Boston Coastal Storm Risk Management Study

Draft Integrated Feasibility Report and

Programmatic Environmental Assessment

Executive Summary

Photos: Top and Middle- 2018 Nor'easter courtesy of businessinsider.com
Bottom- Flooding beneath Evelyn Moakley Bridge. Courtesy of Alison Brizius, December 2022

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USACE New England District | City of Boston

US Army Corps of Engineers

Executive Summary

ES-1 Purpose and Need

This study is happening because of a request from the City of Boston to the U.S. Army Corps of Engineers (USACE) under a congressional authorization from the U.S. Senate Committee on Public Works on September 12, 1969.

RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report on the Land and Water Resources of the New England-New York Region, transmitted to the President of the United States by the Secretary of the Army on April 27, 1956, and subsequently published as Senate Document Numbered 14, Eighty-fifth Congress, with a view to determining water resource improvements for flood control, navigation and related purposes in Southeastern New England for those wetlands, streams and estuaries which drain into the Atlantic Ocean and its bays and sounds in the reach of the coastline of Massachusetts, Rhode Island and Connecticut southerly of, and not including, the Merrimac River in Massachusetts, to, and including the Pawcatuck River in Rhode Island and Connecticut, with due consideration of enhancing economic growth and quality of the environment.

USACE is conducting this study to address part of that authorization. The team is focused on managing flood risk from coastal storms along the 47 miles of coastline in Boston, Massachusetts.

The Boston Harbor area is in danger of flooding from different kinds of storms, from higher frequency storms to low probability but high damage storms. These floods threaten people's safety, homes, and important public services like roads and hospitals. This danger is expected to get worse over time, sea level change contributes to the frequency of flooding as waters rise.

What appears to be nuisance flooding today, will increase in depths and damages in the future. The increase in flooding risk expands inland in the future, putting neighborhoods, businesses, government buildings, and public transportation at risk (Figure ES- 1).

By the year 2090, relative sea level change in Boston could be as high as four feet. A major storm, the kind that has a low probability of occurrence, but high impact consequence could flood 20,000 or more structures. This includes important public services like the Massachusetts Bay Transit Authority (MBTA) transit system and historic city buildings. Over time, the cost of damage from flooding could accumulate to over $54B.

If nothing is done, the risk of storm damage in this area will continue to increase over the next 100 years. It is not a matter of *whether* these changes will happen, but *when*.

