Projected Expansion of the Floodplain with Sea Level Rise in New Bedford, Massachusetts

Buzzards Bay National Estuary Program and
Massachusetts Office of Coastal Zone Management
Technical Report SLR13-1
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Data at: http://www.buzzardsbay.org/floodzone-expansion-slr.html.

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Summary

The Buzzards Bay National Estuary Program (BBNEP) and the Massachusetts Office of Coastal Zone Management evaluated the potential expansion of the 100-year floodplain in New Bedford, Massachusetts resulting from 1, 2, and 4-foot increases in sea level. A baseline conditions floodplain was developed by adjusting the most landward extent of the 100-year floodplain as mapped by the Federal Emergency Management Agency (FEMA) in their 2009 digital Flood Insurance Rate Map (FIRM) coverages. This boundary was adjusted by matching the FIRM base flood elevations to a highly detailed elevation data set. This adjusted baseline conditions floodplain map was then expanded by adding 1, 2, and 4-foot increases using the same detailed elevation data. Using a 2012 assessor's data set for the City of New Bedford, the number of buildings, their assessed values, and municipal structures were enumerated within these various floodplain expansion scenarios. This evaluation was not meant as a quantification of the impacts of storms with sea level rise, but rather to define an approximate likely geographical expansion of the floodplain, a jurisdictional area used by many state, federal, and municipal agencies and boards.

There are currently 23,644 built upon parcels in the New Bedford 2012 Assessor's database. Of these, only 337 (1.4 %) have the primary structure within the adjusted coastal baseline floodplain of the 100-year storm used in this study. This low number, relative to the other municipalities in the Buzzards Bay watershed, is due to the fact that most of the City is protected from flooding by a hurricane barrier. Of these 337 built-upon parcels, 227 are located outside of the area protected by the hurricane barrier. The total building value of the 337 properties in the adjusted floodplain is $167.8 million, which is 3.2% of the cities $5.329 billion total assessed structure value.

With a 1 ft sea level rise, 23 parcels with primary structure values totaling $2.3 million are added to the adjusted baseline floodplain. With a 2 ft sea level rise, an additional 35 parcels worth $4.2 million are added. However, in the case of the 4-ft rise scenario, the hurricane barrier is presumed to be appreciably overtopped, adding an additional 2,360 structures worth $613.9 million are added. Cumulatively, the baseline to 4-ft sea level rise scenario adds 2,755 additional built parcels with primary structures worth over $794.8 million in assessed value added to the adjusted baseline floodplain. This addition is greater than 8 times more built parcels and 3.5 times more structure value than in the baseline scenario.

Limited portions of the New Bedford municipal wastewater treatment facility are in the 100-year floodplain of the existing FIRM. However, in the vicinity of the wastewater facility, stated FIRM base flood elevations are inconsistent with the FIRM mapping product, and the adjusted baseline floodplain used in this study could not be completed for the Fort Rodman area of Clarks Point. Based on this finding, the Buzzards Bay NEP and Massachusetts Office of Coastal Zone Management recommend a review of the flood study of this area by FEMA. In this analysis, the facility was presumed to be outside the adjusted baseline floodplain. The city properties assumed to be in the adjusted baseline floodplain have an assessed value of $46 million for the primary structures. There are an additional $4 million dollars of state owned structures in this baseline floodplain. With the 4-ft sea level rise scenario, and the associated overtopping of the hurricane barrier, an additional $99 million in City-owned structures would be in the floodplain, as well as an additional $63 million in New Bedford Housing Authority properties.

Because most of New Bedford is densely developed, the maps resulting from this effort are limited in their usefulness to help guide the siting and construction of new development. However the maps can be used as planning tools to help modify and flood-proof structures as they need to be reconstructed and expanded. These maps can also be used as a visual aid to educate municipal officials and the public about the potential impacts of sea level rise, and help define local climate adaptation strategies.

1. Introduction

FEMA Flood Insurance Rate Maps (FIRMs) are the basis for federal, state, and local hazard mitigation planning. They are also used to establish the regulatory jurisdiction for mandated flood insurance, and are used by building inspectors, conservation commissions, and other local regulators to establish standards for the siting, construction, and maintenance of buildings, sea walls, and land alteration. In the coastal zone, FIRMs generally define the area that has a 1% chance or greater of being flooded in any particular year (commonly called the "100-year storm") as being either in the Zone V (Velocity or V-zone); which are areas subjected to waves greater than 3 feet during a storm, or Zone A, which are areas subjected to waves less than 3 feet during a storm. Most typically in coastal areas, these two zones are assigned a base flood elevation (BFE). The BFE corresponds to the top of the wave crest during the projected 100-year storm. The methodology for determining these elevations and their boundaries is described in the *Guidelines and Specifications for Flood Hazard Mapping Partners, Volume 1: Flood Studies and Mapping* (FEMA, 2003).

The predicted landward limit of the floodplain, as depicted in the FEMA FIRMs, corresponds to a specific real-world elevation as defined by the BFE. The FIRMs prepared by FEMA are in fact an approximate depiction of which properties are in or out of the specified flood-zone elevation. While the FEMA FIRMs are generally good for broadly defining which homes are in or out of the jurisdictional floodplain, the maps are limited by the quality of topographic data that is available. Whether a particular structure near a mapped BFE boundary is actually in the floodplain can only be determined definitively by actual field surveys. In fact, FIRMs can be amended based on such field investigations, and often are.

In 2009 and 2011, FEMA updated the FIRMs in Bristol and Plymouth counties based on recent LiDAR[1] surveys, contracted by FEMA or United States Geological Survey (USGS), and limited new coastal engineering analyses[2]. The basis of the changes in the maps are summarized in Flood Insurance Studies for each county available on the FEMA website[3]. Due to funding limitations, FEMA was unable to do new engineering analyses for all portions of each community. These new maps have increased precision and reliability, although like any data set, they are subject to errors in interpretation and processing of the elevation data as described below.

For this study, we considered only the landward-most extent of the FIRM 100-year storm floodplain, and the published BFE, to define the adjusted baseline floodplain. We then expanded this adjusted

[1] Light Detection And Ranging (also abbreviated LiDAR and LADAR) is an optical remote sensing technology that can measure the distance to a target by illuminating it with pulse of light from a laser.

