

Memorandum – Coastal Engineering Review BOST 249576 Easton Building Rehabilitation Design TAR 15421

14 October 2020

Review Request Summary:

BOST 249576 Easton Building - Design

Coastal Engineering Review of Project Site Design

- Review FEMA map
- Provide specific guidance for the resiliency requirements to meet NPS policies
- Due date: on or before Oct 14, 2020

Review:

A. Introduction:

- Review of the site situation: This memo presents the considerations regarding the Design Water Level for the planned renovation at the BOST office building. All elevations are referenced to NAVD88 unless otherwise noted.

Issue review:

(from NPS email correspondence; Oct 2, 2020)

“The Easton building is located on State street and Devonshire in Boston (15 State Street). The street elevation (at the building location) is approximately 21' (NAVD88). Therefore the basement elevation is 10' and if the high water elevation is at 12' (based up on current FEMA BFE and additional 2' of free-board added per NPS recommendation per [Addressing Climate Change and Natural Hazards- Level 3 Handbook 2015, modified 2018](#)) the project would need to have all Mechanical Electric and Plumbing (MEP) items 2' off the floor level.

The gas and steam line enters the building on the Devonshire side of the building. The current project is for a steam heat exchanger to be placed in the basement. Emergency generator and fuel storage is also planned to be located in the basement. The electrical with switch gear are currently located in the basement and at this time are not planned for replacement or modification.”

- Existing regulatory flood level elevations and proximal tidal data:

The current site is not within the FEMA regulated 100-yr or 500-yr floodplain. It is within Zone X indicated as Area of Minimal Flood Hazard. The most proximal 100-yr water surface elevation is approximately 500' north of the site at elevation 10' (NAVD88).

The diurnal tidal range measured at nearby [NOAA Station 8443970 Boston, MA](#) is 9.49' with measured Mean Higher High Water (MHHW) observed to be 4.77' (NAVD88) from the Tidal Epoch 1983-2001. Currently MSL (from the Tidal Epoch 1983-2001) is -0.3' NAVD88.

- Design Water Level Guidance from NPS, Commonwealth of MA, Federal, City of Boston:

Per NPS document [Addressing Climate Change and Natural Hazards- Level 3 Handbook 2015, modified 2018](#) which establishes the approach for both Baseline Hazard and Future Hazard in the case of sea level changes (see page 12 of 24). The document defers to current FEMA Flood Insurance Rate Maps for baseline hazards for locations within the floodplain and identifies a 2-foot minimum freeboard (3' for critical assets) for planning for sea level rise (unless project location projections are higher). The City of Boston's Planning and Development Agency's [Coastal Flood Resilience Design Guidelines](#) and the Commonwealth of Massachusetts's [State Building Code and Climate Change Primer](#) also includes the use of a 2-foot additional freeboard for projects.

How changing sea level considerations would interact with the regulatory and advisory constructs over time:

Still water sea level rise (SLR) projections developed in 2019 for Boston by [VIMS \(Virginia Institute of Marine Science\)](#) indicate a likely increase of 1.36' from present conditions by the year 2050. [Boston Planning and Development Agency Climate Change Checklist Guidance – December 14, 2017](#) also provides a summary of expected SLR projections, which is provided in Table 1. In addition to the still water SLR projections included in Table 1, 100-year and 500-year recurrence flood elevations are included under varying SLR scenarios. These elevations are based upon the current FEMA 100-year and 500-year flood elevations of 10.0' and 11.5' respectively. When these values are added to SLR under 2100 high emission scenarios as an approximation of future storm impacts, the water elevation would be approximately 16.7' and 18.2'. These elevations would still be below the road surface elevation of 21', but above the basement elevation of 10'.