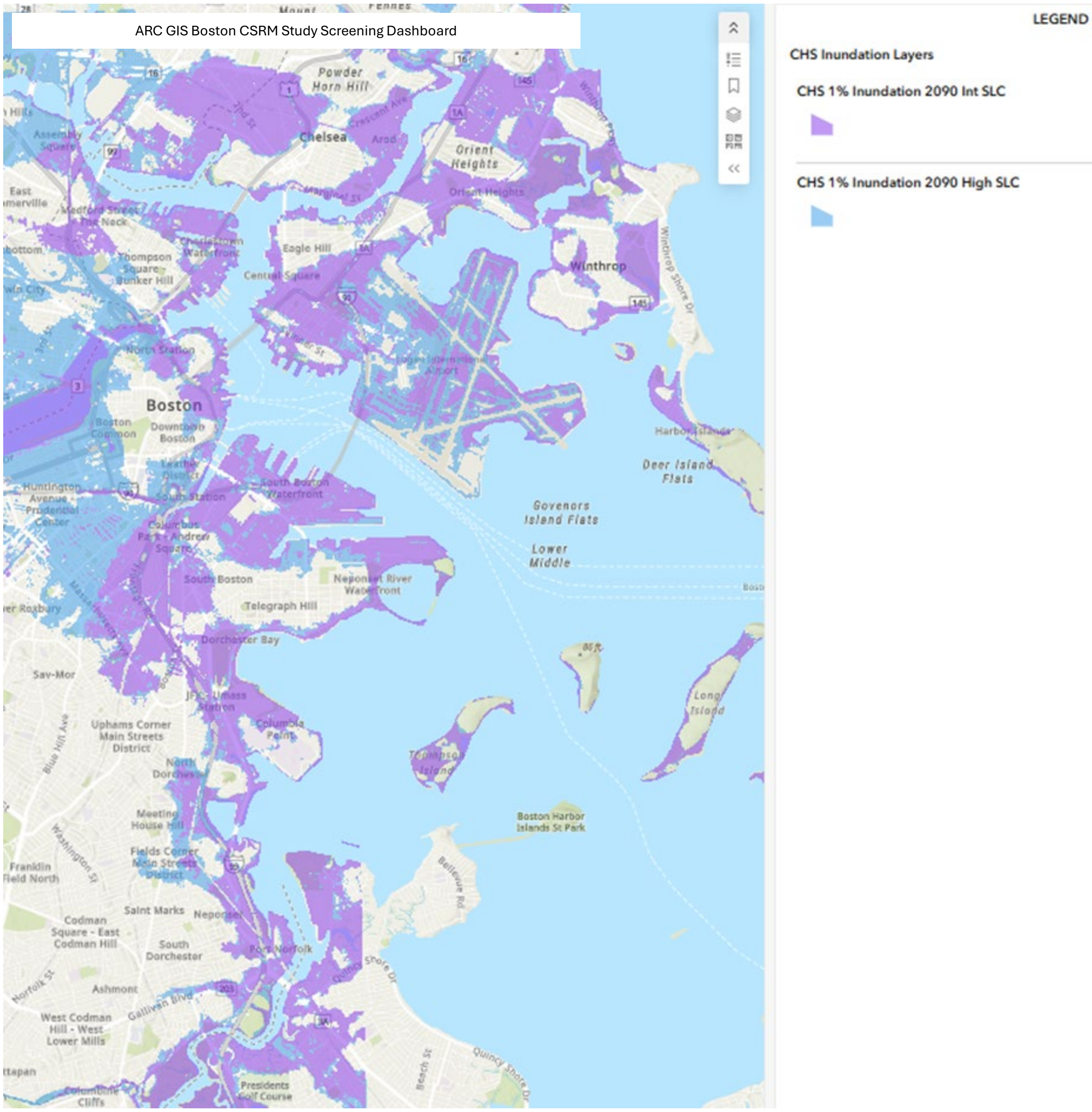

Figure ES- 1. Study Area Inundation Map (Year 2090)

Generated from Coastal Hazards System (CHS) output at the 1-percent annual exceedance probability (100-year event) at both the intermediate and high sea level change (SLC) scenarios.

ES-2 Plan Formulation

The Project Delivery Team (PDT) developed the plans identified in this report in three different steps or phases using multiple strategies, discussed in ES-2.1.

- Phase one was conducted during a series of workshops to brainstorm different approaches to managing the coastal storm risk in the city along Boston Harbor.
- A second phase occurred between the workshops and the USACE milestone confirming federal interest and study scope. This narrowed the concepts from

brainstorming down to a focused array of alternatives to be evaluated for engineering effectiveness, economic opportunities, and environmental impacts.

- Finally, the focused array of alternatives was further screened using engineering, economic, and environmental data coupled with input received from stakeholders, resource agencies, and the community to identify a final array of alternatives.

This final array was evaluated looking closely at costs and benefits, both monetary and non-monetary. The environmental and cultural resource impacts, both positive and negative, were also evaluated for each plan in the final array.

Due to the project's size and complexity, the cost and time necessary to design and construct the full system is substantial. Rather than delaying the entire system for full design, the project can be implemented over phases. These phases will include additional tiered NEPA documents and associated Chief's Reports for actions done by USACE. A No Action plan (Action Plan One) and the full system plan (Action Plan Two) are identified in this report. There are also opportunities for non-USACE entities to carry components of the full system forward. The first potential USACE element is identified as Action Plan Three in the Programmatic NEPA array of alternatives.

