5. Understanding What We Need To Do

5.1 General Guidance for Responding to Coastal Flood Risk

In formulating its recommendations, the Commission considered existing approaches to establishing general design and construction standards for structures and facilities that have been considered and enacted in New Hampshire, other states, and at the Federal level. These guidance resources have been summarized in Appendix C. Based on that research, the Commission lays out general guidance and planning principles for responding to coastal flood risk in New Hampshire.

Options for Responses

The increased risk of exposure to coastal flooding from storm surge, sea-level rise, and extreme precipitation raises a number of important issues that should be considered at the state, regional, and local levels. There are considerations that apply to our collective approach and response to this challenge as a state and as communities, as well as responses that apply to the specific asset classes affected (e.g. our economy, our built landscape, our natural resources, and our heritage). The options for responses can be divided into three categories.

1. Defend

This response employs primarily engineered solutions whereby specific sections or features of coastline are protected to prevent coastal erosion and the loss of structures and facilities from flooding—to "keep the water out." Defense techniques can include natural and built systems. Examples of natural systems include creating, protecting, or refurbishing existing sand dunes, vegetated and appropriately sized buffers along rivers and streams and intact wetland systems that can serve to absorb flood waters and wave energy. Built structures include seawalls, dikes, revetments, and ablative defenses such as beach nourishment. There are also hybrids of built and natural defense strategies. Other states have utilized sea walls that incorporate vegetated sections in certain areas. This approach enhances the look of the structure and offers additional benefits from natural defenses and other ecosystem services that vegetation can provide (habitat, food, shading, etc.). Defensive strategies may be appropriate where total cost is not excessive relative to the value of the assets being protected or where safety of populations is at stake. In the case if continuing sea-level rise, the cost effectiveness of this strategy can be expected to decline over time as the cost to defend fixed assets and populations becomes progressively greater. At some point, safety may no longer be reasonably assured regardless of the built and natural defenses.

Adapting Our Coastal Communities Together

The New Hampshire Coastal Adaptation Workgroup (NHCAW) is a collaboration of 22 partners and organizations working to help communities in southeastern New Hampshire prepare for the effects of extreme weather events and other effects of long term climate change.

Photo credit: Cathy Coletti

Since inception in 2010, NHCAW has led numerous projects and events that have elevated discussions about climate preparedness at municipal, state, and regional levels. NHCAW partners incorporate peer-reviewed science and research in the development of tools and technical guidance, and outreach in the coastal watershed to help communities better prepare for the effects of a changing climate in order to protect their social, economic, human and environmental health. For more information, refer to NHCAW's website at **www.nhcaw.org**.

2. Accommodate

Photo credit: Daniel Gobbi

Accommodation combines engineered, natural, behavioral, and land use solutions to minimize flooding and, where possible, "live with water." Common accommodate examples include elevating structures on pilings in flood prone areas and designing buildings to allow flood waters to enter the lowest floor while relocating vulnerable systems (heating/cooling units, electricity, and plumbing) to upper floors to avoid damage. Another accommodate strategy is the use of cleared natural drainage corridors for storm driven waves between the ocean and back channel sides of barrier islands. Accommodation usually happens incrementally in response to changing conditions; however, this incremental approach presents significant challenges in the case of linear facilities such as roads, sewer lines, and other utilities. They must be modified in logical segments requiring a coordinated approach. The mix of accommodate strategies can be expected to change incrementally as some strategies decline in effectiveness as the severity of the flooding impact progresses.

3. Retreat

This response involves abandoning or converting areas where the frequency and severity of flooding impacts are such that permanent settlement is no longer viable or desirable. This response could be undertaken quickly as the consequence of a government buyout or resettlement program (e.g., immediately after a severe flood), or it could occur slowly – the result of a growing inability to provide essential services and of many independent decisions made over time by individual property owners to leave a vulnerable area because of rising costs, repeated loss, or unacceptable risk. Innovative regulatory methods such as rolling easements can facilitate incremental retreat by allowing the existing use of properties for as long as use remains viable, but prohibiting any shoreline armoring or other engineered protections.

In New Hampshire, and likely in other coastal states, the approach taken will be a combination of all three options. Appropriate strategies will likely change over time as the degree of flood risk and exposure rises, requiring the State and municipalities to periodically reassess their responses.

