

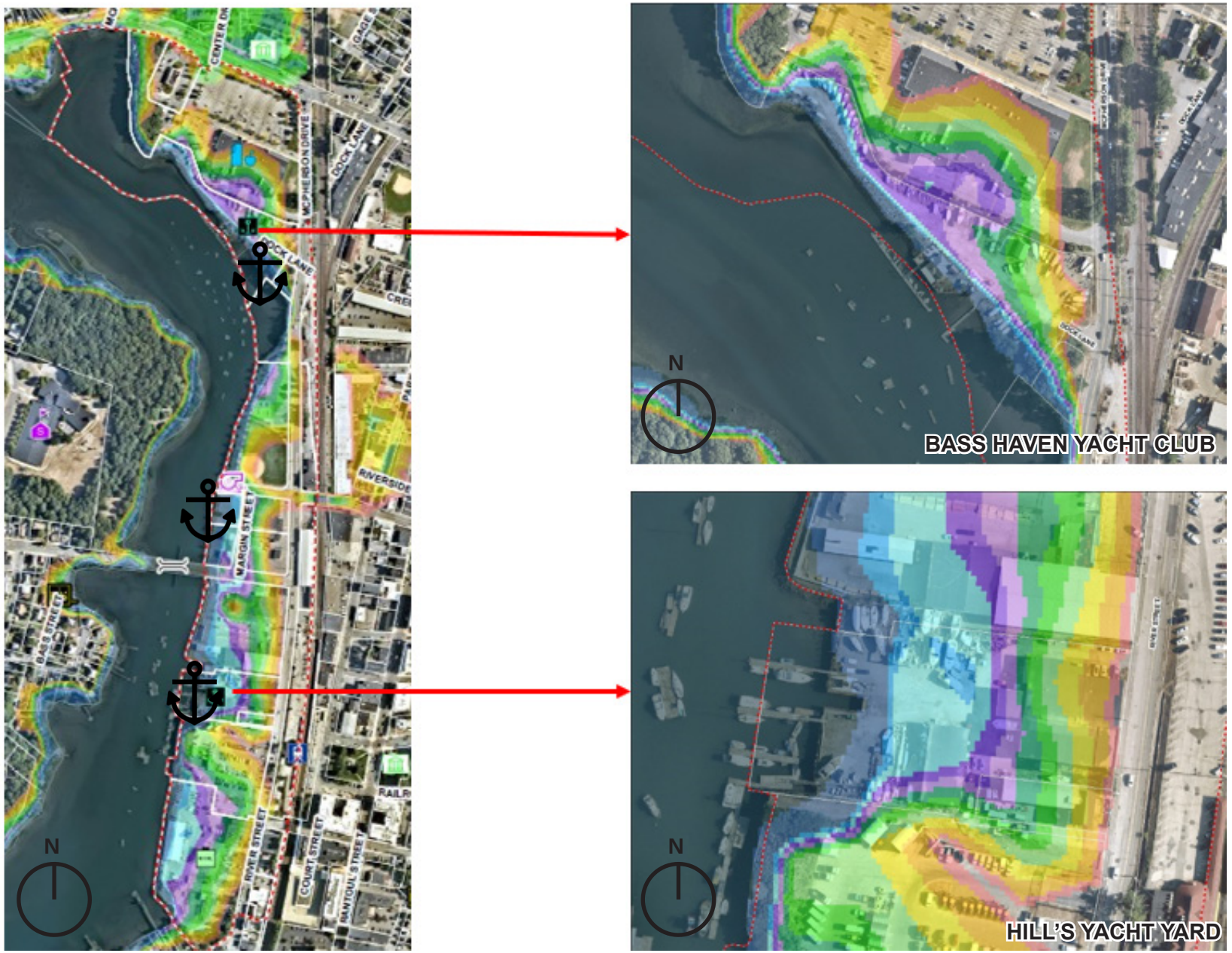


Figure 3-4
Locations of Marine Use Assets
Source: Woods Hole Group, 2023; Tetra Tech, 2023

3.5.2 DESIGN CONSIDERATIONS

Each of these marine uses have an inherent coastal dependency and require direct access to the river, which introduces potential for frequent damage from stronger coastal storms and flood events. While all of the properties within the District are on the front lines of addressing flood resiliency, the symbiotic relationship these particular assets have with the Bass River make their activities fully intertwined with any physical changes to the riverbanks or waterway.

As part of preparing this Resilience Plan, the Beverly Harbor Management Authority (HMA) was interviewed to gain a better understanding of the existing and potential future flooding impacts on the District, as well as these particular marine uses. The HMA supports the City of Beverly on various projects and initiatives that involve waterfront development and use. They also focus on making waterfront access and enjoyment more accessible to all stakeholders in the city. The HMA indicated that during high weather events, the harbor welcomes boats into the Bass River and the Glover Wharf Marina to provide refuge from storms. The HMA indicated they were not aware of a regular plan to move equipment or boats in the river or along the coastline off-site as part of storm preparedness, however, they believed this activity has occurred before.

The HMA also noted they were open to contributing funding (grant matches or direct funds) to investigate further adaptation and preparedness along the Bass River. They are not precluded from supporting private and private/public infrastructure projects that will help maintain the city's river banks and other coastal locations.

There are significant projected future tidal considerations for these marine uses that need to be addressed. The boat ramp and parking area off of Margin Street already experiences substantial flooding as has been seen in recent past storm events. The MHHW marks for all of these uses indicate their existing piers are all projected to experience flooding by 2030. Additionally, other inland areas at these properties are projected to experience flooding by 2050, with substantial impacts being seen at the boat ramp off Margin Street. By 2070, approximately at least 75% of each of these marine uses are projected to see flooding impacts, including the existing buildings at each property (some in their entirety). The Bass Haven Yacht Club and Hill's Yacht Yard may experience storm events that flood the vast majority of their properties with at least five feet of water. These significant flooding impacts are projected to be experienced much earlier by the boat ramp off of Margin Street, which will encounter this level of flood water during events as early as 2050.

3.5.3 NEXT STEPS

With such a strong dependency upon and need for access to the Bass River for these marine uses, increasing their flood resiliency will be challenging and needs to be delicate. Strategies to enhance the flood resiliency of these marine uses could include the following:

- *Developing/Enhancing pre-storm coordination protocols with City of Beverly's Harbormaster's Department*. These procedures prior to storm events can create temporary situations at these marine use properties to protect them from flooding. Since the precautionary measures would only be short term, the properties can be returned to their original, pre-storm state in short order.

- *Enhancing shoreline stability measures, storing essential equipment and fuels in elevated locations, and securing large equipment/objects.* These types of flooding mitigation measures are more permanent and would physically relocate these resources out of harms way of flood events.

- *Investing in physical changes to better protect buildings and stored boats, and use modular infrastructure such as flexible floating docks.* These measures would include installing temporary deployable flood panels and barriers, and replacing features with flood resistant materials where possible. The implementation of floating infrastructure would allow these resources to instantly respond to water level increases during storm events, to a certain extent.

- *Working with the Beverly Harbor Management Authority to identify and apply for funding for further adaptation and preparedness*. A number of state and federal grants, such as those as part of the Hazard Mitigation Assistance Grant Programs or the Flood Mitigation Assistance Grant Program, can be used for projects that reduce or eliminate the risk of repetitive flood damage to infrastructure, buildings, and other resources. The floodproofing or relocation of support buildings and infrastructure, as well as investment in new efficient and adaptable hoist and other marine infrastructure, are potential projects for future grant funding.

Chapter 4

DISTRICT-WIDE FLOOD RESILIENCE STRATEGIES

CHAPTER 4: DISTRICT-WIDE FLOOD RESILIENCE INTERVENTIONS

4.1 INTRODUCTION

In the second half of the process, the project team focused on flood interventions that could be developed to a conceptual level for future pursuits. Flood intervention areas concentrated on near-term opportunities for nature-based solutions along the waterfront, long-term approaches to address significant projected flood depth risk along the riverfront by the end of the century, enhancement of coastal resource areas, elimination of future flood pathways, and other options. The project team used three time horizons (2030/2050/2070) to inform these strategies and interventions based upon the need to phase flood resilience in the District appropriately to react to potential future redevelopment pressures that present opportunities and challenges to District-wide resilience.

The project team developed the nature-based flood intervention concepts on a larger scale to address coastal resource area resilience and adjacent flooding in the District. Wherever feasible, nature-based solutions such as coastal resource area enhancement, vegetative berms, and enhanced open space were integrated into the project. Evaluating environmentally-sensitive approaches to flood mitigation near coastal resource areas is essential to protect the health of the Bass River and its banks. These concepts discuss below would be suitable for future development into design plans at the discretion of the City.

The project team also identified flood pathways within the District and developed flood intervention concepts on a District-wide level that could be implemented at City-owned assets (roadways, parks, etc.). Evaluating District-wide approaches to flood mitigation is essential to protect the critical infrastructure that supports each individual site. These concepts would be suitable for future development into design plans at the discretion of the City. The following four District-wide concept approaches were developed to increase flood resilience: prepare, elevate, revitalize, and buffer. Each of these approaches is discussed in greater detail below.

