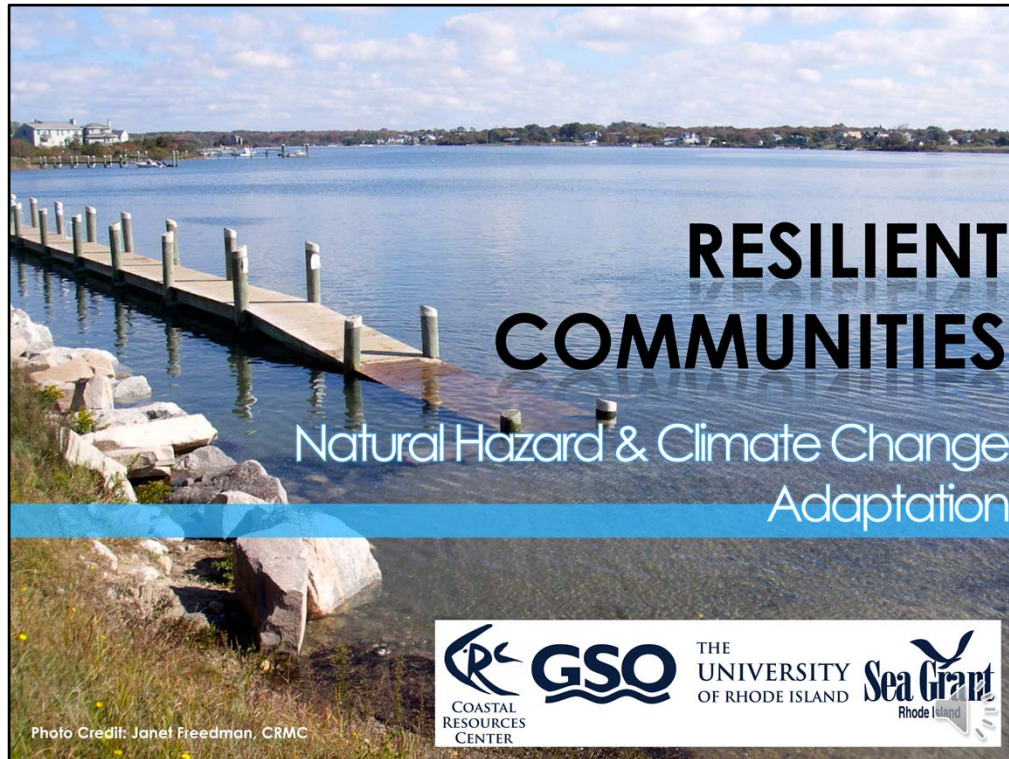




By 2016, Rhode Island cities and towns will need to plan for natural hazards and the impacts of climate change within their community's local comprehensive plan. This presentation was created as a resource for coastal municipalities on how to conduct a preliminary vulnerability assessment and adopt climate change adaptation strategies into the local comprehensive plan. While every community is different and will follow a unique planning process, this presentation is meant to provide insights into how to successfully assess vulnerability, design, adopt and implement adaptation strategies, and monitor their effectiveness.



The guidance provided here is the result of a pilot project conducted by the University of Rhode Island Coastal Resources Center/Rhode Island Sea Grant (CRC/SG) on behalf of the Rhode Island Statewide Planning Program entitled “Adaptation to Natural Hazards & Climate Change in North Kingstown, RI” which was funded by the U.S. Department of Transportation Federal Highway Administration.

The primary objective of this project was to prepare language for North Kingstown’s Comprehensive Community Plan that addresses climate change adaptation as it relates to transportation, land use, and other relevant issues. Sea level rise and flooding were the primary hazards examined, however the process presented here can be duplicated for other types of hazards. Lessons learned through that pilot project are presented here for the benefit of other coastal communities engaging in natural hazard and climate change adaptation planning.

The Rhode Island Division of Planning’s Statewide Planning Program is currently developing **Comprehensive Planning Guidance Handbook #12: Planning for Natural Hazards & Climate Change** on incorporating natural hazards and climate change into local comprehensive plans. This guidance is still in draft stage but is anticipated to be available in the summer of 2015.