Several resources and references were used in developing the plan formulation for this draft report and NEPA document including, ER 1105-2-103, Policy for Conducting Civil Works Planning Studies (07 December 2023), and EP 1105-2-61, Feasibility and Post-Authorization Study Procedures and Report Processing Requirements (01 July 2023). These two references guided the planning process, alternative plan requirements, and the report processing requirements for the study including:

- Identifying the Net Economic Development (NED Plan)
- Identifying the Total Net Benefits Plan
- Identifying the Least Environmentally Damaging Practicable Alternative (LEDPA) as applicable
- Evaluating Nature Based features within Alternative Plans
- Evaluating Nonstructural Measures and Alternatives within Formulation
- Evaluating Life/Safety as an Objective of the Planning Study

ES-2.1 Plan Formulation Strategy

Coastal storm risks will continue to grow over time without intervention. The Project Delivery Team (PDT) focused on identifying where, when, and how bad flooding from storms could occur. Currently, flooding happens during many different types of storms and affects many different areas, primarily near the coast line. Over time, flooding will happen more often and reach deeper inland because of relative sea level change (RSLC), that is, sea level rise in combination with subsidence of the filled lands in Boston.

A minor flood today—which causes very little damage—may cause much worse damage in the future as water levels rise. Because of this, the planning strategies focused on finding different ways to manage storm risks both today and in the future under several different sea level change scenarios.

A formulation of alternatives to manage coastal storm risk was created and consisted of:

- Evaluate as an entire system within Boston Harbor; however, evaluate each neighborhood independently and incrementally within the larger system. Within each neighborhood prioritize risk and separability to identify incremental implementation strategies.
- Evaluate alternatives against both the high and intermediate USACE sea level change (SLC) scenarios to evaluate for phased and adaptable approaches for risk management.
    - Differing geographic conditions and urban density will impact adaptability and land utilization for risk management approaches.
    - Where land utilization and urban density allow, maximize adaptable and or nature-based features to manage risk where practical.
- Consider institutional plans at the regional, local, and state levels to tie this system into larger systems and comprehensive approaches to risk reduction.
    - Consider recommendations under the larger Boston Metropolitan Watershed Study done by the New England District, USACE and Commonwealth of Massachusetts.
    - Consider projects and recommendations under the Climate Ready Boston initiative led by the City of Boston.

ES-2.2 Action Plans

Following standard USACE guidelines, the PDT created flood protection plans in steps. The PDT started with small local areas, combined them into neighborhoods, and finally put them together into one large system.

To do this, the team used "measures." Measures are physical structures (like seawalls) or rules (like building codes) that help stop flooding or lower the damage it causes. The PDT tested plans against both the "high" and "intermediate" scenarios.