[2] As part of FEMA's Map Modernization project, the 2009 Flood Insurance Rate Maps for New Bedford have a new datum, NAVD88, or North American Vertical Datum of the 1988-2001 Tidal Epoch. In New Bedford, the “old” elevation value for 0.0 feet using the National Geodetic Vertical Datum of 1929, or NGVD29 is equal to minus 0.823 feet NAVD88 (calculated for Clarks Cove at http://www.ngs.noaa.gov/cgi-bin/VERTCON/vert_con2.prl). In addition, the new maps show increased flood elevations in many areas that reflect improved flood hazard models, landscape changes, and better land elevation measurements.

[3] Go to: https://msc.fema.gov

baseline floodplain by adding 1, 2, and 4-ft. to the BFE (whether A or V zone). The extrapolations were based on a digital data set of estimated bare earth elevations established by a 2007 aerial survey using LiDAR technology that was obtained from FEMA (from (CDM-Smith 2008 study) and which was used in part to prepare the 2009 updated Bristol and Plymouth County FIRMs.

The selected 1, 2, and 4-ft elevation increases in this study were chosen as convenient management elevation markers. The relative sea level rise rate documented for Woods Hole, MA has been 10.3 inches per century since 1932[4]. The international consensus range for sea level rise, applied to this region, is 1 to 4.5 feet by year 2100[5]. However, some other studies with alternative scenarios with more expanded Greenland and Antarctic glacier melting, or changes in the North Atlantic gyre predict higher local sea level rise rates. We thus leave open ended how quickly the 1, 2, and 4-ft elevation increases may occur.

2. Methods

In this study, ArcGIS® software by Esri (ArcMap Desktop versions 9.3 and 10.1) was used to manipulate the various existing digital data sets, with some additional analysis completed in spreadsheets using pivot table functions. No field collection of data or ground truthing was required for this analysis. We used a 2007 LiDAR study contracted by FEMA, and described in detail in CDM-Smith's *Mapping Activities for Plymouth and Bristol Counties, Massachusetts. Task Order 18 Activity 1--Topographic Data Development / Acquisition Summary Report.* These LiDAR data were provided to the Buzzards Bay NEP as both 2-ft contour lines, and as digital elevation models in the form of Triangular Irregular Network (TIN) raster files. To a limited degree, for certain floodplain expansion areas we also used 2011 Northeast National Map LiDAR project data[6]. In general, the precision of the LiDAR data is 1 cm, but the accuracy is approximately 6 inches over the entire southeast study area, and the relative accuracy over a small geographic area along the same flight path is considerably better[7].

The base flood elevations from the FIRMs released by FEMA for New Bedford in 2009 were overlain on the detailed LiDAR contour data (Fig. 1) and digital elevation models (Fig. 2). Typically, the LiDAR 2-ft elevation contour lines were adequate to estimate expansion or adjustments of the boundaries of each sea level rise scenario. However, where land slopes were slight, and the base flood elevation was set to an odd-number value, the digital elevation model TIN raster images were often used to visually estimate the respective new floodplain boundaries, (see Fig. 2). In this way, an adjusted baseline floodplain was defined and used as the initial conditions for the purposes of this study allowing for more meaningful and precise comparisons among the sea level rise scenarios.

This adjusted baseline floodplain was then expanded to account for 1, 2, and 4-foot sea level rises. This was done by using the LiDAR elevations, and the BFEs identified on the FIRMs to which was added each sea level rise scenario (see Fig. 1). Thus, if the BFE on the FIRM was specified as 14 feet for a site, the boundary of the baseline floodplain would be expanded to the 18-ft LiDAR contour in the 4-ft sea level rise scenario.

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[4] Data available at http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8447930. This is the average rate for the period 1932 to 2006.
[5] IPCC, 2007.
[6] LiDAR for the Northeast (ARRA LiDAR Task Order, USGS Contract: G10PC00026, Task Order Number: G10PD02143, Task Order Number: G10PD01027), project meets U.S. Geological Survey National Geospatial Program Base LiDAR Specification, Version 12, see USGS (2009).
[7] USGS, 2008

Comments

The baseline floodplain developed for this study was based on the base flood elevations and other information contained in the 2009 FIRM digital data set. At this site, the base flood elevation of the AE Zone or the 100-year storm was designated as 14-ft.

To ensure consistency of comparisons among the data sets, an adjusted baseline floodplain was created for this study by precisely matching its boundary to the LiDAR contour elevations. In this case, the adjusted boundary was matched to the 14-ft LiDAR based contour line (blue line).

The process was continued for the 1, 2, and 4-ft sea level rise scenarios. If any portion of a house was in the new boundary, it was included in that sea level rise scenario. A house that crossed multiple boundaries was assigned to the lowest elevation.