Guiding Principles

Based on the science reviewed and documented in the STAP report, flood risk in the coast is rising, but the rate of that rise is uncertain. A response to defend a segment of coast that is sensible and cost effective in 2050 may become untenable in 2100. Making sensible long-term recommendations with this uncertainty is challenging, and requires flexible approaches. Nevertheless, there are some general guidelines and principles that are useful in making the best possible decisions along the way.

Act Early

Responding now to the future threat of coastal flooding will maximize long-term cost savings that result from building more resilient communities. Resilience is achieved in part by ensuring all current and future investments in facilities and structures can accommodate increases in flood levels expected over their design life without sustaining large losses. If all future new construction and major renovations in vulnerable areas incorporate resilient designs appropriate to the risk expected within the facility's design life, communities can become incrementally more resilient over time. By starting now, the normal cycles of construction, replacement, and redevelopment can be harnessed to gradually replace substandard designs, often at minimal additional costs.

Photo credit: Laura Fallis

Communities that implement climate adaptation actions early may see many benefits, including but not limited to:

- Enhanced preparedness and community awareness of future flood risks,
- Early identification of cost-effective measures to protect and adapt to changing conditions,
- Improved resiliency of facilities, structures, and other community investments, and
- Protected life, property, and local economies,
- Protected coastal natural resources and the critical services they provide,
- Preserved historical assets and unique community character, and
- Additional credit points awarded through the NFIP Community Rating System (CRS), which provides flood insurance premium discounts for residents in participating communities.

Respond Incrementally

The most difficult circumstance under which to take action in response to a future threat is when there is uncertainty about the degree of risk from that threat. This is especially true when the threat is distant in time and the cost of responding is high – such as with the coastal flooding threat from climate change. In coastal flooding there is risk both in over- and under-estimating the threat. If overestimated, actions may be taken that are unnecessarily expensive and disruptive. If underestimated significant losses in property, resources, and even lives could result.

In these circumstances, an incremental and iterative approach is best, allowing multiple opportunities to refine and correct actions as understanding improves. An incremental approach can adjust to either gradual or catastrophic sea-level rise. At this juncture wholesale investment in hardened shoreline protection structures and major efforts to retreat are not necessary, though these strategies may be appropriate in select, isolated locations. Instead, improving resiliency and the ability to adapt to a wide range of scenarios is the best course of collective action.

Revisit and Revise

Over time, we expect projections of sea-level rise and other contributors to coastal flooding to become more certain, and as they do, we will be better able to predict both the rate at which and by how much sea level is expected to rise. This refinement will allow estimates of vulnerability to become more precise. Likewise, our responses must keep pace with changes in understanding. It is vitally important that state and municipal officials periodically revisit these projections and assumptions and adjust the report's recommendations accordingly.

Collaborate and Coordinate

The State and municipalities share built and natural assets on the coast, and as a result, they need to align policies, assumptions, and responses about future coastal flood hazards to the greatest extent possible. Failure to coordinate such policies and actions will increase the cost and decrease the effectiveness of planning and preparation. Long-term planning and actions to prepare for future flood risk should be developed collaboratively between state, regional, and local governments.

Photo credit: Nathalie Morison

Incorporate Risk Tolerance in Design

With respect to future coastal flood risk, structures, facilities, and other resources should be designed with high safety margins, however, in preparing for future hazards, not all situations warrant the same precautions. Risk tolerance is an important concept in creating sensible and flexible building and design standards. Buildings and facilities that are critical to public functions or safety, that are intended to last a very long time, or that are very expensive to replace should be considered to have low risk tolerance. Facilities and assets with low risk tolerance include (but are not limited to) hospitals, water treatment facilities, bridges, and utilities, as well as irreplaceable or unique historic sites, essential ecosystems, and high value economic assets. In other words, these are assets we can't afford to lose. Design standards should be high for facilities that have low risk tolerance, even if cost is higher to build or maintain them – because as a society we can't afford to do otherwise. Conversely, facilities and structures that are low value, short-lived, easily replaced, or that don't serve a critical function have a high risk tolerance. They do not necessarily require as much concern and can be designed to lower standards.

