

**TIDES TO STORMS 2 – ADAPTATION IMPLEMENTATION**  
Funded by a grant from the Northeast Region Ocean Council

**CITY OF PORTSMOUTH, NEW HAMPSHIRE**  
**SEA-LEVEL RISE AND CLIMATE ADAPTATION GUIDANCE**  
**November 3, 2016 DRAFT**

**Background**

As documented in the Coastal Resilience Initiative report, the City of Portsmouth may be impacted by rising seas and storm surge particularly commercial and residential areas adjacent to North Mill Pond, South Mill Pond, Little Harbor and the South End. There may be opportunities in these high risk areas to construct barriers that prevent flooding (e.g. tide gates, sea walls and saltmarsh protections), elevate structures and roads, and adapt existing development to rising water levels (e.g. removing habitable space below the base flood elevation). Managing stormwater runoff will also be a key component of any flood reduction strategy as coastal storms are often accompanied by heavy precipitation that can overwhelm drainage infrastructure especially during high tides.

The real or perceived threat of sea-level rise depends often on the scale, timeframe, type of development or natural resource goals being considered. Storm surge represents the greatest threat today in any given year while sea-level rise may manifest itself in longer-term impacts of rising tides and flood waters. However, conditions today have not become dire enough to impact property values. In fact, the assessed value of coastal properties in New Hampshire continue to rise while many other properties have seen modest declines in assessed value.

Recent news articles report no shortage of willing and capable investors and people who want to live in these high risk coastal areas which has kept development growing in places like Florida and the mid-Atlantic coast despite daily flooding from rising tides and events like Super Storm Sandy. These articles also state that property values often start to slide after a catastrophic event hits or when it's just around the corner (e.g. extensive erosion), and in the (near) future when the cost of repair and insurance become prohibitive. New Hampshire's coast remains an important local and regional economic resource. Efforts to better understand flood risk will help municipalities and the state plan for changing conditions and the possibility of managing land use and natural resources differently in the future.

Adaptation offers options to extend the longevity of structures and natural resources, protecting them against minor tidal and storm related flooding, thus protecting property values at least in the short-term and perhaps as far out as 2050. Iterative adaptation actions will likely be necessary to respond to changing conditions until

adaptation become too costly or infeasible to sustain. Architects and developers in areas impacted by Super Storm Sandy report that elevated structures weathered the storm with moderate to little damage.

<http://www.air-worldwide.com/Publications/AIR-Currents/2015/Insights-into-Storm-Surge-Vulnerability/>

### **Request for Technical Assistance**

The City of Portsmouth, New Hampshire requested technical assistance from the Rockingham Planning Commission using the Coastal Resilience Initiative (CRI) recommendations as a starting point to:

- A. Review the CRI recommendations and other possible changes to the Zoning Ordinance, Building Code, and Site Review Regulations to make the City more resilient to impacts from climate change.
- B. Research examples of other communities that have successfully implemented changes to protect communities from sea level rise.
- C. Review the feasibility of implementation; for example, is enabling legislation in place, or there are conflicting state statutes or rules which may restrict passage of proposed ordinance or regulation changes.

Below are responses to the technical assistance requested in A-C above.

### **A. Options for Implementing land use and development standards and natural resource protections that increase resilience and minimize impacts to climate change.**

#### **1. Land Development Standards**

##### Zoning

##### *1. Performance-Based Zoning*

Performance-based standards require a site to function in a particular way, regardless of the design or its use. Performance-based standards can allow for greater functions at lower costs than prescriptive standards because they accommodate more creative and integrated designs. The goal is for every development site to attain specific measurable objectives, for example: accommodate flood waters of a certain depth; locate first floors of structures, utilities and living space above a certain based flood elevation; or tie into existing or retrofitted infrastructure, including access ways and roadways. These standards could be adopted as part of the local building code, zoning dimensional standards, and land development regulations (site plan review and subdivision). See following sections for additional detail.