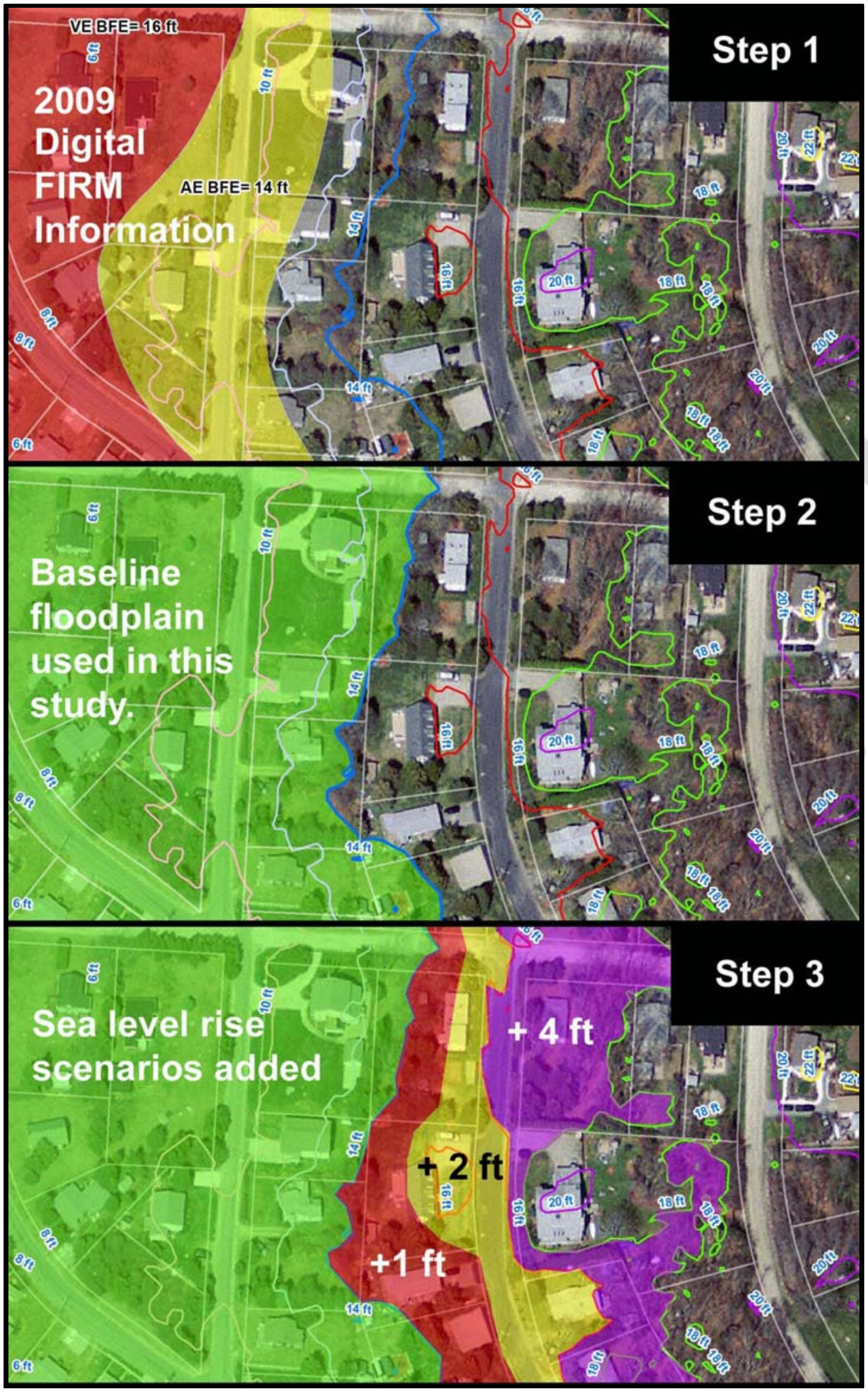

Fig. 1. Summary of approach for defining expanding floodplains for each of the sea level rise scenarios. Step 1: The landward most base flood elevations for a 100-year storm from 2009 digital FIRM data were compared to LiDAR contours (or digital elevation models). Step 2: An adjusted baseline floodplain area was defined (shaded green) for the purposes of this study. Step 3: The adjusted baseline floodplain was expanded for the 1-ft (shaded red), 2-ft (shaded yellow), and 4-ft (shaded magenta) sea level rise scenarios.

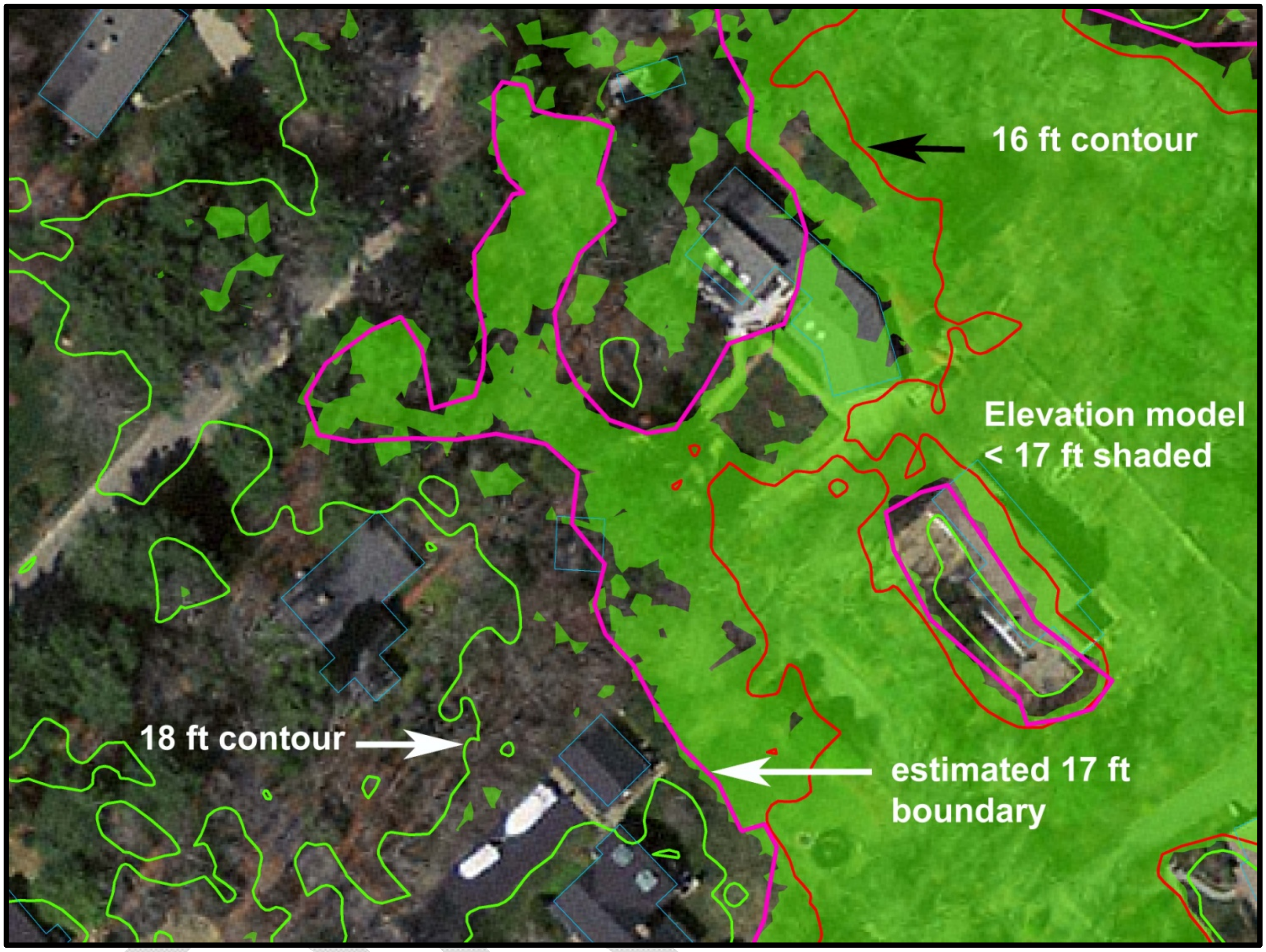

Fig. 2. Mapping BFEs with odd numbered values. In areas where the base flood elevation was set to an odd number value and elevation contours wide spaced, the TIN raster digital elevation model files were coded to match the same base flood elevation boundaries. In this image, a floodplain scenario (shaded green, right) was matched to an estimated 17-ft LiDAR elevation in the elevation model (shaded magenta, left).