4.2 FLOOD RISK VULNERABILITIES WITHIN THE DISTRICT

This project examined flood intervention strategies and concepts for an extremely vulnerable area. The strategies derived from this Plan will assist in protecting resources, communities, and ecological systems within the Bass River District from devastating flood-related damages. The Plan incorporates recommended solutions into adaptation strategies on a site typology and District-wide basis given the densely developed and commercialized nature of the District. After analyzing the District, the project team determined the following areas/elements were the most vulnerable to flooding.

Eroded Bank near Elliott Street/Route 62

In the northernmost portion of the District, on the north and east banks of the Bass River, there is significant bank erosion and sparse vegetation adjacent to existing drainage outfalls. These areas need to be improved otherwise future flooding events will continue to erode the bank and possibly bring damage to the adjacent public pathway or even the Elliott Street/Route 62 roadway. This i low-lying area should be revegetated for additional protection. See Figure 4-1, Photo 1: Eroded Bank Near Elliott Street/Route 62.

Narrow Section of the McPherson Drive Right-of-Way

A section of McPherson Drive between the Bass Haven Yacht Club and Innocenti Park immediately abuts the river and exhibits significant bank erosion adjacent to the road and the overhead utility infrastructure. Flooding and stormwater events have the potential to destabilize the roadway and utility infrastructure over time if there is not any intervention to address these items. The strongest flood intervention solution for this situation is realignment of this stretch of roadway to the east which would allow for the expansion in width of the protective bank and vegetative buffer in this area. See Figure 4-1, Photo 2: McPherson Drive Adjacent to Bass River.

Federal Street Underpass

Within the District, two roadways travel underneath the Newburyport/Rockport Line Commuter Rail tracks. One of those roadways is Federal Street near its intersection with McPherson Drive/River Street. Currently, there is stormwater flooding risk at this location and there is a trigger for the Margin Street Pump Station located at the existing catch basins in this area. Height clearance considerations are also a factor at this underpass. Consideration should be given to raising the roadways approaching the Federal Street underpass, including Margin Street, in coordination with any redevelopment of the 100 River Street property. See Figure 4-1, Photo 3: Federal Street Underpass.

Pleasant Street Underpass

The other roadway which passes underneath the Newburyport/Rockport Line Commuter Rail tracks is Pleasant Street between its intersections with River Street and Park Street. Current stormwater flooding risk and height clearance considerations are present for this underpass as well. During storm events, flooding of this underpass will limit vehicular and emergency access on River Street and Pleasant Street. This roadway also should be considered for elevation at/around its intersection at River Street in coordination with the utility company's substation to the west. See Figure 4-1, Photo 4: Pleasant Street Underpass.

Photo 1: Eroded Bank near Elliott Street/Route 62

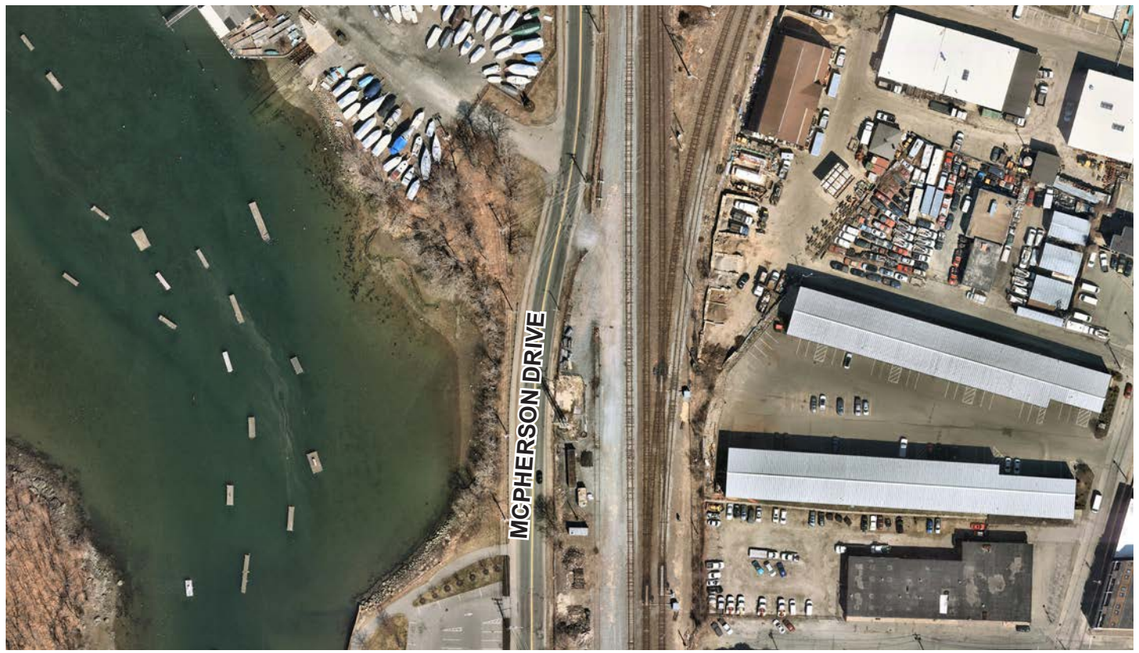


Photo 2: McPherson Drive Adjacent to Bass River

Photo 3: Federal Street Underpass

Photo 4: Pleasant Street Underpass

Figure 4-1
Flood Risk Vulnerabilities
Source: Tetra Tech, 2022; Google, 2022; Nearmap, 2023

4.3 APPROACHES TO DISTRICT-WIDE FLOOD RESILIENCE

It is abundantly clear that properties and infrastructure along the Bass River are currently at risk of flooding. In Chapter 3, this Plan looked at site-level strategies to minimize near-term flooding and implement minor coastal resource area restoration. This specific section of this chapter examines long-term district-wide flood intervention methods and recommends the following protections and strategies where practical.

Harden Shoreline Protections – Restore seawalls and revetments, prevent inundation at stormwater outfalls, raise/elevate roadways, install storm surge barriers and bulkheads.

Soft Shoreline Protections – Construct rain gardens, and living shorelines, revegetate coastal banks, increase stabilized permeable land cover

Hybrid Protections – These are combinations of structural/hard and natural/soft flood resilience measures. One example would be a flood barrier wall for significant coastal storm surge protection with adjacent nature-based solutions for wave attenuation.

The next sections of this chapter examine both near-term and long-term District-wide flood resilience interventions along the Bass River by breaking down proposed actions into four types of approaches: prepare, elevate, revitalize, and buffer.

4.4 "PREPARE THE DISTRICT" APPROACH

This approach recommends taking steps to prepare various buildings, pieces of infrastructure, and different properties in the District to be more resilient against future flood events. The project team determined these actions should be taken before 2050 to ensure their effectiveness and produce the greatest benefit to the District as a whole.

- *Identify adaptation measures for current land uses*. A variety of actions at properties abutting the Bass River can be taken to make the uses at those sites more flood resilient.

    - Temporary relocation of equipment and vehicles: At the utility substation, lumber yard, and car wash, relocate materials, stored goods, equipment, and especially vehicles before high tides and significant storm events. At the Bass Haven Yacht Club, relocate boats and equipment in advance of these events as well.

    - Relocate vulnerable facilities*:* Permanently relocate the existing building with residential units at the River House to a setting outside of the District by 2050. The City actively plans to rebuild the McPherson Youth Center away from the river closer to McPherson Drive and elevate the building to reduce flood risk. The plan to relocate and elevate the building is a direct and tangible result of this study.

    - Formalize public access points to the river*:* Access paths should be provided to the river off of the public walkway on the eastern bank of the river near Elliott Street/Route 62 to reduce the negative impact of informal foot traffic on bank erosion and vegetation and encourage public use of the intertidal area for recreation.

Other adaption measures can likely be implemented at each of these properties depending upon the willingness of the property and/or business owners.

- *Consider storm preparedness measures along Bass River properties*.

    - Floodproof buildings: In addition to adaptation measures, storm preparedness measures can be taken at many properties in the District, including the two buildings closest to the riverbank at the utility substation, the rear-most, or rear-most portions of, buildings at Hill's Yacht Yard and the lumber yard, and the Margin Street Pump Station. Depending on the use of the building, wet floodproofing (use of flood-resilient interior materials, protection of service equipment, etc.) or dry floodproofing techniques (installation of flood barrier panels and other products at vulnerable entry points to the building) may be employed.

    - Maintain coastal infrastructure: Coastal infrastructure is subject to degradation due to routine exposure to salt water conditions. Maintenance, including replacing of sealants/coatings on wall surfaces, and/or repair of damaged sections of the sea

wall along Hill's Yacht Yard and Innocenti Park should also be conducted. Similarly, the revetment along the riverbank of the lumber yard and the boat ramp off of Margin Street should also be inspected and repaired as needed.

