

CITY OF NEWBURYPORT, MASSACHUSETTS

Modeling Future Effects of Coastal Storms & Sea Level Rise

Newburyport



Businesses and recreational areas in Downtown Newburyport suffer from coastal and Merrimack River flooding. photo credit: J. Teixeira

Like many communities along the North Shore of Massachusetts, the City of Newburyport is vulnerable to climate-driven hazards, including sea level rise and storm surge. Predicted sea level rise and increased storm surge have the potential to significantly impact Newburyport's coastal economy and the natural systems that the community depends upon. Understanding where and how these hazards are likely to impact the community is a necessary first step in addressing vulnerability.

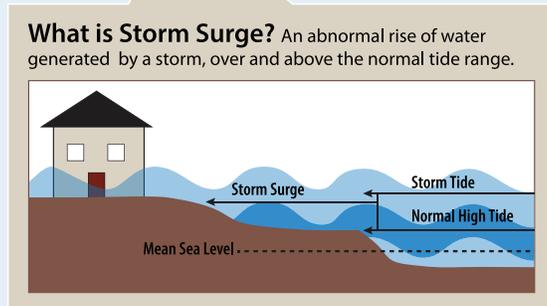
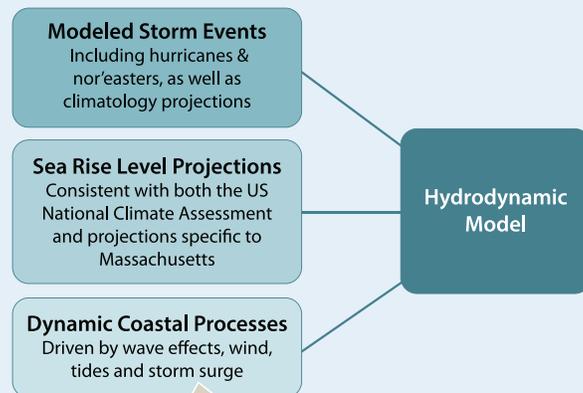
Newburyport has high exposure to coastal flooding, riverine flooding, and erosion due to its topography, hydrology, and geographic location. Plum Island, with dense residential development, faces the open ocean and is highly exposed to wind, wave action, and sea level rise – with no buffering landmass to diminish these hazards. Interior portions of Newburyport rely on Plum Island and its salt marshes to buffer the worst storm effects. However, the Merrimack River and the Little River, bordering the northern and southern parts of the city, can bring floodwaters to much of Newburyport's most valued areas.

As seen in the maps on the reverse side, much of Newburyport's residential, commercial, and industrial infrastructure is located along the coast and in low-lying areas that are susceptible to flooding from storm surge, sea level rise, and riverine flooding. In particular, Newburyport's downtown waterfront district is located along the Merrimack River, where major storms repeatedly expose commercial businesses and public recreational areas to flooding.

Current activities in Newburyport and throughout the Great Marsh are seeking to manage flood waters and restore beach and marsh systems. However, these activities may not be sufficient to protect our communities in the future. We need to expand on our efforts to restore natural systems, while simultaneously providing support for existing infrastructure.

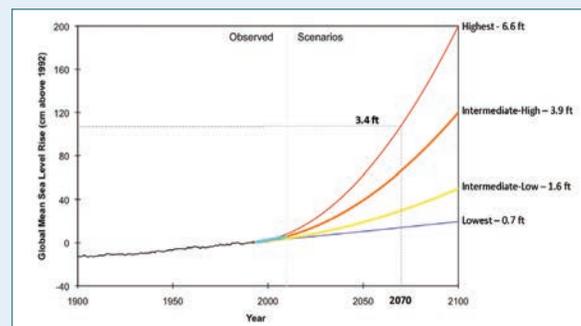
The goal of the Great Marsh Resiliency Planning Project is to work together on identifying and prioritizing strategies which will help our communities adapt to future climate changes. We aim to reduce the vulnerability of coastal communities through protection of the marsh and our natural systems.

As part of the Great Marsh Resiliency Planning Project, the City of Newburyport took part in a mapping effort to identify areas that are particularly vulnerable to coastal inundation. The hydrodynamic model used in the maps was comprised of several, highly detailed sets of data.



How Much Sea Level Rise?

- Present day (considered 2013) results incorporate existing sea level conditions.
- 2070 results incorporate 3.4 feet of sea level rise, which is also approximately the "Intermediate-High" scenario for 2090



Global Mean Sea Level Rise Scenarios. The highest, or worst-case scenario is based on estimated rise in ocean temperatures leading to thermal expansion combined with maximum melting of the glaciers and ice sheets. The lowest scenario assumes a historical rate of sea level rise with no increase due to climate change. Adapted from the US National Climate Assessment (Melillo et al. 2014) and NOAA (Parris et al. 2012).