This is a simplified approach, and a more accurate approach would involve predictions of erosion and landform change, and detailed engineering analyses to determine how much the flood elevations would rise along the coast given the submergence of land in the new floodplain areas, but such an effort was beyond the scope of this study.

After the floodplain scenario boundaries were created, the precise placement of the primary structure was assigned to a floodplain scenario (or out of the floodplain). In the first step, to approximate the locations of primary structures, a centroid label point was created for each parcel to represent the location of each primary structure. The position of these points, representing the vulnerability of the structures to sea level rise, was carefully examined on aerial photograph base maps for all parcels crossed by a sea level rise scenario. The positions of these points were moved to precisely coincide with the house footprint. If a house was crossed by several floodplain scenarios, the point was placed in the lowest elevation scenario as illustrated in Fig. 3. Secondary or ancillary detached structures were ignored, and the property building value was assigned to the main structure, typically the primary residential structure. On some parcels, there are multiple detached dwelling units, but no parcels of this particular type were bisected by a floodplain in New Bedford.

Once the position of structures was set relative to the sea level rise scenarios, the position of these points were converted to x y coordinates for each parcel, matched to the assessor's database file[8], which was imported into ArcGIS®. This extra step captured those parcels where many tax records (and multiple structures and owners) exist on one parcel, as is the case with parcels containing condominiums. The new point data set (containing assessor's data and sea level rise scenario location)

Fig. 3. Structure Assignment in Floodplain Expansion Areas with Different Sea Level Rise Scenarios. Multiple structures (outlined in yellow), if present on a parcel, were converted to label points representing the position of the largest structure. If no structure was present on the GIS coverage, a label point was created for the parcel. The position of these points were used to initially place the primary structure in a flood zone scenario. If a house was crossed by several scenarios, the point location was adjusted to place the building in the lowest elevation zone.

[8] The data sets were logically joined using the "LOC_ID" variable in the two data sets.

was then evaluated[9] to quantify the number and value of primary structures in each floodplain scenario. The resulting data set was processed in an Excel spreadsheet, and a pivot table was used to quantify building data using various classifications of structures by floodplain and if the structure is protected by the hurricane barrier.

Various quality control and data validation approaches were implemented to ensure the accuracy of the data following the protocols described above. These validation techniques included check sum approaches to ensure property counts and values and other data are not inadvertently double counted or omitted. Additional information on the methods, the QAPP, and the digital data sets related to this study area available at the Buzzards Bay NEP website: http://www.buzzardsbay.org/floodzone-expansion-slr.html

Hurricane Barrier Overtopping Assumptions

The potential overtopping of the US Army Corp of Engineers' New Bedford-Fairhaven Hurricane Barrier, which protects portions of New Bedford, Fairhaven, and Acushnet, has important implications for this study. The barrier forms a seawall across the harbor which can be closed by a gate. An area on the eastern side of Clarks Point is protected by a dike with a gate, and another large portion of the city is protected by the dike along Clarks Cove. There are two additional Hurricane Barrier segments in Fairhaven.

For this study, we assume that the hurricane barrier will remain protective of the inner harbor under the 1-ft and 2-ft sea level rise scenarios. However, in the case of a future storm associated with the 4-foot sea level rise scenario, we assume appreciable overtopping of the harbor segment of the hurricane barrier for the reasons explained below.

The elevation of the hurricane barrier (based on the LiDAR data) varies along each dike segment. The New Bedford Harbor portions of the barrier are mostly between 17 and 18 feet. The Fairhaven side of the harbor barrier is above 19 feet, as is the Clarks Cove barrier. The 2009 updated FIRMS show a BFE along the New Bedford side of the barrier of 17 feet, and 18 feet on the Fairhaven side of the harbor hurricane barrier. It is based on these observations, and because of the elevations of the barrier in parts of Fairhaven (see that report), that we presumed the barrier will be overtopped in the 4 ft scenario. This scenario assumes, of course, that no action was taken to retrofit the barrier to accommodate rising sea level.

The supposition that the barrier will be overtopped in the 4-ft scenario is supported by two other sources. First, the 2009 FIRM maps are based on the presumption that the hurricane barrier is adequately protective for the 100-year storm. However, in the case of the 500-year storm (X-zone), the hurricane barrier is presumed to be inadequate. Second, in the ACOE SLOSH maps for New Bedford[10], a large portion of the inner harbor area of New Bedford and areas protected by the hurricane barrier in the south end of New Bedford are likewise inundated under the worse case storm scenario.

[9] The shapefile's dbf files was imported into Excel and analyzed in a pivot table.

[10] In the 1994 report, the ACOE wrote, "the New Bedford Hurricane Barrier is designed to provide complete flood protection during the vast majority of hurricanes that can be sustained in New England's meteorological climate. The SLOSH model indicates, however, that certain Category 3 and 4 hurricanes, which landfall on critical storm tracks coincident with high astronomical tide, may exceed the Barrier's minimum top elevation. Inundation Area D delineates the maximum stillwater flood limits behind the Barrier should a storm of this nature be forecasted. More information about this topic is provided in the Study's Technical Data Report."

Because of the various assumptions tied to overtopping the barrier with the 4-ft sea level rise, we break out this flooding separately in terms of the number of structures and values in terms of its location relative to the hurricane barrier.