- Coastal bank stabilization: Stabilize the coastal banks along the section of McPherson Drive which directly abuts the river and along the eastern riverbank in the northern most section of the District near Elliott Street/Route 62. The banks should be regraded to achieve a gentler slope and remove invasive trees, nourished with beach compatible sediment, stabilized with a coir erosion control blanket, and planted with salt-tolerant, native grasses.

- *Incorporate anticipated Bridge Street roadway modifications*. In the near future, the Hall-Whitaker Bridge will be completed reconstructed. Given this area of the District between Margin Street and the riverbank already experiences significant flooding, Bridge Street should be elevated further between the bridge structure and River Street. The increased elevation of Bridge Street on the east side of the bridge will need to be coordinated with and tied into the plans to reconstruct the bridge. Elevation changes may also need to be conducted to Margin Street in order to tie into a newly elevated Bridge Street. Elevating Bridge Street would help minimize the number of storm events in which the roadway is overtopped by flooding.

See Figures 4-2: Prepare the District - South of the Bridge and 4-3: Prepare the District – North of the Bridge.

PREPARE THE DISTRICT
SOUTH OF THE BRIDGE

FLOODPROOF BUILDINGS

RELOCATE STORAGE & VEHICLES DURING HIGH TIDES/STORMS

RESTORE PLANTINGS TO ENHANCE NATURAL BUFFER

MAINTAIN SEA WALL

MAINTAIN REVETMENT

RELOCATE MATERIALS & EQUIPMENT DURING HIGH TIDES/STORMS

RAISE BRIDGE ST TO MARGIN ST

MEAN HIGHER HIGH WATER LINE (CIRCA 2070 OR LATER) APPROX. ELEVATION 9.4

1% ANNUAL CHANCE FLOOD EXTENT (CIRCA 2050 OR LATER) APPROX. ELEVATION 11.6

1% ANNUAL CHANCE FLOOD EXTENT (CIRCA 2070 OR LATER) APPROX. ELEVATION 13.5

EXISTING SUPPORTIVE HOUSING USE ANTICIPATED TO BE RELOCATED

FLOODPROOF BUILDINGS

BRIDGE STREET

MARGIN STREET

RIVER STREET

PLEASANT STREET

+7 +8 +9 +11 +16 +13 +10 +14

GOALS OF "PREPARE THE DISTRICT" Flood Intervention

- Identify adaptation measures for current land uses.
- Consider storm preparedness measures along Bass River properties.
- Incorporate anticipated Bridge St roadway modifications.

Figure 4-2
Prepare the District - South of the Bridge
Source: Tetra Tech, 2023

PREPARE THE DISTRICT
NORTH OF THE BRIDGE

MEAN HIGHER HIGH WATER LINE
APPROX. ELEVATION 9.4
(CIRCA 2070 OR LATER)

ACCESS PATH TO RIVER

STABILIZE
COASTAL BANKS

RELOCATE VEHICLES
DURING HIGH TIDES
& STORMS

MAINTAIN REVETMENT

FLOODPROOF
PUMP STATION

MAINTAIN SEA WALL

RELOCATE BOATS AND
EQUIPMENT DURING
HIGH TIDES & STORMS

STABILIZE
COASTAL BANK

RESILIENT REBUILD OF
MCPHERSON YOUTH CENTER

1% ANNUAL CHANCE FLOOD EXTENT
(CIRCA 2070 OR LATER)
APPROX. ELEVATION 13.5

1% ANNUAL CHANCE FLOOD EXTENT
(CIRCA 2050 OR LATER)
APPROX. ELEVATION 11.6

BRIDGE STREET
MARGIN STREET
MCPHERSON DRIVE
FEDERAL STREET
ELLIOTT STREET/ROUTE 62

+13 +8 +7 +9 +10 +8 +9 +10 +11.6 +7 +13 +14 +13 +13 +13 +11 +9 +10

GOALS OF "PREPARE THE DISTRICT" Flood Intervention

- Identify adaptation measures for current land uses.
- Consider storm preparedness measures along Bass River properties.
- Incorporate anticipated Bridge St roadway modifications.

Figure 4-3
Prepare the District - North of the Bridge
Source: Tetra Tech, 2023

4.5 "ELEVATE THE DISTRICT" APPROACH

A second approach to flood resilience in the District is through elevating different elements, including raising sites and roads. The recommended actions under this approach are longer term in nature and should be completed at or near the year 2050 to ensure their effectiveness.

- *Identify resilient design approaches to elevate occupiable building spaces and critical utilities in redevelopment sites.* Around the utility substation's infrastructure, it is anticipated that a new perimeter flood barrier will be installed along with a new retaining wall to protect existing and upgraded substation infrastructure. For underutilized properties, such as the area bounded by River Street, Federal Street, Margin Street, and Bridge Street, any redevelopment of these sites should include a flood resilient design approach that elevates occupiable building spaces and building utility equipment above projected flood elevations, limits storage of vehicles and other materials in flood risk areas to the extent feasible and encourages a landscaped buffer to the river.

- *Adapt existing coastal infrastructure for rising sea levels.* Raise/rebuild the sea wall along the riverbank of Hill's Yacht Yard and modify the hoist equipment at this business to extend the marine use of this site. Extend the revetments at the rear of the lumber yard, car wash, and boat ramp deeper inland and raise them to approximately Elevation 10 feet or higher (NAVD88) to protect existing businesses. Maintain and repair (as needed) the sea wall along Innocenti Park, which is starting to show signs of deterioration and needed investment to maintain flood resilience at the park. The salt marsh areas north of the Hall-Whitaker Bridge should also be restored. These marshes are found near the south end of the Bass Haven Yacht Club and along the eastern riverbank near Elliott Street/Route 62.

- *Incorporate anticipated Bridge Street roadway modifications.* As part of the work occurring to reconstruct the permanent span of the Hall-Whitaker Bridge, Bridge Street should be elevated further between the bridge and River Street. The increased elevation of Bridge Street on the east side of the bridge will need to be coordinated with and tied into the plans to reconstruct the bridge. In addition, this approach also recommends the raising of Federal Street between Margin Street and River Street.

Note that local, state, and/or federal environmental permitting will be required to alter the current ground cover and elevations of delineated wetland resource areas, including existing floodplain extents and riverfront area, and associated buffer zones.

See Figures 4-4: Elevate the District - South of the Bridge and 4-5: Elevate the District – North of the Bridge.

ELEVATE THE DISTRICT
SOUTH OF THE BRIDGE

MEAN HIGHER HIGH WATER LINE
APPROX. ELEVATION 9.4
(CIRCA 2070 OR LATER)

PROTECT UTILITY INFRASTRUCTURE WITH PERIMETER FLOOD BARRIER

FLOODPROOF/ RELOCATE EXISTING STORAGE FACILITY

RELOCATE STORAGE AND VEHICLES DURING HIGH TIDES/STORMS

RAISE SEA WALL

MODIFY HOIST EQUIPMENT

RELOCATE STORAGE DURING STORMS

EXTEND REVETMENT

RAISE BRIDGE & MARGIN STREETS

FLOODPROOF EXISTING BUILDINGS

1% ANNUAL CHANCE FLOOD EXTENT
(CIRCA 2050 OR LATER)
APPROX. ELEVATION 11.6

ADD RETAINING WALL

1% ANNUAL CHANCE FLOOD EXTENT
(CIRCA 2070 OR LATER)
APPROX. ELEVATION 13.5

FLOODPROOF EXISTING BUILDINGS

BRIDGE STREET

RIVER STREET

PLEASANT STREET

+7 +8 +9 +9 +10 >15 +10 +13.5 +11 +16

GOALS OF "ELEVATE THE DISTRICT" Flood Intervention

- Identify resilient design approaches to elevate occupiable building spaces and critical utilities in redevelopment sites.
- Adapt existing coastal infrastructure for rising sea levels.
- Incorporate anticipated Bridge St roadway modifications.

Figure 4-4
Elevate the District - South of the Bridge
Source: Tetra Tech, 2023

ELEVATE THE DISTRICT
NORTH OF THE BRIDGE

MEAN HIGHER HIGH WATER LINE
APPROX. ELEVATION 9.4
(CIRCA 2070 OR LATER)

SALT MARSH RESTORATION AREAS

RELOCATE BOATS AND EQUIPMENT DURING HIGH TIDES/STORMS

FLOODPROOF EXISTING PUMP STATION

EXTEND REVETMENT

RAISE FEDERAL STREET BETWEEN MARGIN AND RIVER STREETS

MAINTAIN SEA WALL

SALT MARSH RESTORATION AREA

BRIDGE STREET

MARGIN STREET

MCPHERSON DRIVE

FEDERAL STREET

ELLIOTT STREET/ROUTE 62

>15 +10 +13.5 +9 +8 +10 +12 +11.6 +7 +11 +9 +10 +13 +14 +9 +13 +13

1% ANNUAL CHANCE FLOOD EXTENT
(CIRCA 2050 OR LATER)
APPROX. ELEVATION 11.6

1% ANNUAL CHANCE FLOOD EXTENT
(CIRCA 2070 OR LATER)
APPROX. ELEVATION 13.5

SITE REDEVELOPMENT WITH RESILIENT DESIGN APPROACH

GOALS OF "ELEVATE THE DISTRICT" Flood Intervention

- Identify resilient design approaches to elevate occupiable building spaces and critical utilities in redevelopment sites.
- Adapt existing coastal infrastructure for rising sea levels.
- Incorporate anticipated Bridge St roadway modifications.