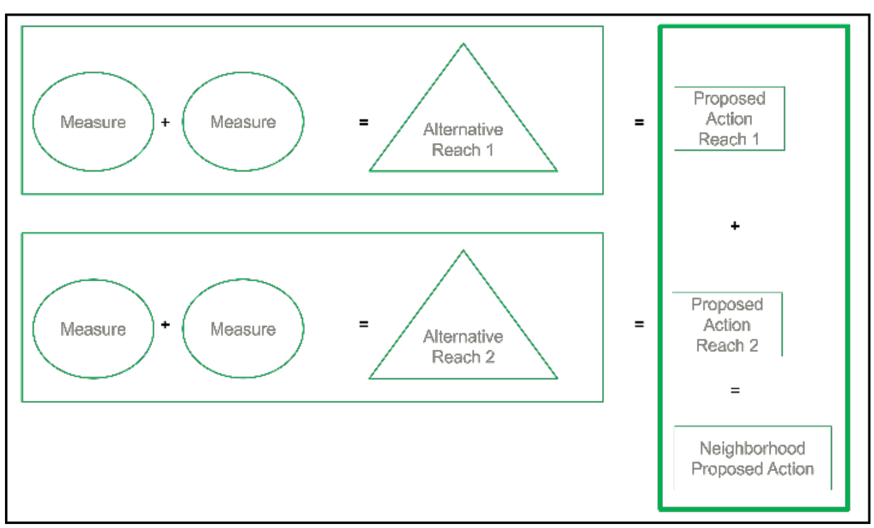

Figure ES- 2. Alternative Creation Application

Selected Alternatives for each local area became the proposed action for that geographic reach. Proposed Actions were then combined into a neighborhood level proposed action (see Figure ES- 2). Finally, neighborhood proposed actions were combined into the Comprehensive System Plan, described in Plan Action Plan 2 below. Because of limits on time and funding, the PDT may not be able to build the comprehensive , whole-system plan (Plan Action Plan 2) in the near-term. Instead, the team created Action Plan 3. This plan focuses on building smaller, high-priority pieces of the project first that meet specific safety and budget criteria outlined below.

Action Plan 1: *No Action*

Action Plan 1: The no action alternative has impacts on the environment. As water surface elevations continue to change under relative sea level change (RSLC) conditions in the future, natural resources such as urban salt marshes and other habitat will be adversely impacted. Additionally, the built environment will be flooded more frequently resulting in pollutants such as trash and degrading building materials more likely to end up in the water, impacting near shore marine habitats.

Action Plan 2: *Comprehensive System Plan*

Action Plan 2 is the total net public benefits plan that comprehensively manages risk to the five neighborhoods from increased coastal storm risk. Within Action Plan 2 there are multiple geographically separate proposed actions for each neighborhood. These proposed actions are made up of different measures intended to manage the coastal storm risk. Individual proposed actions may also be separable and complete, able to be constructed as standalone projects without committing funding and resources to the remaining proposed actions within Action Plan 2.

Action Plan 3*:* *Early Actionable Increment Element*

Action Plan 3 includes separable proposed actions from within Action Plan 2 that are elementally separable as early actionable elements (EAE). These elements, when combined into an early actionable element, were identified by the non-federal sponsor and the PDT. The decision criteria included:

- Does not increase, induce, or transfer risk to adjacent areas
- Sufficient design of 35% with class 3 cost estimate for budgeting
- Is part of the larger system of features, addresses a more near-term flood pathway as identified through modeling
- Is elementally justified through economic and socio-economic analyses at the full system level of risk management; or a more frequent event without inducing, increasing, or transferring risk
- Aligns with the non-federal sponsor’s resilience priorities and plans

ES-3 Tentative Plan

The draft report does not identify a tentative plan for multiple reasons. First, in some neighborhoods, there are different options that are very close in cost and benefits. Hearing from the public and local agencies will help make the best final recommendation. Second, the biggest plan that does the best is Action Plan 2. However, there may not be enough time or money in the current study to finish all the detailed designs needed for Congress to approve it. Action Plan 3 might be the largest plan that can be realistically finished under current schedule and budget. If Action Plan 3 is recommended, Action Plan 2 may still be built in the future federal actions, including completing additional NEPA analyses through a tiered process under this Programmatic EA. However, starting with Action Plan 3 does not guarantee Action Plan 2 will be implemented in the future. If USACE ends up recommending a final plan that is different from the choices shown in this draft report, the new plan would circulate for another round of public review and comments before making any final decisions.

ES-4 Full System Comprehensive Plan (CSP) (Action Plan 2)

As mentioned, the full system has a few variations due to alignments in Downtown and South Boston still being considered. The plans, when combined are all very close in both total net benefits as well as monetary return on investment. Costs for the full system vary between ~$9B and ~$10.5B. Cost estimates include real estate, contingency, mitigation, and post-study activities like design and construction management. The following table incorporates cost and benefit information for the final alignments in each neighborhood. The table includes the remaining variations in Downtown (DT) and South Boston (SB) which is detailed in Chapter 3 of the report.