Performance based zoning can also include designation of flood hazard overlay districts (which may be contained within or extend beyond the regulatory 100-year floodplain) based on specific sea-level rise and storm surge flood scenarios. More than one overlay district may be identified based on the existing development pattern and feasibility of allowing natural landscapes to persist, such as saltmarsh and freshwater systems. In cases where development or structures cannot be located or relocated outside a flood hazard area, floodproofing techniques and installation of flood barriers may be an appropriate strategy. In cases where development or structures can be set back outside a flood hazard area, the overlay district may require the setback area to remain in a natural condition to allow for marsh migration and flood storage.

##### Building Code

##### *2. Elevate Single Structures*

Elevating new and substantially improved residential structures located in a designated flood hazard area is one of the best flood protection measures. Elevated structures will be less vulnerable to current storm related flooding and long-term impacts of sea-level rise. Current guidance from the federal Executive Order 13690 recommends all new or substantially improved non-critical structures and facilities be elevated 2 feet above the base flood-elevation and adding an additional 3 feet to the base flood elevation for critical structures and facilities. See Appendix A for detailed information about Executive Order 13690.

### *3. Flood-Proof Multiple Attached Non-Residential Structures*

Elevating multiple attached non-residential structures becomes difficult given the unlikelihood that all structures would be modified at the same time and because they are served by shared infrastructure and utilities. Portsmouth's historic district and waterfront have many attached structures making these high risk flood areas challenging from an adaptation standpoint. In this instance, adaptation would occur as individual properties are substantially improved or redeveloped. Adaptation options for individual structures might include: wet and dry floodproofing; relocating utilities to the second floor or higher; and converting living space below the base flood elevation to uses such as parking or other low risk uses. Additional flood prevention strategies may include the construction of sea walls or berms to protect attached structures or an entire block of structures.

*Below are 3 Options for establishing expanded flood hazard area and requiring elevation of structures in these designated areas. Option A would be a good starting point for increasing resilience in the regulatory floodplain, and the adoption of Option B and Option C would further strengthen this approach.*

#### **SAMPLE LANGUAGE: ELEVATION OF STRUCTURES AND EXPANDED FLOOD HAZARD AREAS**

- A. OPTION A.** Add a freeboard requirement to the existing floodplain management ordinance, substituting the freeboard value for the requirement to elevate to the base flood elevation. This would apply to all new or substantially improved structures in the 100-year regulatory floodplain.
- B. OPTION B.** Expand the authority of the existing floodplain ordinance to include the 500-year floodplain whereby all requirements would apply within the expanded floodplain area.
- C. OPTION C.**
- 1.) Designate special flood hazard areas outside the 500-year regulatory floodplain. Designated special flood hazard areas would include areas located outside the 100-year and 500-year regulatory floodplains where flooding from precipitation, seasonal high tides and storm surge frequently occurs. These additional special flood hazard areas would be subject to the requirements of the city's floodplain ordinance.
  - 2.) Identify additional special flood hazard areas based on mapping from the Community Resilience Initiative report, capturing areas where flooding from sea-level rise and/or storm surge is projected beyond the 100-year and 500-year floodplains.
  - 3.) Expand the jurisdiction of the existing floodplain management ordinance to include these designated flood hazard areas.

The designated flood hazard area is defined as land at or below [*select a higher elevation based on sea-level rise or storm surge scenarios such as the intermediate 11.5-foot flood elevation contour*]. The purpose of the designated flood hazard area(s) [*such as a flood hazard overlay district*] is to provide the following: storage of flood waters; accommodation of sea-level rise; inland migration of salt marsh; and preservation of coastal aquatic habitats. Structures in the designated flood hazard areas must comply with the following standards.

#### Site Review Regulations

##### *4. Performance Based Site Design*

As described in the Zoning section above, performance based development standards may provide for more flexible and resilient designs for new development, expansion and redevelopment. Development is designed to achieve and accommodate a specific “flood condition” [e.g. the 11.5-foot flood elevation or 50-year precipitation event] that can be met using different means resulting in any number of varying designs. In historic districts exterior aesthetic and historical character would need to be addressed as well. Site design standards might include: impervious cover limits; capacity for storage of flood waters; stormwater management practices that retain and store runoff; retention of pervious surfaces and natural ground cover; and buildings and structures designed to allow for adaptive modifications in the future.