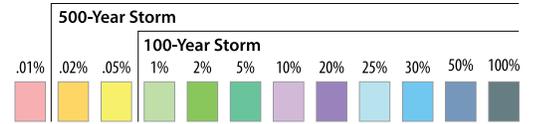


A Closer Look at Coastal Inundation

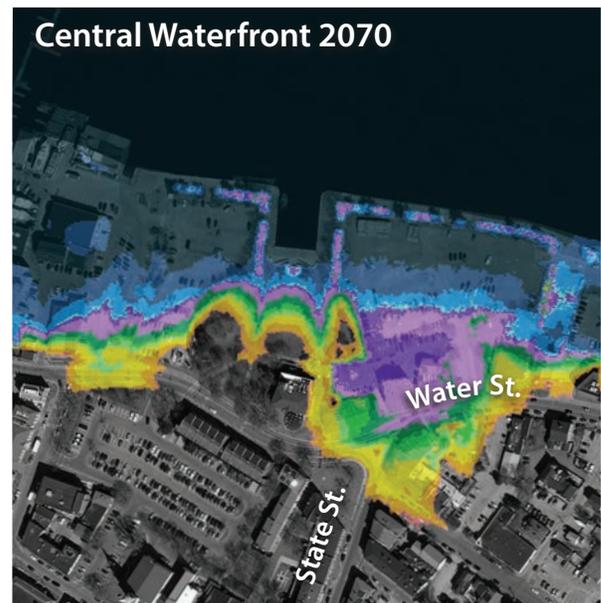
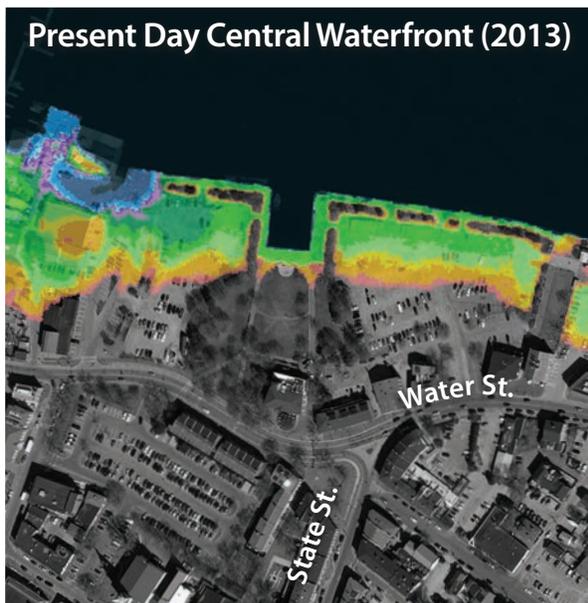
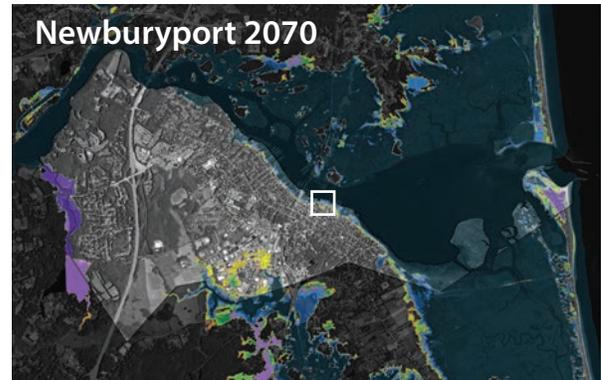
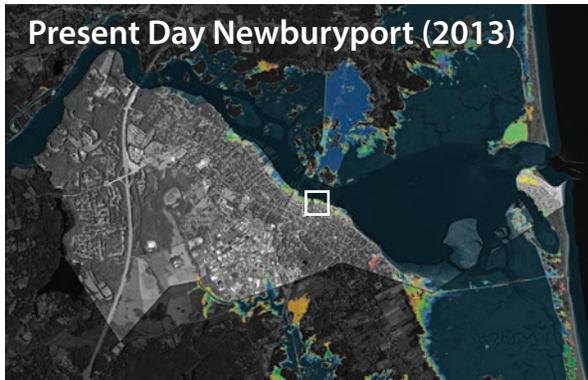
These maps illustrate current (2013) and future (2070) probability of coastal inundation in Newburyport, Massachusetts. Results are based on a hydrodynamic model developed for the Massachusetts Department of Transportation (Famely et al. 2016). Note: This data does not take into account inland freshwater flooding or the influence of waves as they move over land.

Percent risk of coastal flooding, also called probability of inundation, is defined as the likelihood that at least two inches of flood water will encroach on the land at a particular location at least once in a calendar year.

Percent Risk of Coastal Flooding



What does this mean? A building that lies within the 50% flood exceedance zone would have a 50% chance of flooding at least once in the calendar year.



By 2070, the majority of the Downtown Waterfront in Newburyport will be inundated at least once per year, with floodwaters extending across and above Water Street.

For more maps and information, please visit:
www.greatmarshresiliency.org



Maps created by the National Wildlife Federation with funding provided by the Massachusetts Office of Coastal Zone Management through their Coastal Community Resilience Grant Program.
 Literature Cited: Famely, J., K. Bosma and B. Hoffnagle. 2016. *Sea Level Rise and Storm Surge Inundation Mapping – Great Marsh Communities (Essex County, MA)*. Prepared by Woods Hole Group for National Wildlife Federation and U.S. Geological Survey.
 Meilillo, J.M., T.C. Richmond, and G.W. Yohe. Eds. 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. Washington, DC: U.S. Global Change Research Program, 841.
 Paris, A., P. Bromirski, V. Burkett, D. Cayan, M. Culver, J. Hall, R. Horton, K. Knutti, R. Moss, J. Obeyesekere, A. Sallenger, and J. Weiss. 2012. *Global Sea Level Rise Scenarios for the United States National Climate Assessment*. NOAA Tech Memo OAR CPO-1. Silver Spring, MD: National Oceanic and Atmospheric Administration, 37.
 Data Source: Bosma, K., E. Douglas, P. Kirshen, K. McArthur, S. Miller and C. Watson. 2016. *MassDOT-FHWA Pilot Project Report: Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options for the Central Artery*. Photo Science, Inc. (2012). State of Massachusetts (Raster DEM); LIDAR for the North East – ARRA and LIDAR for the North East Part II. (USGS Contract: G10PC00026, ARRA LIDAR Task Order Numbers) USGS Contract: G10PC00026 Task Order Number: G10PD02143 Task Order Number: G10PD01027 (ARRA) and G10PD02143 (non-ARRA). Aerial Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Coordinate System: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001.