Figure 4-5
Elevate the District - North of the Bridge
Source: Tetra Tech, 2023

4.6 "REVITALIZE THE DISTRICT" APPROACH

This approach recommends the most significant physical changes and alterations across the Bass River District. Naturally, these types of actions take significant amounts of planning, effort, coordination, and time. As such, these recommended actions are much longer-term flood interventions and should be considered for any proposed significant redevelopment or capital investment in the District.

- *Align development with River Street/McPherson Drive to promote flood resilience with a natural buffer to the river.* Both the McPherson Youth Center and Margin Street Pump Station would be relocated eastward to be adjacent to McPherson Drive. Redevelopment adjacent to the roadway should promote flood resilience with a natural buffer to the river as part of this approach. Additionally, the increased opportunity for public access through the implementation of Ch. 91 regulations as riverfront properties are invested in for future redevelopment can supplement this resilience planning approach. Additionally, it is anticipated that the major infrastructure area of the utility substation would be redesigned and elevated as part of future capital investments. The sea wall long the rear of Hill's Yacht Yard and Innocenti Park would need to be rebuilt to maintain the stabilized riverfront. The eastern riverbank in the northernmost section of the District near Elliott Street/Route 62 would also be stabilized as part of this goal.

- *Encourage public open space and access along the Bass River.* For a nature-based solution as part of this approach, a large floodable vegetated passive park space could be implemented along the riverbank from Hill's Yacht Yard in the south to the northmost point of the Bass Haven Yacht Club. This 25-50 foot depth of vegetated space would be sloped upward from coastal infrastructure at approximate Elevation 12.5 (NAVD88) feet. The reconstruction and reconfiguration of Innocenti Park would include recreational space within the park would be elevated to El 14.5 (NAVD88) or higher to provide further flood resiliency.

- *Incorporate anticipated future transportation infrastructure.* Significant changes to the transportation infrastructure in the District would occur under this goal. McPherson Drive would be relocated eastward adjacent to the Newburyport/Rockport Line Commuter Rail tracks and raised to approximate El. 14.5 (NAVD88) or higher. However, this elevation increase would taper down slightly as the roadway approached the Federal Street intersection. The south side of this intersection, which turns into River Street, would also be raised as well. The stretch of River Street in front of the utility substation in the southern portion of the District would be elevated just over El. 12.5 (NAVD88). This would necessitate the elevation of a section of Pleasant Street which intersects River Street in this location. As discussed earlier, Bridge Street would also be elevated to El. 15 (NAVD88) or higher and this should be coordinated as part of the Hall-Whitaker Bridge reconstruction. Retaining walls would be needed on the south side of Bridge Street and a section of Margin Street. While one portion of Margin Street would also be raised to align with this elevation change of Bridge Street,

the northern portion of Margin Street would be eliminated in its entirety. This newly found developable space would allow for increased flood resiliency and redevelopment options in this area.

Note that local, state, and/or federal environmental permitting will be required to alter the current ground cover and elevations of delineated wetland resource areas, including existing floodplain extents and riverfront area, and associated buffer zones.

See Figures 4-6: Revitalize the District - South of the Bridge and 4-7: Revitalize the District – North of the Bridge. See Figures 4-8 through 4-10 for additional renderings of the Revitalize the District vision for a transformed Innocenti Park in the District.

REVITALIZE THE DISTRICT
SOUTH OF THE BRIDGE

MEAN HIGHER HIGH WATER LINE
APPROX. ELEVATION 9.4
(CIRCA 2070 OR LATER)

1% ANNUAL CHANCE FLOOD EXTENT
WITH 2.5 FT SEA LEVEL RISE
(CIRCA 2050 OR LATER)

1% ANNUAL CHANCE FLOOD EXTENT
WITH 4.3 FT SEA LEVEL RISE
(CIRCA 2070 OR LATER)

REDESIGNED/ ELEVATED
UTILITY SUBSTATION

REBUILD SEA WALL

RELOCATE
STORAGE
DURING
STORMS

EXTEND
REVETMENT

ELEVATE RIVER STREET

RETAINING WALLS

BRIDGE STREET

RIVER STREET

PLEASANT STREET

+8 +13.5 +9 +12.8 +12.5 +>15 +12.5 +12.5 +12.6 +16 +15 +15 +14

GOALS OF "REVITALIZE THE DISTRICT" Flood Intervention

- Align development with River Street/McPherson Drive to promote flood resilience with natural buffer to the river.
- Encourage public open space and access along the Bass River.
- Incorporate anticipated future transportation infrastructure.

Figure 4-6
Revitalize the District - South of the Bridge
Source: Tetra Tech, 2023

REVITALIZE THE DISTRICT
NORTH OF THE BRIDGE

MEAN HIGHER HIGH WATER LINE
APPROX. ELEVATION 9.4
(CIRCA 2070 OR LATER)

INCREASED RIVERFRONT PUBLIC ACCESS AND NATURE-BASED SOLUTIONS

ACCESS POINT TO THE RIVER

ELIMINATE PORTION OF MARGIN STREET

FLOODABLE VEGETATED PASSIVE PARK SPACE

REBUILD REVETMENT

REBUILD SEA WALL

ELEVATED RECREATIONAL PARK SPACE

BRIDGE STREET

MARGIN STREET

MCPHERSON DRIVE

ELLIOTT STREET/ROUTE 62

FEDERAL STREET

1% ANNUAL CHANCE FLOOD EXTENT
(CIRCA 2050 OR LATER)
APPROX. ELEVATION 11.6

1% ANNUAL CHANCE FLOOD EXTENT
(CIRCA 2070 OR LATER)
APPROX. ELEVATION 13.5

RAISE ROADS APPROACHING FEDERAL STREET UNDERPASS

RESILIENT REBUILD OF MARGIN STREET PUMP STATION

RELOCATED MCPHERSON DRIVE

GOALS OF "REVITALIZE THE DISTRICT" Flood Intervention

- Align development with River Street/McPherson Drive to promote flood resilience with natural buffer to the river.
- Encourage public open space and access along the Bass River.
- Incorporate anticipated future transportation infrastructure.

Figure 4-7
Revitalize the District - North of the Bridge
Source: Tetra Tech, 2023