## **2. Natural Resource Protection**

##### *5. Salt Marsh Migration*

Based on the Coastal Resilience Initiative report (2013) and Tides to Storms Vulnerability Assessment (2015), future inland migration of salt marsh is most viable in the Sagamore Creek watershed and its tidal tributaries. Currently, 167 acres of salt marsh lie within Portsmouth. At the 3.9 feet sea level rise by 2100 scenario there is potential for 160 acres of new marsh to form and at the 6.6 feet scenario there is potential for 210 acres. Protecting land where salt marsh can potentially migrate is a good strategy to enhance coastal resiliency. Although opportunities for conservation are limited due to the developed nature of Portsmouth, there are potential areas, particularly along Sagamore Creek. Of those available, a few areas are priority for conservation as they are currently mainly undeveloped and may persist under the highest sea level rise scenario modeled at 2100. There are several opportunities to remove or modify barriers to tidal flow, although not all will be logistically feasible. Refer to the Tides to Storms Vulnerability Assessment for maps of potential migration areas and barriers.

##### *6. Flood Storage Buffers for Salt Marsh and Freshwater Wetlands*

Aside from their ecological benefits, natural buffers from salt marsh and freshwater wetlands offer substantial benefits in storing flood waters and accommodating rising sea-levels in the future. Preserving these buffers in a natural state also prevents new development and expansion of existing development in these areas of high flood risk. For expansion of existing development, structures should be no closer to the highest observable tide than existing structures, and preferably set back a greater distance.

#### **SAMPLE LANGUAGE: PROTECTIVE BUFFER IN THE DESIGNATED FLOOD HAZARD AREA**

- A. Pursuant to RSA 674:21 the Planning Board is hereby authorized to grant a Conditional Use Permit to allow structures in the Flood Hazard Area Overlay District in accordance with the restrictions and requirements of this section. **OR** Pursuant to RSA 674:33 the Zoning Board of Adjustment is hereby authorized to grant a

Special Exception to allow structures in the Flood Hazard Area Overlay District in accordance with the restrictions and requirements of this section.

- B. The purpose of the Flood Hazard Area Overlay District [*flood hazard overlay district since some areas may not be contiguous*] is to establish a protective flood buffer that provides the following functions: storage of flood waters; accommodation of sea-level rise; inland migration of salt marsh; and preservation of coastal aquatic habitats.
- C. The Flood Hazard Area Overlay District is depicted on the map [*insert map name and adoption date*]. The Flood Hazard Area Overlay District is defined as land beyond the boundary of designated special flood hazard areas, as identified by the Federal Emergency Management Agency (FEMA) in its “Flood Insurance Study for Rockingham County, NH” [*insert map adoption date*], and landward to the elevation of [*choose an elevation that corresponds with a sea-level rise or other scenario that will offer long-term flood impact protection and meet the purpose statements*].
- D. New structures and impervious surfaces shall be located outside of the Flood Hazard Area Overlay District to the maximum extent possible. New construction shall comply with the standards in part E in cases where less than 2,000 square feet of a parcel or lot is located outside the Flood Hazard Area Overlay District.
- E. Existing structures and impervious surfaces within the Flood Hazard Area Overlay District may be maintained in their current configuration and footprint. If the footprint of an existing structure is enlarged, and for new construction, the enlarged or new structure must be elevated to [*choose an elevation that corresponds with a sea-level rise scenario that will offer long-term flood impact protection, such as Mean Higher High Water plus 3.9 feet which is the intermediate high sea-level rise scenario from the 2014 National Climate Assessment*]. The total area of existing impervious surface on a parcel or lot, other than structures, shall not be increased within the Flood Hazard Area Overlay District.