Make No Regrets Decisions

Generally a no regrets policy or approach refers to actions that yield multiple benefits even under the lowest sea-level rise scenario.[vii] More often than not, acting in ways that improve a community's resilience to present-day risk and hazards will enhance its adaptive capacity to address longer term climate change impacts. Additionally, no regrets decisions should incur relatively low costs or save money over the medium to long term. For example, elevating a pump station three feet above current base flood elevation will increase its ability to function during current coastal storm and flood events, regardless of how much sea level rises in the future. Not only will a functioning pump reduce flooding impacts, it may also remove the need and associated risk and costs for repairs or replacement during or immediately following an emergency or disaster.

5.2 Science and Technical Advisory Panel Guidance

As described in Section 3, The Science and Technical Advisory Panel (STAP) report synthesized the best available science regarding future estimates of storm surge, sea-level rise, and extreme precipitation. The STAP report includes several suggested planning guidelines for the three hazards: storm surge, sea-level rise, and extreme precipitation.

[vii] The National Climate Assessment (2014) *lowest scenario* (0.7 feet by 2100), summarized by the STAP, assumes the historical rate of sea-level rise over the past century continues into the future and does not account for projected rapid changes in atmospheric and ocean temperatures over the 21st century, nor the projected rapid loss of ice from the Greenland and West Antarctic ice sheets.

5.2.1 Storm Surge

The STAP recommends using probabilities of storm frequency and magnitude embodied in updated FEMA Federal Insurance Rate Maps for coastal New Hampshire.

5.2.2 Sea-level Rise

The STAP recommends that for coastal locations where there is little tolerance for risk to a built or natural asset; the range of sea-level rise to consider in planning and design includes the 'Intermediate High' and 'Highest' scenarios (see Figure 2). The STAP suggests the following planning guidance to determine the appropriate range based on design life:

1. Determine the time period over which the system, structure, or facility is designed or desired to serve (either in the range 2014–2050, or 2051–2100).
2. If the design time period is 2014–2050, commit to manage to 1.3 feet of sea-level rise, but be prepared to manage and adapt to 2 feet if necessary.
3. If the design or desired time period is 2051–2100, commit to manage to 3.9 feet of sea-level rise, but be prepared to manage and adapt to 6.6 feet if necessary.
4. Be aware that the projected sea-level rise ranges may change and prepare to adjust design considerations if necessary. The choice of management strategies can include strategies to protect, accommodate, or retreat from the flood risk.

For example, in the case of a new tide gate intended to last until 2075, the gate could be constructed for the Highest scenario (6.6 feet) now, which would be the most robust approach, or constructed for 2 feet of future sea-level rise now but in a manner that would facilitate expanding and raising the gate to protect against 3.9 or 6.6 feet of sea-level rise, if future assessments indicate that is necessary. This could be accomplished by designing and constructing the gate foundation for the 6.6 feet sea-level rise scenario while only constructing the gate for a 2-feet sea-level rise scenario. The choice of management strategies can include strategies to protect, accommodate, or retreat from the threat.

5.2.3 Extreme Precipitation

For extreme precipitation the STAP recommends:

- If the design time period is 2014–2050, buildings and infrastructure should be designed to withstand extreme precipitation intensities based on the most current precipitation data[viii], with the assumption that a gradual increase in frequency of extreme precipitation events will occur over time.
- If the design period is 2051–2100, buildings and infrastructure should be designed to manage a 15 percent increase in the amount of precipitation produced during extreme precipitation events after 2050.

Over time, improved data collection, analysis, and modeling will provide better scientific understanding and higher confidence in projected future changes in storm surge, sea level, and extreme precipitation. Given the current limitations in providing narrow estimates of future conditions with high confidence, applying the concept of risk tolerance becomes important in determining how best to plan and design for the future. The STAP guidance strongly suggests that adaptive and flexible designs that anticipate future flood scenarios become standard procedures for construction within vulnerable areas.

[viii] Current precipitation data can be taken from the NOAA Atlas 14 (**http://hdsc.nws.noaa.gov/hdsc/pfds/**), the Northeast Regional Climate Center (**http://www.nrcc.cornell.edu/**), or more up to date or better resolution sources.