An exact cost share is unavailable until a specific plan is selected, however, a cost share for each of the full comprehensive system plans (CSP) is available in Table ES- 1 below. The cost share is assumed to be in accordance with Section 103, WRDA 1986, as amended, which is 65% federal and 35% non-federal for coastal storm risk management (CSRM) projects during implementation.

Table ES- 1. Downtown and South Boston: Full System Combined Analysis

This figure shows the full system combined analysis including the variable alignments in Downtown and South Boston.

	CSP [DT3, SB2]	CSP [DT3A, SB2]	CSP [DT3, SB3]	CSP [DT3A, SB3]
	CSP [DT3, SB2]	CSP [DT3A, SB2]	CSP [DT3, SB3]	CSP [DT3A, SB3]
Total Investment Cost	$9,410,680,429	$8,726,540,306	$10,531,071,093	$9,846,930,970
Average Annual Cost	$383,300,000	$355,435,000	$428,934,000	$401,069,000
Average Annual Benefits	$1,666,360,000	$1,656,060,000	$1,714,000,000	$1,703,700,000
Net NED Benefits	$1,283,060,000	$1,300,625,000	$1,285,066,000	$1,302,631,000
BCR	4.3	4.7	4.0	4.2
Damages Prevented	$40,911,986,980	$40,658,951,804	$42,081,637,479	$41,828,602,303
Residual Risk	25%	26%	23%	24%
Life Loss Prevented	106.24	106.23	106.24	106.23
Residual Risk of Life Loss	15%	15%	15%	15%

ES-5 Early Actionable Element (Action Plan 3)

The Early Actionable Element is Dorchester 1 (DOR1), and is comprised of:

- DOR1 – an upland vertical wall behind Day Boulevard transitioning to a shallow foundation levee feature through the contours of Moakley Park tying into the existing stadium (Moakley Park and Northern Connector) (see Figure ES- 3

Figure ES- 3. DOR1

Blue Line Represents the Alternative for Moakley Park and Northern Connector[1]

The comprehensive system plan includes the Dorchester neighborhood level alternative, DOR 2 (Harbor Point), as described in Chapter 3.6. DOR 2 has a benefit to cost ratio of 3.9 and net annual economic benefits of ~$44M. Within DOR 2 is an increment of Moakley Park that includes a floodwall and levee, described in the report as Moakley Park and Northern Connector, DOR 1. DOR 1 is separable from DOR 2

[1] This alignment is being coordinated with the city of Boston and Boston Parks Department based on the larger resilience plan for Moakley Park. This alignment is a snapshot in time and is subject to minor variations without impacting economic analysis or environmental impacts.

based on the criteria described in ES 2.2. However, DOR 2 is not effective without DOR 1 because DOR 1 is the cornerstone of DOR 2.

Considering the necessary level of design and the resources available for the study, there aren't sufficient resources to complete DOR 2. There are sufficient resources to complete DOR 1. DOR 1 has a cost range of $129M to $97M; including contingency and interest during construction (economic cost). The contingency is based on risk and uncertainty analysis and is added to the cost based on achieving a particular confidence level. There is 175.25% contingency added to the overall estimate for an 80% confidence level or 89.2% contingency added for a 50% confidence level in the cost estimate. The contingency loaded estimates range from $129M (80% confidence) to $97M (50% confidence). Based on these cost estimates, the BCR range is 0.7 to 1.03. If the refined cost estimate, on the 35% design submittal (post draft release) results in a BCR below 1.0, an NED policy exception may be required through the ASA (CW).

However, looking beyond economics, this feature is in the public interest as it is the plan that is a necessary feature of the larger DOR 2, provides maximum public safety benefits, and offers the public value described below.

Table ES- 2. Early Action Economic Performance

	DOR1
Total Investment Cost	$129M-$97M
Average Annual Cost	$5.2M-$3.9M
Average Annual Benefits	$4M
Average Annual Net Benefits	-$1.38M - $85K
BCR	0.7- 1.02
Damages Prevented	$99M