Figure 4-8
Revitalize the District Rendered View
Source: Tetra Tech, 2023

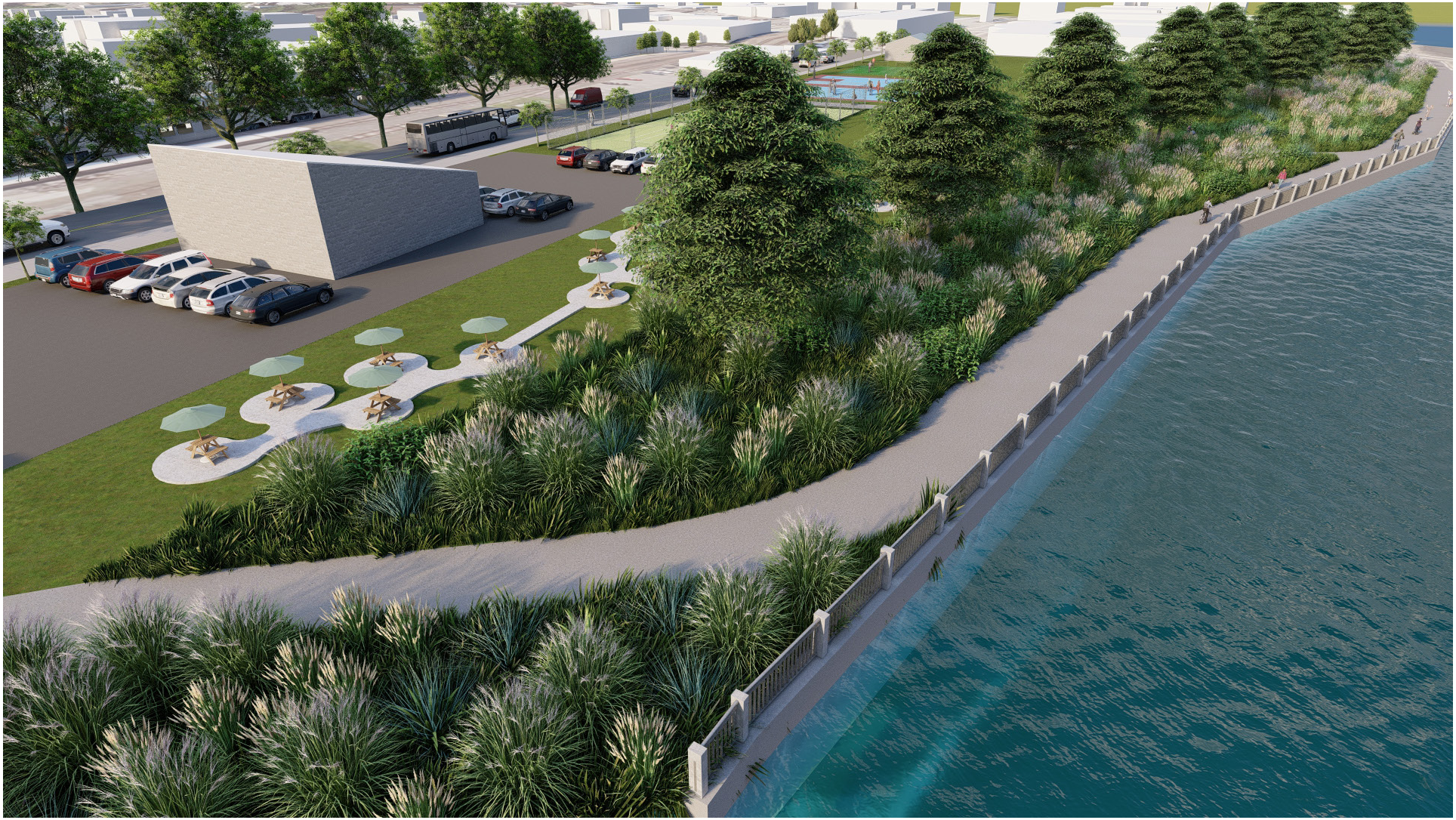


Figure 4-9
Revitalize the District Rendered View
Source: Tetra Tech, 2023

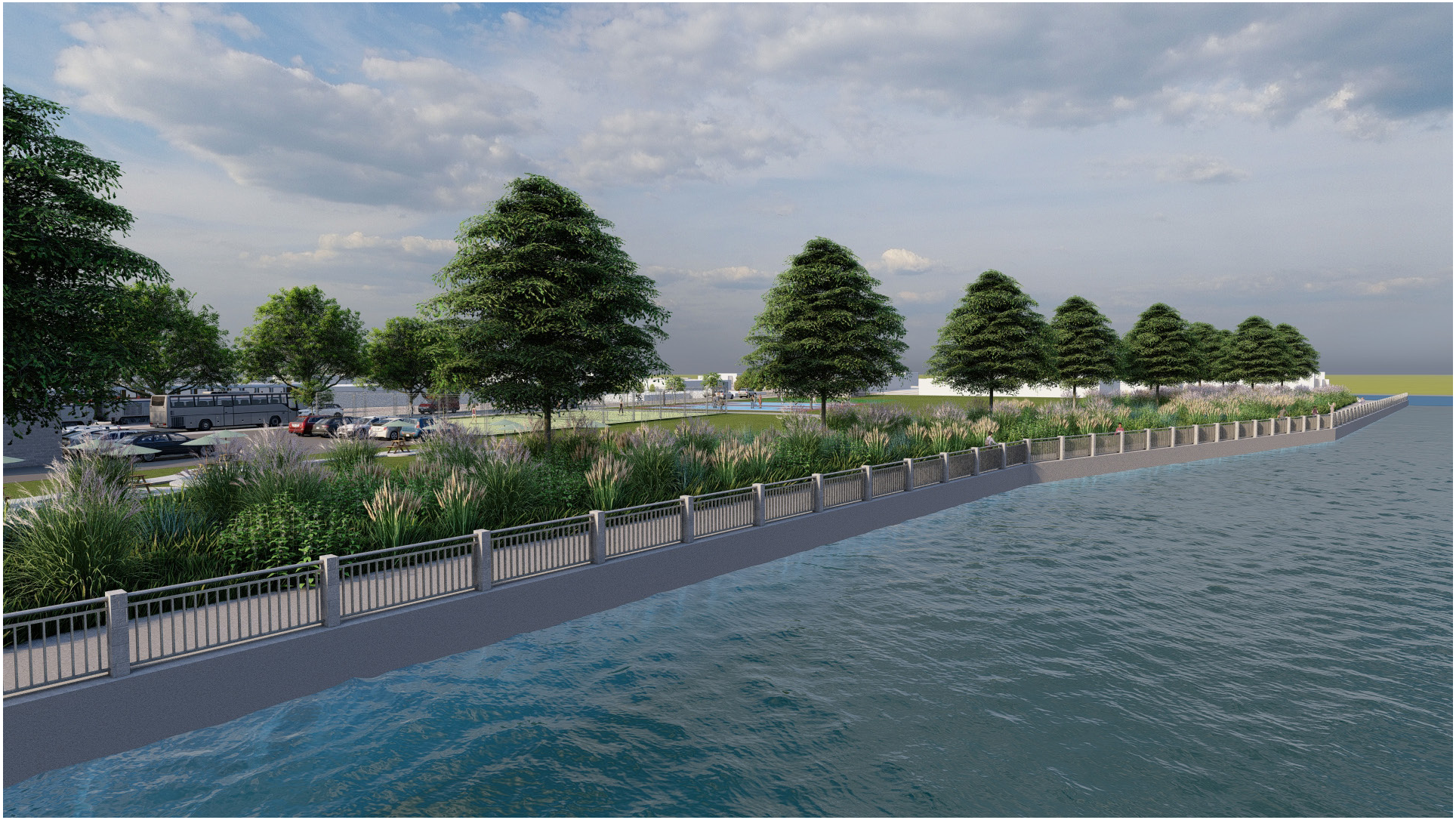


Figure 4-10
Revitalize the District Rendered View
Source: Tetra Tech, 2023

4.7 "BUFFER THE DISTRICT" APPROACH

In this final recommended approach, the flood resilience actions implement nature-based solutions within the Bass River District. In doing so, the approach strives to enhance the existing coastal resource areas within the District. This means the focus of the approach is entirely located north of the Hall-Whitaker Bridge where these coastal resource areas are presently located. The timeframe of these actions would be near- to longer-term depending on environmental permitting, funding, capacity, and site control constraints. Some actions will not be achievable until sea level rises to a level that provides suitable conditions for wetland habitats to migrate upland.

- *Enhance existing coastal resource areas along the Bass River.* To achieve this goal, create a living shoreline that would stretch from the north end of Innocenti Park to the north end of the District at Elliott Street/Route 62. A living shoreline is a protected, stabilized coastal edge made of natural materials such as plants, sand, or rock. Additional space along the riverbank also needs to be created to enhance these coastal resources which will assist with increasing flood resiliency. Finally, provide formal access paths or structures to the river from the public walkway on the eastern bank of the river near Elliott Street/Route 62.

- *Restore coastal banks as a buffer to erosion and sediment supply for seaward wetlands.* Restore and stabilize coastal banks using methods described in "Prepare the District" to address erosion, not only to protect critical roadways from damage, but also the waterfront trail between Bass Haven Yacht Club and Elliott Street/Route 62 which provides an important recreational service. As sea level rises, the existing beach and salt marsh seaward of the bank will be increasingly inundated and eventually transition to less productive wetlands unless they are able to build up sediment, naturally or through restoration. Erosional forces are likely to increase with higher sea levels and more intense storms. The seaward beach and salt marsh would benefit from the natural erosion of clean beach compatible sediments from the restored bank compared to the industrial debris the bank is currently supplying. Industrial debris should be removed from the beach and replaced with clean sediment as part of the bank restoration process. Maintaining the restored banks by adding additional sediment from time to time will both be necessary and help the beach and salt marsh adapt to sea level rise. This strategy is permittable under existing environmental regulations and should therefore be implemented in the near-term.

- *Restore existing salt marsh.* Salt marshes buffer the shoreline from waves and erosion, while also improving water quality and providing habitat for fish and wildlife – essential elements of a resilient District. There are only a few small areas of salt marsh in the District, and all of them exhibit signs of stress, including erosion of peat platforms and vegetation die-back due to low peat platforms and increasing tide levels. Existing peat platforms are restored to productive salt marshes by adding sand to the denuded platforms, installing natural fiber logs and blankets to

stabilize the sand and platform, and planting salt marsh vegetation. This strategy requires maintenance, particularly if storms dislodge the fiber elements or vegetation does not establish due to the platform not being sufficiently elevated. It is permittable under existing environmental regulations and should be implemented in the near-term to avoid further loss of salt marsh. Once salt marsh fully converts to another type of wetland, it will be more difficult to permit restoration under existing regulations.