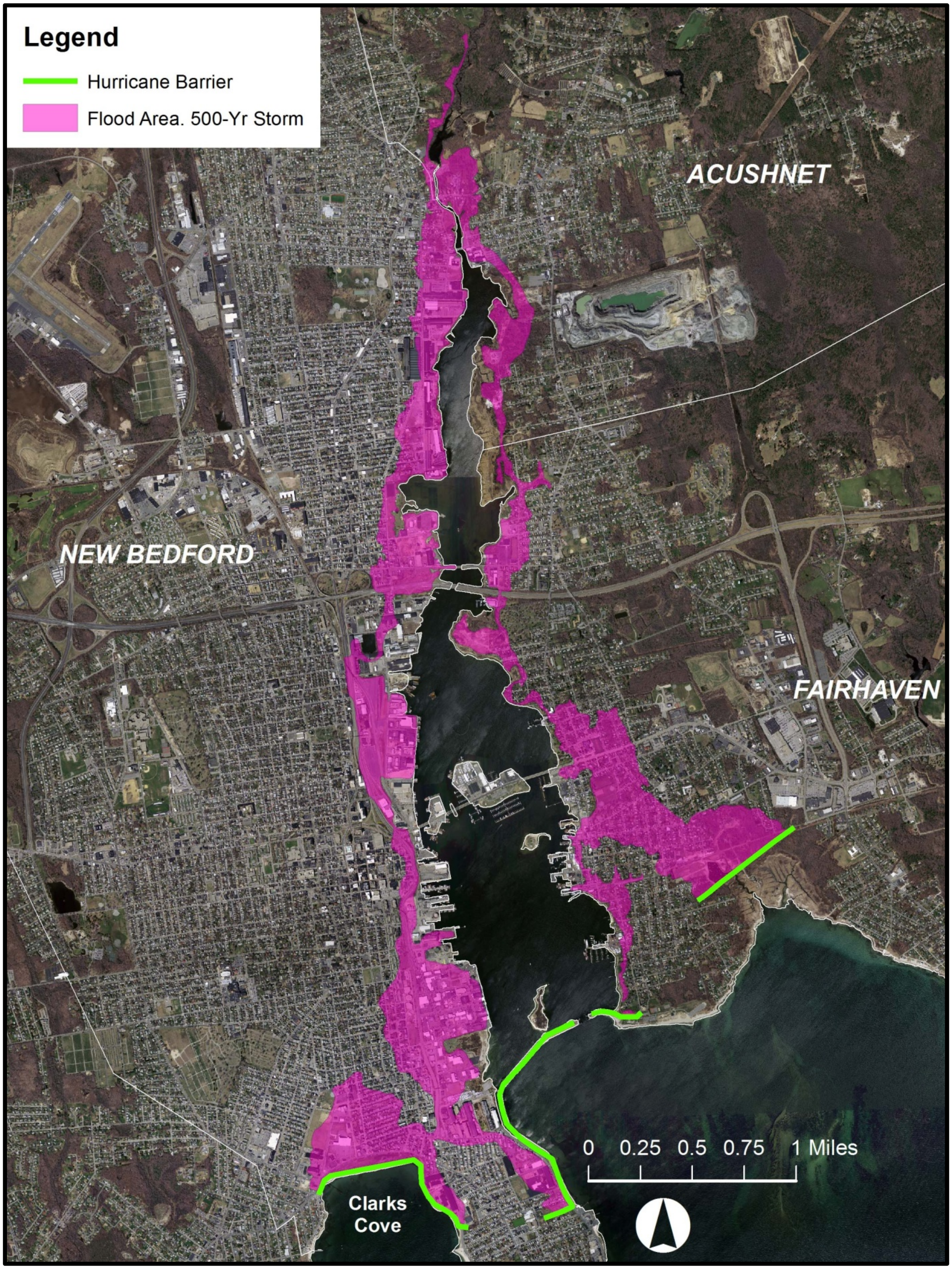

Fig. 4. New Bedford – Fairhaven Hurricane Barrier and 500-yr Floodplain. The New Bedford-Fairhaven Hurricane Barrier (green lines). The areas shaded magenta are in the 500-yr floodplain of the 2009 FIRMs and represent additional flooded areas caused by the overtopping of the barrier, and flooding behind it to roughly a 14-ft elevation.

3. Results

Fig. 5 shows the difference between the FIRM 100-year floodplain and the adjusted baseline floodplain used in this study. The two coverages were comparable, with 40 parcels with structures excluded from the adjusted baseline floodplain that were included in the FIRM floodplain.

Fig. 6 shows a portion of the City to illustrate the differences of the boundaries under the various sea level rise scenarios. Appendix A includes additional detailed maps of this analysis. As shown in Table 1, using the adjusted baseline floodplain, there are 337 parcels with building structures, out of a citywide total of 23,644, or 1.4% of the parcels with structures in the City. However, because many of the structures in the floodplain have a higher proportion of commercial and industrial use, they equaled 3.3% of the cumulative $5.329 billion assessed structure values in the City.

With a 1 ft sea level rise, 23 parcels with primary structure values totaling $2.3 million are added to the adjusted baseline floodplain. With a 2 ft sea level rise, an additional 35 parcels worth $4.2 million are added. However, in the case of the 4-ft rise scenario, the hurricane barrier is presumed to be appreciably overtopped, adding an additional 2,360 structures worth $613.9 million are added. Cumulatively, the baseline to 4-ft sea level rise scenario adds 2,755 additional built parcels with primary structures worth over $794.8 million in assessed value added to the adjusted baseline floodplain. This addition is greater than 8 times more built parcels and 3.5 times more structure value than in the baseline scenario.

Limited portions of the New Bedford municipal wastewater treatment facility are in the floodplain of the existing FIRMS. However, in the vicinity of the wastewater facility, stated FIRM base flood elevations are inconsistent with the FIRM maps (Fig. 7), and the adjusted baseline floodplain used in this study could not be completed for the Fort Rodman area of Clarks Point. In this analysis, the facility was presumed to be outside the adjusted baseline floodplain.

A 1-foot increase in the BFE of the 100-year storm due to sea level rise results in only a small increase in potential storm damage (Table 1 and Fig. 8).