Table 1. Water Levels under Varying Scenarios

Year	Emissions Scenario	Still Water Increase (ft)	Mean Sea Level (NAVD88)	100-Year Recurrence (NAVD88)	500-Year Recurrence (NAVD88)
1983-2001 Epoch (current)	1983-2001 Epoch (current)	N/A	-0.3	10.0	11.5
2050	Moderate Emissions	1.0	0.7	10.7	12.2
2050	High Emissions	1.1	0.8	10.8	12.3
2070	Moderate Emissions	0.9	0.6	10.6	12.1
2070	High Emissions	2.7	2.4	12.4	13.9
2100	Moderate Emissions	2.0	1.7	11.7	13.2
2100	High Emissions	7.0	6.7	16.7	18.2

Sources: [NOAA Tide Station/Gauge = 8443970/Boston MA, NAVD88 Datum](#); [Boston Planning and Development Agency Climate Change Checklist Guidance – December 14, 2017](#); [Virginia Institute of Marine Science](#); [FEMA Flood Map 2502500077J eff. 3/16/2016](#)

The [Sea Level Rise and Storm Surge Projections for the National Park Service](#) 2018 report also provides sea level rise projections for the area. Specifically for the *Boston National Historic Park*, SLR increases range from 0.6' to 2.0' under various climate change scenarios based on potential greenhouse gas concentration trajectories introduced in the fifth climate change assessment report of the Intergovernmental Panel on Climate Change (IPCC 2013).

- **EA Comments:**

The current FEMA BFE (Base Flood Elevation: 10' for 100-year flood plain and identified 500-year flood plain) does not reach the project location, the closest extent is 500' north of the Easton Building where the 100-yr and 500-yr levels are depicted at the same location. Surface flood elevation would have to overtop 21' elevation to enter the building from the surface. This is 11' greater than the current identified FEMA BFE of 10' as noted. This means that during a coastal flood event to the current 100-year flood plain, water could only enter the building from subsurface/groundwater flow through perforations in the foundation wall. Depending on the elevation of entry of the existing gas and steam service pipelines as well as water and wastewater systems, these could be the source of flooding at the building from groundwater. Surface derived, non-stormwater flooding in this present-day scenario would not occur.

In general, building construction within areas of expected high groundwater use methods of waterproofing on the foundation walls and entry of mechanical systems (such as piping and ducts) to prevent groundwater intrusion. It is not known specifically how water-tight the subject building foundation, constructed in 1903, may be to high groundwater seepage, as it was beyond the scope of the current review to identify this information. However, it was noted during conversations with NPS that there were no noted incidences of groundwater or surface flooding in the past at the site. In addition, there was no readily available information available regarding the subsurface environment near the subject building. Subsurface considerations in urban environments related to the transmissivity of groundwater are governed not just by site geology but the number and proximity of underground utilities or tunnels as well as adjacent buildings. These items can either reduce or increase subsurface flow rates of groundwater depending on the particulars.

As SLR causes coastal water to move closer to the subject location, considerations may be given to make sure the subsurface foundation is flood-proofed against groundwater impacts. It should be noted that this is not expected over an extended time-period (outside of storm impacts) within the 21st century. There are a variety of measures that can be provided to a building to increase the flood-proofing of the foundation. These include both dry-flood proofing measures (to keep water out) and wet proofing techniques (which allow water entry while protecting the structural integrity of the structure). These techniques are outlined in the 2019 Draft City of Boston's [Coastal Flood Resilience Design Guidelines](#) document and a brief overview of each is provided below:

Dry Floodproofing:

In some situations, a building can be made watertight below the flood protection elevation (FPE), so that floodwaters cannot enter. This method is called dry floodproofing. The purpose of dry floodproofing a building is to make it watertight to floods of limited duration and depth. Making a building watertight requires sealing the walls with waterproof coatings, impermeable membranes, or supplemental layers of masonry or concrete. Also, doors, windows, and other openings below the FPE must be equipped with permanent or removable shields, and backflow valves must be installed in sewer lines and drains. Dry floodproofing within the FEMA defined floodplain is restricted based on building use; not allowed by MA State Building Code for residential structures.

Wet Floodproofing:

Wet floodproofing a building is done by modifying the uninhabited portions (such as a crawl space or an unfinished basement) so that floodwaters will enter but not cause significant damage to either the building or its contents. Any materials used below the base flood elevation (BFE) in wet floodproofing measures must be flood-damage resistant. The purpose of allowing water into

portions of the building is to ensure that the interior and exterior hydrostatic pressures will be equal. Wet flood proofing is often used when all other retrofitting methods are either too costly or are not feasible, but it is practical in only a limited number of situations and would not be a consideration for the subject site building.