- *Create spaces for salt marsh to migrate upland.* Salt marsh plants will naturally migrate into relative flat, low-lying areas, upland of existing marsh habitat as sea level rises. However, steep topography or, more often, adjacent development and infrastructure will prevent migration from occurring. Squeezed between rising tides and developed shorelines, marshes will eventually drown and transition to other less productive wetland types. Assisting migration includes protecting migration opportunity areas from development and infrastructure expansion, moving existing development and infrastructure away from opportunity areas, and eventually preparing the land and planting for habitat formation. Opportunity areas for marsh migration landward of existing salt marsh include the low-lying area at the north end of the Bass Haven Yacht Club yard and the undeveloped parcel at the south end of the yard abutting McPherson Drive. This approach also calls for a coastal beach restoration area to be implemented along approximately half of the riverbank upland area where the Bass Haven Yacht Club is located and to formalize a resilient riverfront access point for marine users. The area along McPherson Drive has a higher elevation but could be excavated and regraded to a suitable elevation. As was discussed in an earlier approach, relocating McPherson Drive eastward adjacent to the Newburyport/Rockport Line Commuter Rail tracks would create a large, gradually sloping buffer area in which a range of natural shoreline habitats, including salt marsh, could be established. These actions are permittable under existing environmental regulations. However, salt marsh will not establish in areas that are not flooding regularly, so the implementation timeframe is long-term.

- *Expand coastal resource areas through the creation of new living shorelines/salt marsh areas to provide buffer.* There are intertidal areas along the Elliott Street/Route 62 embankment and south along the waterfront trail embankment to Bass Haven Yacht Club that are currently other coastal wetland types but could support new or expanded living shoreline. These would be established be reconstructing existing rock sills or constructing new ones to retain added sediment for new marsh platforms, blanketing with natural fiber blankets, and planting salt marsh vegetation. These actions would involve constructing new coastal engineering structures (rock sills) in coastal beach resources areas, converting coastal beach to salt marsh, and potentially impact existing rocky intertidal shores, which is challenging to permit under existing environmental regulations. However, there are currently several legislative and advocacy efforts underway to create

permitting pathways for these types of actions . Implementation of these strategies is therefore a longer-term action.

The actions outlined in this approach would be work in concert to create a continuous natural buffer to waves and erosion as well as create ecological resilience and the social and economic benefits that go along with it across the entire northern section shoreline of the District.

See Figure 4-11: Buffer the District - North of the Bridge. See Figures 4-12 through 4-13 for additional renderings of the Buffer the District vision for a transformed riverfront.

BUFFER THE DISTRICT
NATURE-BASED SOLUTIONS

MEAN HIGHER HIGH WATER LINE
APPROX. ELEVATION 9.4
(CIRCA 2070 OR LATER)

ACCESS PATH TO RIVER

LIVING SHORELINE AREA

COASTAL BEACH
RESTORATION AREA

BRIDGE STREET

MARGIN STREET

ELLIOTT STREET/ROUTE 62

MCPHERSON DRIVE

FEDERAL STREET

+8 +7 +9 +9 +8 +10 +9 +9 +13 +14.4 +13 +13 +10

1% ANNUAL CHANCE FLOOD EXTENT
WITH 4.3 FT SEA LEVEL RISE
(CIRCA 2070 OR LATER)

1% ANNUAL CHANCE FLOOD EXTENT
WITH 2.5 FT SEA LEVEL RISE
(CIRCA 2050 OR LATER)

RELOCATED
MCPHERSON
DRIVE

GOALS OF "BUFFER THE DISTRICT" Flood Intervention

- Enhance existing coastal resource areas along the Bass River.
- Address existing erosion issues on the coastal riverbanks.
- Expand coastal resource areas through creation of living shorelines/salt marsh restoration areas to provide buffer.

Figure 4-11
Buffer the District - North of the Bridge
Source: Tetra Tech, 2023

Figure 4-12
Buffer the District Rendered View
Source: Tetra Tech, 2023

Figure 4-13
Buffer the District Rendered View
Source: Tetra Tech, 2023

Chapter 5

PUBLIC INVOLVEMENT AND COMMUNITY ENGAGEMENT

CHAPTER 5: PUBLIC INVOLVEMENT AND COMMUNITY ENGAGEMENT

5.1 INTRODUCTION

Public and stakeholder outreach and engagement was a critical aspect of this Plan, including interviews, public meetings, robust public education, hands-on social connections to the community, and engagement with local businesses on infrastructure resilience. This chapter provides information on the public informational meetings and events held to gather feedback to shape the outcomes of this Plan. Additionally, the chapter describes how community partners supported the City in promoting environmental stewardship along the Bass River by organizing community riverfront cleanups and other events to promote awareness of this coastal riverine environment and the adjacent District.

5.2 PUBLIC INFORMATIONAL MEETINGS

Two community-wide public forums were held on March 21, 2023, and June 13, 2023, respectively. The first public forum was held via Zoom from 6:00 PM to 7:30 PM. The second forum was held in person at the Beverly Police Station from 7:00 PM to 8:30 PM. The two meetings were publicized across the entire community using Salem Sound Coastwatch SoundNet mailing list and social media outlets, as well as the City of Beverly's event calendar and social media outlets. Both events had representatives from the City of Beverly, Salem Sound Coastwatch, and the consultant team as panelists. Attendees at the forums were presented with the PowerPoint presentations and received information from the panelists. Public participants also had opportunities to engage with the material and panelists through live survey poll questions and a question and answer session held at the end of each forum.

Following the completion of each public forum, the presentations and recordings of the meetings were posted on the BevCam Government YouTube page and the City of Beverly project webpage to allow community members to access the information anytime. See Appendix F for the presentation slides from the March 22, 2023 public forum. See Appendix G for the presentation slides from the June 13, 2023 public forum.

The first public forum included a discussion of the Project Focus Area, Existing Conditions, Increase in Tidal Flooding Incidents, Growing Flood Risk in the Bass River District, Future Flood Risk for Coastal Storms, Coastal Resource Areas, Existing Land Use Categories, Margin Street Stormwater Pumping Station and Infrastructure, Bass River Clean Up, Walk and Talk Event, Ongoing Stakeholder Interviews, and Next Steps with an aerial video of the District and polling questions to engage with the audience. See Table 5-1: Public Forum #1 Public Polling Questions below for more information.

Table 5-1: Public Forum #1 Public Polling Questions

Polling Question	Question
Question 1	What Ward do you live or work in?
Question 2	How often do you pass through the Bass River District?
Question 3	Have you seen or been impacted by flooding in the Bass River District?
Question 4	What activities do you do in the Bass River District?

The second public forum was held in the Beverly Police Station Community Room on Elliot Street/Route 62, across the street from the north end of the District. The forum began with a 30-minute site visit in which members of the consultant team, City staff, and Salem Sound Coastwatch took attendees across the street to the project site. During the site walk, a representative from Woods Hole Group led a discussion on the coastal resources in the area and their vulnerabilities.

The presentation covered the Project Focus Area, Coastal Resource Areas North of the Bridge, Increase in Tidal Flooding Incidents, Growing Flood Risk in the Bass River District, Future Flood Risks from Coastal Storms, Site Level Flood Resilience Strategies, Options for Site Level Flood Resilience, Prepare the District – North and South of the Bridge, Elevate the District – North and South of the Bridge, Margin Street Stormwater Pump Station, Revitalize the District – North and South of the Bridge, Providing Multiple Rendered Views, Buffer the District – Nature-Based Solutions, and explaining the coastal resource areas. The question and answer session covered questions about funding streams, how stakeholders can use data from the study, flooding events and their impacts, salt marsh restoration, and other nature-based avenues.

5.3 STAKEHOLDER INTERVIEWS

The nonprofit organization Salem Sound Coastwatch spearheaded the stakeholder interview process conducted between February 2023 and June 2023. Interviews were used to identify and engage with a range of stakeholders within the District, and to receive feedback on the experiences and operations of day-to-day users of the area. Nine businesses participated in the interviews and were asked eight questions developed to prompt open discussion on the Bass River District's resiliency. See Table 5-2: Stakeholder Interviews Conducted and Table 5-3: Stakeholder Interview Questions below.

Table 5-2: Stakeholder Interviews Conducted

Organizations Represented	Interview Date
Salem Plumbing Supply	March 9, 2023
Beverly YMCA/ McPherson Youth Center	March 13, 2023
Moynihan Lumber of Beverly INC	March 16, 2023
Bass Haven Yacht Club	May 19, 2023

Organizations Represented	Interview Date
Beverly Car Wash	May 19, 2023
Parlee Cycles	May 19, 2023
Hill's Yacht Yard	May 19, 2023
Advanced Ceramic Coating	May 19, 2023
Ownership Group for 60 River Road	May 22, 2023

Table 5-3: Stakeholder Interview Questions

Order	Question
1	How long has your business been in the Bass River District?
2	Do you have concerns about flooding? What are they?
3	What flooding impacts or storm damage have you experienced here?
4	Do you have any records, such as photos, of flooding that has affected your business? If yes, are you willing to share these?
5	Where do you see your business located in 5 years? 20 years? Is potential flooding a factor in these plans?
6	Have you thought or made plans about how you can prepare your business for flooding? If yes, what are you planning?
7	Do you have any ideas about solutions to reduce the impacts of flooding in the Bass River District?
8	Is there anything else you would like to share?