At a town-wide level, with a 4-ft sea level rise, the percent area of the town in the expanded adjusted baseline floodplain increased from 3.2% to 10.5% (Fig. 8, top). Similarly, the total number of primary structures in the floodplain increased from 1.4% to 11.7% of the total number of primary structures in town (Fig. 8, middle), and the property values of primary structures in the floodplain increased from

Table 1. Expansion of floodplain with different sea level rise (SLR) scenarios. Totals are for parcels with building values greater than zero using a 2012 assessor's records and parcel database.

Floodplain	parcels with structures	cumulative parcels w/ structures	value of structure	cumulative value of structure
Baseline	337	337	$174,320,800	$174,320,800
1-ft SLR	23	360	$2,312,800	$176,633,600
2-ft SLR	35	395	$4,230,400	$180,864,000
4-ft SLR	2,360	2,755	$613,892,295	$794,756,295
4-ft SLR outside HB	73		$60,204,000	
Outside of coastal floodplains	20,889		$4,534,094,985	
Grand Total	23,644		$5,328,851,280	

3.3% to 14.9% of the total town primary structure property value (Fig. 8, bottom).

Fig. 5. Comparison of FIRM 100-yr Floodplain to Adjusted Baseline Floodplain in the south end of New Bedford. Figure shows the adjusted baseline floodplain conditions adopted in this study, and how it differed from the 2009 FIRMs 100-year (1% annual risk) coastal floodplain. Area inside the Hurricane barrier had negligible differences between the two coverages. Inland floodplain areas were excluded from the analysis.

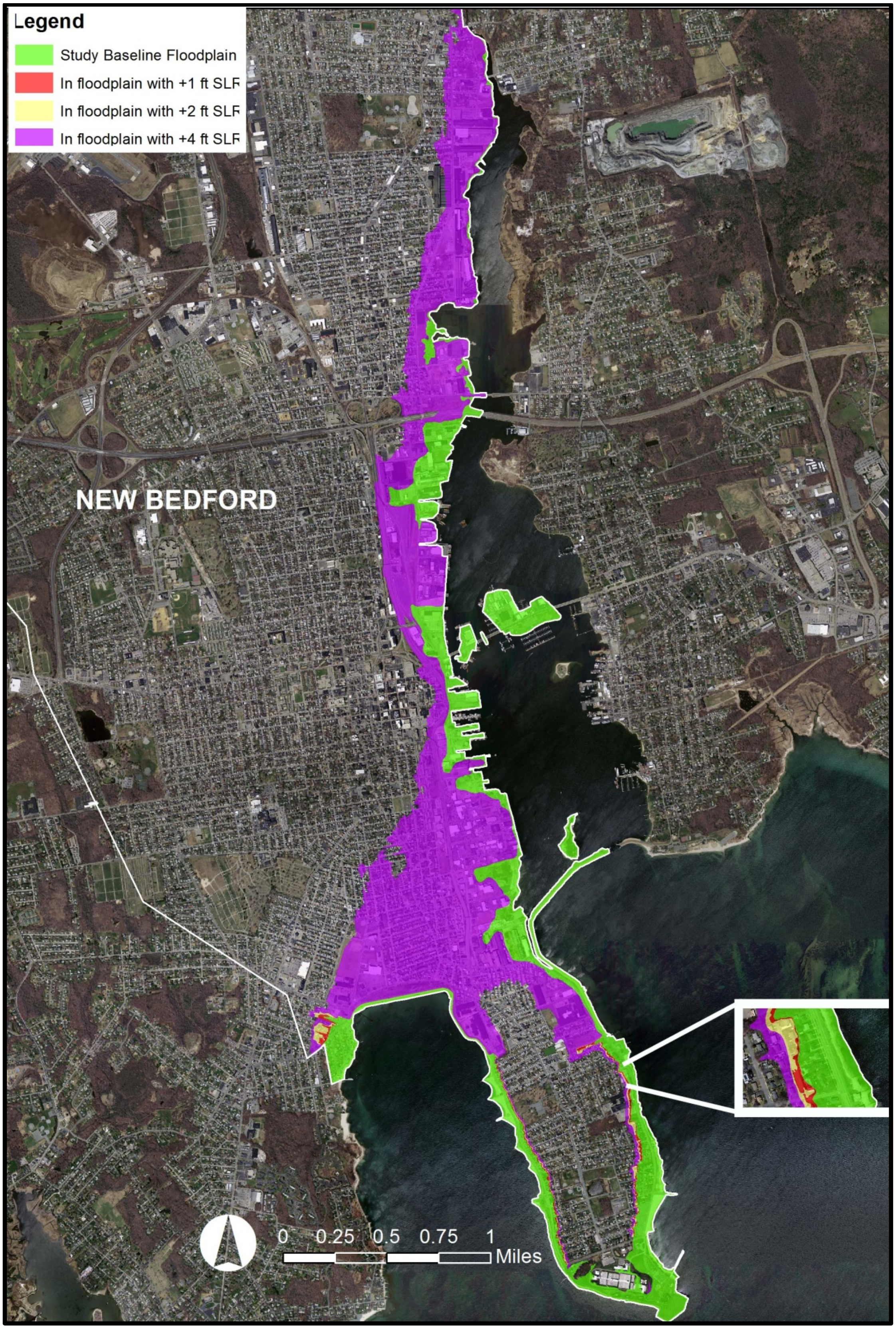

Fig. 6. Overview of the City of New Bedford showing changes in expansion of floodplain boundaries with various sea level rise scenarios over the adjusted baseline floodplain. Note that the 1and 2-ft scenarios, occurring outside the hurricane barrier, are too small to see at this scale. See detailed maps in Appendix A.

Fig. 7. FIRM Floodplains in the vicinity of the New Bedford Wastewater Facility showing stated base flood elevations and LiDAR 2-ft contours. AE zones (all 12-ft base flood elevation except 13 feet in one nearby area) shown in yellow, velocity zones are shown in red. As shown ,the AE zones coincide best with the 16 ft LiDAR contour. See text for explanation.