B. Options for the renovation project:

The following options could be available for the building renovation:

- Keep equipment at the same elevation and in the same location in the building:

This is understood to be the current project design intent. Based on information provided to EA, it is recommended to proceed as designed.

- Move equipment above the design water level and/or higher (roof or other options):

Based on surface flooding projections this step is not deemed necessary at the is point. For future planning it is recommended to review the foundation and utility system entry point flood-proofing as well as the installation of back flow prevention systems. It should be noted that if in the future equipment is moved to the roof or other visible location at the subject site building, there are possible impacts to view-shed or historical components that would have to be considered.

- Provide flood protection to the building:

This step is not deemed necessary at this time due to current projected surface and groundwater flooding probability. For future planning at this project site, it is recommended that NPS review City of Boston protection plans for SLR and coastal resiliency as the Easton Building will likely benefit from comprehensive municipal planning which will be tasked with tackling this issue. Current planning for future protection is outlined in the 2019 Draft City of Boston's [Coastal Flood Resilience Design Guidelines](#) document. This document and another City of Boston publication, [Resilient, Historic Buildings Design Guide \(2018\)](#) provide a listing of measures that could be executed at the subject site building in the future if necessary.

C. Summary:

Since the Easton Building is located at a surface elevation of 21', which based upon current SLR and coastal storm surge projections, is expected to be protected against surface impacts within the 21st Century. As such It is not recommended to modify the current MEP focused renovation plans for the basement at this time. However, consideration should be given to reviewing foundation water seal and utility perforation areas for future protection. In addition, it is recommended that NPS management continue to track ongoing sea level rise projections in the area as these will likely change as we move through the century and could change some of the conclusions within this memorandum.

The assessments and statements contained within this memo are based on limited information provided to EA and on-line resources and are not meant to supplant the permitting, design, and engineering assessment performed by the architect/engineer of record and should be used as guidance only.

D. References:

Boston Environment Department. 2018. Boston Resilient, Historic Buildings Design Guide, A comprehensive guide to retrofitting Boston's historic buildings to address climate change. https://www.boston.gov/sites/default/files/imce-uploads/2018-10/resilient_historic_design_guide_updated.pdf

Boston Planning and Development Agency. 2017. Climate Resiliency Guidance. <https://www.vims.edu/research/products/slrc/localities/boma/index.php>

- Boston Planning and Development Agency. 2019. Coastal Flood Resilience Design Guidelines. <http://www.bostonplans.org/getattachment/d1114318-1b95-487c-bc36-682f8594e8b2>
- Conservation Law Foundation. 2019. The Massachusetts State Building Code & Climate Change, A legal primer and summary of convenings. https://www.clf.org/wp-content/uploads/2019/03/CLF_ClimateCodeReport_2019.pdf
- Federal Emergency Management Agency (FEMA). 2016. FEMA Flood Map Service Center: 15 State Street, Boston, Massachusetts. [FEMA Flood Map 25025O0077J eff. 3/16/2016](#)
- NOAA Tides and Currents. Boston, MA - Station ID: 8443970. <https://tidesandcurrents.noaa.gov/stationhome.html?id=8443970>
- US Department of the Interior and National Park Service. 2015, modified 2018. Addressing Climate Change and Natural Hazards. Facility Planning and Design Considerations Level 3 Handbook. https://www.nps.gov/dscw/upload/AddressingClimateChangeAndNaturalHazards-Level3Handbook_Jan2015_041218AF2.docx
- US Department of the Interior and National Park Service. 2018. Sea Level Rise and Storm Surge Projections for the National Park Service, Natural Resource Report Series NPS/NRSS/NRR—2018/1648. <https://www.coastalreview.org/wp-content/uploads/2018/08/2018-NPS-Sea-Level-Change-Storm-Surge-Report-508Compliant.pdf>
- Virginia Institute of Marine Science. Boston, Massachusetts Sea-Level Report Card 2050 Projection. <https://www.vims.edu/research/products/slrc/localities/boma/index.php>