5.4 PUBLIC EDUCATION & OUTREACH EVENTS

The study team implemented multiple unique stakeholder engagement strategies to educate community members on the threats to and resiliency of the Bass River District and how it will respond to the impacts of climate change. Beyond the two public forums and the stakeholder interviews, Salem Sound Coastwatch led two Bass River clean-up events, a free Walk & Talk guided tour, and a free paddling event. The variety of events offered was purposeful, with the intention to connect the Bass River and the project with many members of the public with various interests. See Table 5-4: Public Education and Outreach Events for additional information.

Table 5-4: Public Education and Outreach Events

Event	Date	Description
Bass River Clean-Up #1	3/9/2023	The clean-up event, coordinated by SSCW, occurred at the beginning of the river walk at Elliott Street/Route 62 north of the Bass Haven Yacht Club. There were 51 participants total and 241 pounds of trash was collected.
Bass River Walk & Talk	3/11/2023	SSCW walked 28 members of the public from the river walk starting at Elliott Street/Route 62 down to the Margin Street Pump Station and provided site-specific flood education.
Public Forum #1	3/21/2023	The first public forum was held to introduce the project and resiliency goals to members of the public.
Bass River Clean-Up #2	4/29/2023	The second clean-up event was coordinated by SSCW and occurred from Bridge Street down to Elliott Street/Route 62, collecting trash on both sides of McPherson Drive. The clean-up event resulted in 119 pounds of trash collected by the 20 individuals who attended the event.
Bass River Paddle	5/21/2023	SSCW led over 20 kayakers in a paddle down the Bass River. During the paddle, they worked to cultivate an understanding of what the Bass River looks like from the water, sites of erosion, and utilized flags to illustrate sea level rise.
Public Forum #2	6/13/2023	The second public forum was held to introduce the final project deliverables to members of the public. Six members of the public attended in person.

5.5 SOCIAL RESILIENCE PROGRAM INTEGRATION

As social resilience refers to improving the lives of the people in the project area, the City worked with the two facilities in or near the Bass River District serving the City's most vulnerable community members. River House is a homeless shelter on River Street managed by Lifebridge North Shore with 34 shelter beds and 5 units of supportive permanent housing, currently undergoing transformation to become a shelter for women. Beverly Bootstraps was established in 1992 as a food pantry and has developed into a leading social service agency on the North Shore. Beverly Bootstraps provides a wide range of services such as tax preparation, case

management, youth and family services, adult education programs (high school equivalency and English for speakers of other languages), food assistance, and operates a thrift shop on Rantoul Street.

In February 2023, City staff organized a community-focused pop-up event at the Beverly Bootstraps food pantry with Spanish and Portuguese language translation, coordinating utility debt relief and bill assistance program administrators as well as an energy efficiency nonprofit delivering income-eligible programs to residents to help build resilience at their home. Originally, the City coordinated five groups to have a presence at this outreach event, including a City table for this study equipped with outreach materials used for the guided tour and youth outreach activities. Beverly Bootstraps staff requested that the event be slimmed to ensure community members' comfort in the constrained lobby area. City staff maintained a presence but forwent a table in order to secure space for representatives who could provide direct assistance to help community members save money and feel more comfortable at home. Connections developed through this outreach continue to serve community members; the utility now has a regular presence to connect residents with discounted energy rates, debt relief programs, and personal contact for any questions about their bill.

In May 2023, City staff met with leadership at Beverly Bootstraps and River House to discuss their vulnerability to flooding or other climate threats and other ways in which staff could engage with the population they serve through this project.

The Beverly Bootstraps facility has not experienced flooding, though it is situated outside of the project area, and has only experienced two or three significant power outages in the past 15 years. They now have a generator to maintain refrigeration in the event of an outage. Bootstraps also runs a mobile market in the summer and operates 16 food lockers. At the Executive Director’s request, the City directed social resilience funds to help address the facility's greatest need--affording a continuous supply of food for the pantry.

The River House shelter has temporarily closed to enable much-needed capital improvements and, adapting to community needs, will reopen as a women’s shelter. Learning of the facility's HVAC reliability issues and lack of central cooling, City staff initiated a connection with the utility's income-eligible multi-family energy program to identify opportunities for heating and cooling upgrades at low or no cost during the facility renovation. City staff and Lifebridge leadership discussed the need for supplies for women and other continuously in-demand supplies as the most impactful way for this project to contribute directly.

Photo 1: First Bass River Clean Up, March 9, 2023

Photo 2: Bass River Walk and Talk, March 11, 2023

Photo 3: Second Bass River Clean Up, April 29, 2023

Photo 4: Bass River Paddle May 21, 2023

Figure 5-1
Photographs from Community Events
Source: Salem Sount Coast Watch, 2023

Chapter 6

RECOMMENDATIONS & NEXT STEPS

CHAPTER 6: RECOMMENDATIONS & NEXT STEPS

6.1 RECOMMENDATIONS FOR CONTINUED ASSESSMENTS

By addressing coastal flood risk in the District, this Resilience Plan and the work that follows will help to shape the future of this growing community, reinforce critical utility services in the area, promote marine recreation uses, and protect the vulnerable residents within this floodplain. The following section provides recommendations regarding additional assessment and considerations needed when evaluating next steps and future actions to address coastal impacts.

Consider Increased Stormwater Flooding Risk in and around the District

During previous stakeholder engagement activities for prior climate resilience planning around the city, residents raised concerns about existing stormwater flooding from rainfall and whether conceptual future actions to address coastal flooding would mitigate or worsen the situation. When evaluating next steps and future actions, consideration should be given to whether the net effect of implementation would exacerbate stormwater flooding especially during the transition period to increased resiliency in the District. One important factor is that increased impervious area, if any, should be minor and not expected to substantially increase stormwater runoff volumes. The District-wide flood resilience concepts identified through this study all include opportunities to incorporate low-impact development strategies, green infrastructure elements in redevelopment areas, and the inclusion of underground storage of stormwater in tanks/chambers as needed under green spaces or proposed built infrastructure.

Increased risk of flooding due to intensifying precipitation also impacts inland neighborhoods that drain to the Margin Street Pump Station, which will increase the burden on the Pump Station. Updated stormwater modeling of the inland catchment area to Margin Street, as well as the District itself, is recommended. Incorporating smart stormwater planning is prudent in the near-term to inform long-term capital planning and investments in city utility infrastructure. Additionally, the City should continue to be diligent about promoting low-impact redevelopment strategies, innovative stormwater management systems that provide both stormwater storage and treatment, and the incorporation of green infrastructure to address both flooding and urban heat island effect in a changing climate.

Consider Impacts to Coastal Resources from Potential Implementation of Coastal Resilience Measures in the District

Coastal resource areas along the Bass River have been fairly degraded by urbanization at the adjacent properties over the years, including their active uses which continue to tax resource areas with untreated stormwater runoff, lack of vegetation on sloped areas, and other challenges. Significant work and resources may be needed to enhance these resource areas. These resource areas have fairly limited existing widths due to the existing Mean Higher High Water mark of the river in these areas and how the uses along much of this stretch of the river extend right up against the edge of the bank. Addressing these items when considering enhancing these coastal resource areas will go a long way in assisting these resources to act as highly functional ecological habitat and natural flood protection strategies.

The possible size expansion of these areas or adjustments in operational practices at the properties which abut these coastal resource areas is critical as rising seas limit the functionality of coastal resource areas. Implementation of only hardening flood resilience measures to protect existing buildings and land uses puts coastal resource areas at further risk. The City of Beverly will need to continue to be diligent about promoting low-impact redevelopment strategies and hybrid and/or nature-based solutions in the Bass River District to protect coastal resource areas. Incorporating these key coastal resource areas in open space planning efforts for the riverfront going forward is encouraged, as is promotion of environmental stewardship by community partners whose support of this work was key to community engagement and a cleaner Bass River riverfront area.

Consider Impacts to Existing Marine Uses from Potential Implementation of Coastal Resilience Measures in the District

Beverly has a rich marine history where residents, businesses, and visitors have flocked to the city to engage with its waterfront since the 1600s. Flooding due to sea level rise and increased coastal storm surge risk, in addition to intensifying precipitation-based risk, pose great challenges to marine uses in the District. Each of the current marine uses have an inherent coastal dependency and require direct access to the river. While all of the properties within the District are on the front lines of addressing flood resiliency, the symbiotic relationship these particular assets have with the Bass River make their activities fully intertwined with any physical changes to the riverbanks or waterway.