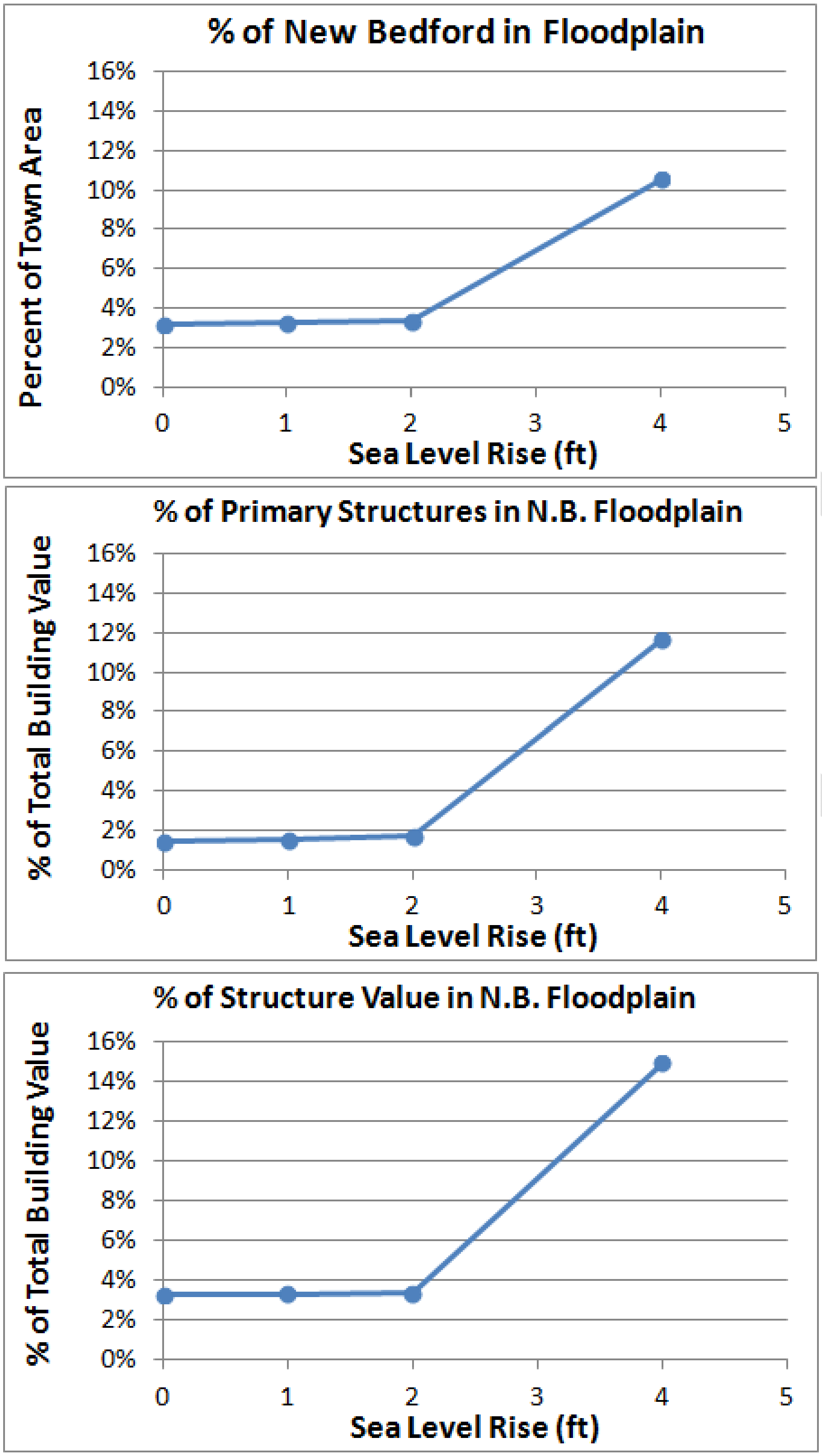

Fig. 8. Percent change in town area within the floodplain (top), percent of total primary structures in the floodplain (middle), and percent of total primary structure value in the floodplain (bottom) for each of the sea level rise scenarios (baseline conditions = 0 ft).

Discussion

Because of the importance of the $53 million dollar wastewater facility and ancillary buildings (assessed values), it is important that the City of New Bedford work with FEMA to refine the base flood information on the City's Fort Rodman parcel.

The greatest cause of concern revealed by the study was that while there were areas on the top of the harbor hurricane barrier that may have some wash-over in the 2-ft sea level rise scenario, it is the 4-ft sea level rise scenario where that barrier would be appreciably overtopped across large lengths of the barrier. This would flood an additional 917 acres. This area includes the urban and industrial harbor waterfront and the residential and commercial area in the south end of the City (Fig. 7). In this 4-ft sea level rise scenario zone, behind the Hurricane Barrier there are 2287 built upon parcels with an assessed value of $553.7 million (these totals subtract out the properties not protected by the Hurricane Barrier in Table 1).

It is worth stressing that the inundation area we define for the hurricane barrier overtopping is somewhat conservative in that we presume that the overtopping will occur for a long enough time to completely fill the area behind the barrier. However, as noted earlier, this approach appears consistent with both FEMA's 500-year floodplain (the X-Zone area, Fig. 4), and the ACOE "SLOSH" maps.

With respect to properties owned by a public entity, no public properties with structures were added to the floodplain with the 1 and 2-ft sea level rise scenarios. However, in the case of the 4-ft rise scenario, additional public properties were added, mostly within the hurricane barrier protected area. Table 2 shows a complete list of public properties and their building values in the adjusted baseline floodplain as defined by this study, and the 4-ft sea level rise. As shown, the highest valued public buildings to be affected by a 4-ft sea level rise and overtopping of the hurricane barrier will be the sewage treatment plant, the Alfred J. Gomes School on Second Street, the John B. DeValles School on Katherine Street, the Howland Greene Library, a fire station, and various sewer pump stations.

As mentioned earlier the BBNEP and CZM have concerns about the BFE provided by the FIRM in the area of the sewage treatment plant, and recommends the at the City request a relook at this area by FEMA.

Uncertainties and Use of This Information

There are a number of uncertainties in the analysis presented. If future storms are more severe than in the past, the actual extent of inundation could be greater than described here. Second, this analysis did not consider the elevation of the buildings. Buildings near the margins of a floodplain tend to have minimal flooding compared to properties close to shore and at lower elevations. For these reasons, the maps should be used as general planning tools by public officials and residents about where to construct future structures to minimize their susceptibility to storms with sea level rise, and future liabilities associated with flood insurance. They also can help identify areas that may subsequently enter the jurisdictional regulated area known as the 100-year floodplain that is used by many agencies. Other ways this data can be used is described in the Massachusetts Climate Change Adaptation Report (EEA, 2011).