## **A. Municipal Infrastructure**

### *7. Flood Barriers and Control Structures*

Structural improvements can offer substantial protection against rising seas, coastal storm surge and increased precipitation. As discussed previously, land development and natural resource standards can increase the adaptive capacity of the built environment and natural landscapes in the face of changing conditions over time. However, Portsmouth has several areas along its waterfront and tidal systems where simply constructing barriers to flooding may be the most effective strategy. These areas include the North and South Mill Ponds, Strawberry Banke and Puddledock, and the South End. Sea walls, tide gates and other types of barriers would be costly but offer long term solutions that could protect property, infrastructure, and historical and cultural resources. These structures can be designed to allow for future adaptive modifications to accommodate rising flood levels. Also see Case Study: Salisbury, Massachusetts.

### *8. Flood Storage and Control Structures*

Cities along the eastern seaboard have begun investing in large infrastructure projects aimed at increasing flood storage capacity (e.g. underground tunnels and storage chambers, and surface retention areas). Creating additional flood storage as part of the developed landscape paired with strategies that reduce runoff have proven effective in alleviating flooding in places like New York City, Miami (FL), Norfolk (VA) and Charleston (SC). Also see Case Study: Salisbury, Massachusetts.

**B. Research examples of other communities that have successfully implemented changes to protect communities from sea level rise.**

*Case Study: Salisbury, Massachusetts*

The Town of Salisbury Massachusetts is currently completing installation of a sea wall to protect a low-lying neighborhood from 9<sup>th</sup> Street to Lewis Street west of Route 1A. The project was approved by U.S. Army Corps of Engineers and the Town of Salisbury, and funded by the U.S. Army Corps of Engineers and the Massachusetts Department of Conservation and Recreation. The project construction cost was \_\_\_\_\_, excluding permitting expenses. The 2-4 feet high molded plastic, interlocking wall was constructed just beyond mean high water with extensive marsh of the Hampton-Seabrook Estuary and Dead Creek behind it. The wall has several outfalls to divert stormwater runoff from local streets. With few options to protect these properties and limited space between the densely developed area and the saltmarsh, the low profile wall offers protection against tidal flooding and storm surge based on current conditions. The project did not incorporate sea-level rise scenario or climate change data in the design. If these properties were to be abandoned in the future, some sort of structural treatment or dune restoration would be necessary to protect Route 1A.

**Photo 1: molded plastic sea wall.**

**Photo 2: stormwater outfall.**

**Photo 3: stormwater catch basin.**



*Case Study: Sea-Level Rise Strategy for Charleston, South Carolina (2015)*

Since 2013, City of Charleston staff representing various areas of expertise, including engineering, planning, sustainability, emergency management and information technology, began the process of analyzing the potential for sea level rise in the Charleston region and its impact. Charleston recognized the need to define its vision and strategy to support specific improvements in infrastructure and processes that will be required to prepare for higher tides. Staff concluded that actions and investments to address sea level rise now will avoid or reduce expected future costs and provide immediate community benefits through reduced risks to life and property, lower flood insurance premiums and lessened interruption of business during and after a flood event. The purpose of their Sea-Level Rise Strategy (2015) is to inform and provide an overall guiding framework to protect lives and property, maintain a thriving economy, and improve quality of life by making the City more resilient to sea level rise and recurrent flooding. Charleston’s Sea-Level Rise Strategy is based upon a resilience framework based on three aspects of resilience: reinvest, respond, ready. The city anticipates the document will be regularly updated to reflect external conditions such as scientific interpretations, extreme events such as the October 2015 flood, current City policy, and priorities and analysis that leads to

new initiatives. The document is available at and available at <http://www.charleston-sc.gov/index.aspx?NID=1432>.

**C. Review the feasibility of implementation; for example, is enabling legislation in place, or there are conflicting state statutes or rules which may restrict passage of proposed ordinance or regulation changes.**

The report *New Floodplain Maps for a Coastal New Hampshire Watershed and Questions of Legal Authority, Measures and Consequences* by the Vermont Law School Land Use Clinic (2012) concludes that New Hampshire statutes do not restrict nor does case law set a precedent that prevents a municipality from adopting zoning or land use regulations that incorporate climate based science and information that estimates future conditions such as sea-levels, storm frequency and severity, and precipitation.