Beverly's Harbor Management Authority ("HMA") is uniquely positioned to collaborate with marine users to aid in the transition needed to a more-resilient coastline along the Bass River and elsewhere in the city. Developing and/or enhancing pre-storm coordination protocols will be key to reducing flood vulnerabilities to other portions of the District and the city, including potential damage from unsecured marine debris during flood events and release of fuels/chemicals due to improper storage. Pre-storm preparedness procedures can also create temporary situations at these marine use properties to protect them from flooding through the implementation of deployable flood barriers around vulnerable

infrastructure, storage of boats and other materials in secure locations outside of the floodplain, and coordinated response actions by marine users, city officials, emergency services, and other entities. Since the precautionary measures would only be short term, the properties can be returned to their original, pre-storm state in short order. While many of these preparedness measures are low-cost, investment in marine infrastructure going forward is necessary to long-term flood resilience. Creating a plan in coordination with the HMA is key to implementing needed next steps for marine users.

Consider Social Resilience in the District

Climate change impacts are acutely felt by Environmental Justice populations and members of the community who are experiencing homelessness, food insecurity, and financial, medical, and other wellbeing challenges. Currently, the River House, a homeless shelter located on River Street, provides 34 shelter beds and five units of supportive permanent housing for formerly homeless adults. Beverly Bootstraps, a community-focused nonprofit organization that strives to help community members overcome issues of food insecurity, financial instability, and shortfalls in education and job skills, also provides community services within the District. It is essential to advance flood resilience strategies that are equitable to all members of the community. Continued collaboration by the City with Beverly Bootstraps, River House staff, and other community providers is essential to delivering on flood resilience solutions that provide benefits for all and incorporate the needs and feedback of a diverse set of stakeholders going forward.

6.2 NEXT STEPS

To be successful in addressing vulnerability preparedness and the long-term resilience of the District and other areas within Beverly with similar potential coastal impacts, the leadership of the City must work together with residents and business owners to actively manage their future. Positive change must be planned and then implemented through thoughtful, focused improvements.

The following guide to future actions by the City, the Department of Public Services, the Harbor Management Authority, and their partners within the District is developed with clear steps to advancing flood resilience in the District. The guide is organized by asset type to inform the community with tangible measures to prepare for anticipated changes within the District. Timelines and priorities for intervention will be heavily influenced by modifications to state-owned transportation infrastructure and investment in redevelopment parcels.

See Chapter 3: Site-Level Flood Resilience Strategies and Chapter 4: District-wide Flood Resilience Interventions for more specific detail to accompany these recommendations and next steps.

6.2.1 HALL-WHITAKER BRIDGE AND BRIDGE STREET CORRIDOR

- Collaborate with the Massachusetts Department of Transportation (MassDOT) on temporary bridge replacement work, including modifications to the Bridge Street roadway at Margin Street to address low points in the roadway alignment that are at increased risk of coastal flooding.

- Identify opportunities to elevate the permanent reconstruction of the Hall-Whitaker Bridge, adjacent Bridge Street roadway between the bridge and River Street, and adjacent properties to meet or exceed the flood resilience design standards for critical transportation infrastructure as provided by the state's Resilient Massachusetts Action Team (RMAT).

- Consider modification or elimination of the Bridge Street/Margin Street intersection to alleviate existing and future flood risk in this corridor.

6.2.2 MARGIN STREET STORMWATER PUMP STATION

- Implement floodproofing methods, including installation of flood protection panels at vulnerable entry points and louvers, elevation of critical electronics and other Pump Station utility infrastructure, and installation of watertight hatches.

- Evaluate existing Pump Station natural gas emergency generator for potential replacement with added flood protection measures.

- Initiate a Hydrologic and Hydraulic (H&H) study of the current and projected stormwater pumping conditions at the Pump Station.

- Implement low-impact development strategies and green infrastructure to minimize stormwater runoff volumes and improve water quality in the Pump Station catchment area and the District.

- Integrate the findings of this Plan into the upcoming City capital planning studies to prepare for mid-term and long-term improvements to the Pump Station.

- Develop detailed costs to further assess the feasibility of relocating the Pump Station adjacent to McPherson Drive.

6.2.3 MAINTENANCE OF COASTAL INFRASTRUCTURE

- Engage a coastal engineer to evaluate the condition of the Innocenti Park seawall within the next year and undertake needed maintenance on this coastal structure.

- Work with property owners to understand the current and planned Operation and Maintenance ("O&M") of existing coastal structures, including the sea wall along

Hill's Yacht Yard, the revetment along the riverbank of the lumber yard, and the boat ramp off of Margin Street.

6.2.4 FLOOD PREPAREDNESS FOR MARINE USERS

- Working with the Beverly Harbor Management Authority to identify and apply for funding for further adaptation and preparedness for marine users in the District. The floodproofing or relocation of support buildings and infrastructure, as well as investment in new efficient and adaptable hoist and other marine infrastructure, are potential projects for future grant funding.

- Work with marine users, including Bass Haven Yacht Club, Hill's Yacht Yard, and other marine users in the region, to prepare a Flood Preparedness Plan that includes the implementation of deployable flood barriers around vulnerable infrastructure, storage of boats and other materials in secure locations outside of the floodplain, and coordinated trainings and response actions by marine users, city officials, emergency services, and other entities.

6.2.5 STABILIZATION OF RIVER BANKS AND EXPANSION OF COASTAL RESOURCE AREA PROTECTION

- Address existing significant bank erosion and sparse vegetation adjacent to existing drainage outfalls near the Elliott Street/Route 62 roadway.

- Work with property owners to introduce more/new native plantings throughout the riverfront where appropriate.

- Stabilize the existing deteriorating bank along McPherson Drive between Dock Lane and Innocenti Park.

- Work with existing property owners to limit and treat stormwater runoff from adjacent urban areas into coastal resource areas. Reducing stormwater runoff from properties within the District would help to minimize sedimentation deposits into the river, reduce water pollution, and assist in maintaining existing water levels in the area, as well as to support the City's Municipal Separate Storm Sewer Systems ("MS4") compliance going forward.

- Expand coastal resource areas through the creation and expansion of living shorelines/salt marsh restoration areas to provide buffer along McPherson Drive up along the Bass Haven Yacht Club property to meet existing banks along Route 62/Elliott Street.

- Investigate river access points north of the bridge to provide residents, boaters, and others with direct connection to the water that minimizes risk of erosion and integrates with flood resilience interventions.

6.2.6 BASS RIVER DISTRICT ZONING INITIATIVE

- Incorporate the results of the Plan into upcoming zoning initiative by promoting resilient redevelopment efforts that align new construction along River Street and McPherson Street and provide a healthy vegetative buffer to the Bass River.

- Recommend that occupiable floors of new buildings be elevated to the Design Flood Elevations (DFE) provided in this Plan. See Appendix D, Water Surface Elevations and Design Flood Elevations.

- Encourage participation in a district-wide flood intervention that incorporates nature-based solutions with co-benefits for a wide range of interests within the District and the larger community.

- Include a building height definition within future zoning initiative to allow for measurement from DFE instead of average existing grade to promote flood resilient building design.

- Update the 2014 City of Beverly Floodplain Overlay District Ordinance. Incorporate projected floodplain extents and depths into design review criteria for floodplain development permits.

6.2.7 MCPHERSON YOUTH CENTER

- Work with the design team for the rebuilding of the McPherson Youth Center to build adjacent to McPherson Drive and incorporate appropriate DFE into building plans.

- Consider options to replace existing parking area with a more efficient parking layout west of the building and incorporate a vegetated buffer along the Bass River.

6.2.8 RAISING OF LOW-LYING ROADWAY SEGMENTS THROUGHOUT AND ADJACENT TO THE DISTRICT

- Consider options to elevate, realign, or eliminate the low-lying Margin Street due to high coastal flood risk. Work with redevelopment partners and existing businesses to integrate site access into a resilient redesign of the surrounding area, including the bridge.

- Investigate raising elevation between the river and the Federal Street underpass to address flooding risk by blocking flood pathway from Bass River.

- Investigate raising elevation of River Street as the roadway approaches the Pleasant Street underpass to address flooding risk by blocking flood pathways from the river.

- Work with MassDOT and adjacent property owners to address flood risk at the adjacent Route 62/Elliot Street, which will limit access to the District in the future unless coastal and stormwater flood risk is addressed.

6.2.9 RESILIENT REDESIGN OF INNOCENTI PARK

- Start planning efforts for a resilient redesign of Innocenti Park that incorporates increased buffer to the Bass River and future siting of the Margin Street Pump Station.

- Consider options for alternate recreational uses within Innocenti Park going forward based upon space limitations due to rising sea levels.

- Plan for the eventual replacement of the existing sea wall at Innocenti Park.

6.2.10 OTHER INITIATIVES

- Promote environmental stewardship at the Bass River with ongoing events such as community cleanups and other community events along the riverfront.

- Build the foundations necessary to develop public consensus between stakeholders on long-term interventions and associated impacts.

- Continue to communicate planning and implementation actions with neighbors in the District.

Source: City of Beverly, Woods Hole Group, Tetra Tech, and Salem Sound Coastwatch, 2023