Table 2. Public properties in the various sea level rise scenarios.

OWNER	STYLE	SITE ADDRESSE	BLDG VALUE
CITY OF NEW BEDFORD	CMTY CTR	950 S RODNEY FRENCH BLVD	$43,080,000
CITY OF NEW BEDFORD	Bath Hse	215 W RODNEY FRENCH BLVD	$1,474,400
CITY OF NEW BEDFORD	CMTY CTR	918 E RODNEY FRENCH BLVD	$321,600
CITY OF NEW BEDFORD	PUMP STA	1699 E RODNEY FRENCH BLVD	$264,400
CITY OF NEW BEDFORD	Public OFC	86 POPES ISLAND	$217,200
CITY OF NEW BEDFORD	Gen Office	MACARTHUR DR	$143,800
CITY OF NEW BEDFORD	Gen Office	MACARTHUR DR	$25,800
CITY OF NEW BEDFORD	PUMP STA	38 WAMSUTTA ST	$17,200
COMMONWEALTH OF MASS	WHSE	MACARTHUR DR	$1,325,900
COMMONWEALTH OF MASS	WHSE	49 STATE PIER	$1,189,400
COMMONWEALTH OF MASS	LABS	706 S RODNEY FRENCH BLVD	$2,664,200
Total for Baseline Conditions			**$50,723,900**
CITY OF NEW BEDFORD	SEWER PLANT	1000 S RODNEY FRENCH BLVD	$53,216,800
CITY OF NEW BEDFORD	Ranch	56 NASH RD	$89,000
CITY OF NEW BEDFORD	3 FAMILY	18 CLEVELAND ST	$58,600
CITY OF NEW BEDFORD	Gomes School	286 S SECOND ST	$41,346,800
CITY OF NEW BEDFORD	Devalle School	KATHARINE ST	$1,897,000
CITY OF NEW BEDFORD	School/CLRM	THOMPSON ST	$698,900
CITY OF NEW BEDFORD	Howland G LIBRARY	3 W RODNEY FRENCH BLVD	$661,400
CITY OF NEW BEDFORD	FIRE STATION	PURCHASE ST	$353,800
CITY OF NEW BEDFORD	Public OFC	170 COVE ST	$305,800
CITY OF NEW BEDFORD	PUMP STA	1095 COVE RD	$272,400
CITY OF NEW BEDFORD	PUMP STA	618 BELLEVILLE AVE	$210,700
CITY OF NEW BEDFORD	PUMP STA	456 S WATER ST	$22,100
CITY OF NEW BEDFORD	PUMP STA	COGGESHALL ST	$14,400
CITY OF NEW BEDFORD	PUMP STA	249 MACARTHUR DR	$14,200
COMMONWEALTH OF MASS	Gen Office	618 ACUSHNET AVE	$369,700
N B HOUSING AUTHORITY	Apartment	12 RUTH ST	$8,852,600
N B HOUSING AUTHORITY	4-5 FAMILY	895 BELLEVILLE AVE	$4,372,800
N B HOUSING AUTHORITY	Apartment	134 S SECOND ST	$3,694,500
N B HOUSING AUTHORITY	6 FAMILY	662 S FIRST ST	$322,300
N B HOUSING AUTHORITY	6 FAMILY	949 S WATER ST	$290,000
N B HOUSING AUTHORITY	6 FAMILY	688 S FIRST ST	$290,000
N B HOUSING AUTHORITY	6 FAMILY	865 S WATER ST	$290,000
N B HOUSING AUTHORITY	6 FAMILY	6 DIVISION ST	$256,100
N B HOUSING AUTHORITY	2 FAMILY	152 S SECOND ST	$244,100
N B HOUSING AUTHORITY	4-5 FAMILY	43 DELANO ST	$232,400
N B HOUSING AUTHORITY	4-5 FAMILY	899 S WATER ST	$230,100
N B HOUSING AUTHORITY	4-5 FAMILY	677 S FIRST ST	$229,300
N B HOUSING AUTHORITY	4-5 FAMILY	24 DELANO ST	$227,400
N B HOUSING AUTHORITY	4-5 FAMILY	126 BLACKMER ST	$226,700
N B HOUSING AUTHORITY	4-5 FAMILY	19 DIVISION ST	$224,200
N B HOUSING AUTHORITY	4-5 FAMILY	640 S FIRST ST	$205,300
N B HOUSING AUTHORITY	CMTY CTR	678 S FIRST ST	$192,100
N B HOUSING AUTHORITY	4-5 FAMILY	21 WHITMAN ST	$183,400
N B HOUSING AUTHORITY	4-5 FAMILY	16 MOSHER ST	$169,700
N B HOUSING AUTHORITY	4-5 FAMILY	21 DESAUTELS ST	$167,800
N B HOUSING AUTHORITY	2 FAMILY	27 DELANO ST	$130,500
N B HOUSING AUTHORITY	2 FAMILY	36 WHITMAN ST	$118,900
N B HOUSING AUTHORITY	2 FAMILY	30 WHITMAN ST	$118,900
N B HOUSING AUTHORITY	Apartment	224 ACUSHNET AVE	$13,456,800
N B HOUSING AUTHORITY	Apartment	116 GRIFFIN CT	$12,799,200
N B HOUSING AUTHORITY	Apartment	116 ACUSHNET AVE	$12,756,000
N B HOUSING AUTHORITY	Apartment	92 S SECOND ST	$1,569,600
N B HOUSING AUTHORITY	4-5 FAMILY	610 S FIRST ST	$1,502,800
N B HOUSING AUTHORITY	2 FAMILY	59 HOWARD AVE	$171,800
N B HOUSING AUTHORITY	2 FAMILY	86 SYLVIA ST	$164,200
NEW BEDFORD REDEVELOPMENT AUTHORITY	Cape cod	424 S FRONT ST	$61,600
SOUTHEASTERN REGIONAL TRANSIT AUTH	COMM GAR	65 POTOMSKA ST	$304,500
Total for 4 ft Sea Level Rise			**$163,587,200**

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Appendix A. Detailed maps showing the expanded floodplain boundaries under the various sea level rise scenarios. The locations of the detailed panel maps can be determined using the key below.