RSA 674:3 was modified in 2013 to allow municipalities to adopt a coastal management section in their Master Plans. This statute enables municipalities to consider and address planning needs resulting from projected coastal property or habitat loss due to increased frequency of storm surge, flooding, and inundation. Portsmouth may incorporate data and analysis from the Coastal Resilience Initiative report and Tides to Storms Vulnerability Assessment to support recommendations and other strategies the city identifies to address the impacts of climate change. Actions identified in this chapter will enable the city to adopt regulations, make infrastructure improvements and adopt policies to implement climate adaptation and promote a sustainable and resilient community.

## COASTAL MUNICIPALITIES CLIMATE CHANGE RESOURCES

**Charleston, S.C.**

Interactive Mapper <http://www.charlestoncitypaper.com/charleston/new-interactive-map-shows-effects-of-sea-level-rise-on-charleston/Content?oid=4972978>

[http://papers.risingsea.net/downloads/Challenge\\_for\\_this\\_generation\\_Barth\\_and\\_Titus\\_chapter4.pdf](http://papers.risingsea.net/downloads/Challenge_for_this_generation_Barth_and_Titus_chapter4.pdf)

<http://www.postandcourier.com/article/20140728/PC16/140729369>

<http://www.climatecentral.org/news/the-front-lines-of-climate-change-charlestons-struggle-16934>

Sea-Level Rise Strategy <http://www.charleston-sc.gov/DocumentCenter/View/10089>

SLR Website <http://www.charleston-sc.gov/index.aspx?NID=1432>

SLR Viewer <http://gis.charleston-sc.gov/interactive/slr/>

**Norfolk, V.A.**

[https://www.washingtonpost.com/business/economy/in-norfolk-evidence-of-climate-change-is-in-the-streets-at-high-tide/2014/05/31/fe3ae860-e71f-11e3-8f90-73e071f3d637\\_story.html](https://www.washingtonpost.com/business/economy/in-norfolk-evidence-of-climate-change-is-in-the-streets-at-high-tide/2014/05/31/fe3ae860-e71f-11e3-8f90-73e071f3d637_story.html)

<http://www.npr.org/2014/06/24/324891517/as-sea-levels-rise-norfolk-is-sinking-and-planning>

PBS Video <http://www.pbs.org/wnet/need-to-know/environment/rising-tide-in-norfolk-va/13739/>

<http://www.dailyclimate.org/tdc-newsroom/2012/08/norfolk-sea-level-rise>

<http://www.wri.org/blog/2014/07/sea-level-rise-cuts-across-political-divide-norfolk-virginia>

Norfolk Flood Awareness and Mitigation website <http://www.norfolk.gov/index.aspx?NID=1055>

## COASTAL DEVELOPMENT AND ECONOMICS

**New Jersey**

[http://www.nytimes.com/2014/04/06/realestate/back-to-the-jersey-shore.html?\\_r=0](http://www.nytimes.com/2014/04/06/realestate/back-to-the-jersey-shore.html?_r=0)

**Florida**

<http://www.air-worldwide.com/Publications/AIR-Currents/2015/The-Growing-Value-of-U-S--Coastal-Property-at-Risk/>

<http://www.johnenglander.net/sea-level-rise-blog/goodbye-miami-rolling-stone-july-4th>

<http://wlrn.org/post/will-south-florida-s-real-estate-market-prices-plunge-seas-rise>

[http://articles.sun-sentinel.com/2013-11-08/news/fl-climate-real-estate-20131108\\_1\\_estate-market-real-estate-values-property-values](http://articles.sun-sentinel.com/2013-11-08/news/fl-climate-real-estate-20131108_1_estate-market-real-estate-values-property-values)

<http://www.miamiherald.com/news/local/community/miami-dade/article1957294.html>

**Annapolis, Maryland**

Flood Mitigation Strategies document

<http://www.annapolis.gov/Government/Departments/PIZon/CDAC/Presentation/Copy%20of%20SEA%20RISE%20STUDY%20Report%20City%20Dock%203-31-11.pdf>

Weather it Together: Facing the Challenge website <https://www.facebook.com/WeatherItTogether/>