Efforts of the Rhode Island Shoreline Change Special Area Management Plan (www.beachsamp.org) also compliment this work.

Purpose

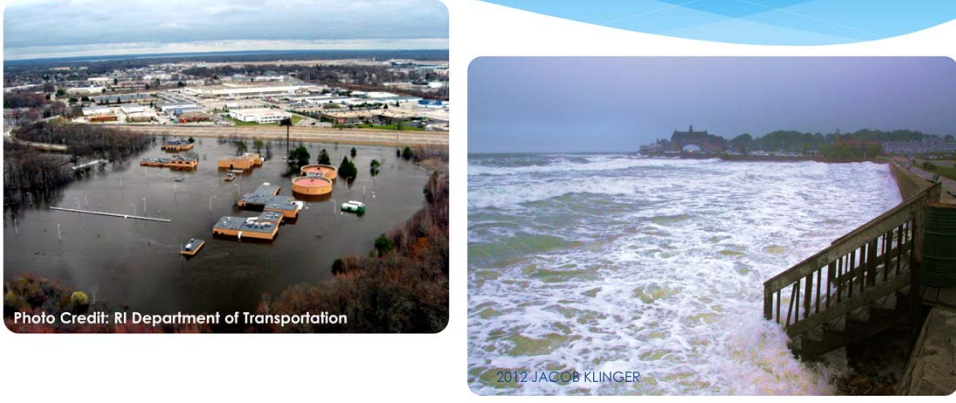


Photo Credit: RI Department of Transportation

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Assessing vulnerability and incorporating adaptation planning into municipal decision making

3

Planning for natural hazards and climate change at the local level can include both planning for mitigation, and planning for adaptation.

Mitigation efforts include actions that seek to limit the magnitude or rate of long-term climate change primarily related to energy use, transportation or land use. For example, energy efficiency or renewable energy goals, policies or actions would constitute mitigation.

Adaptation on the other hand seeks to reduce the vulnerability of a community to the effects of natural hazards and climate change (e.g. through physically changing the design of a building or piece of infrastructure, or changing how decisions are made at the local level). The focus of this presentation is on planning for adaptation through assessing vulnerability and incorporating adaptation efforts into municipal decision making. Therefore, mitigation is not discussed.

This presentation has been created as guidance for local planners or officials to consult as they embark on revisions to their local comprehensive plan, as well as a tool to help communicate with local boards and commissions on incorporating natural hazards and climate change into local decision making.

Drivers to Plan for Natural Hazards & Climate Change

- Public Health, Safety & Welfare
- Investment of Public Funds for Infrastructure
- State Mandate
- Impacts Felt at Local Level from Multiple Hazards



4

Municipalities may be driven to plan for natural hazards and climate change for a number of reasons.

First, Rhode Island's densely populated coastal areas mean that many residents, businesses, assets and infrastructure are potentially at risk from climate change impacts such as sea level rise and increased flooding. In order to protect public health, safety and welfare the impacts of natural hazards and climate change need to be considered. Cities and towns may not know what is vulnerable to natural hazards and climate change over the next 25, 50 or 100 years. While these planning horizons may seem long, the design life of critical infrastructure may span these timeframes and therefore need to consider the effects of natural hazards and climate change.

Second, the State now mandates natural hazard and adaptation planning at the local level through the ***Rhode Island Comprehensive Planning and Land Use Act*** (RIGL 45-22.2). The Act now requires by 2016 that municipalities address natural hazards in the municipal comprehensive plans, as outlined in Section 45-22.2-6(b)(10):

"Natural hazards. The plan must include an identification of areas that could be vulnerable to the effects of sea-level rise, flooding, storm damage, drought, or other natural hazards. Goals, policies, and implementation techniques must be identified that would help to avoid or minimize the effects that natural hazards pose to lives, infrastructure, and property."

Lastly, municipalities may already be experiencing local impacts from natural hazards or climate change. For example, storm related flooding may be an issue in some areas of town, or low lying areas may be routinely underwater during high tide. These types of current issues may drive a community to plan for short-term and long-term adaptation.

To receive state approval local comprehensive plans must:

- **Identify**

- the priority natural hazards & climate change trends for the municipality
- areas of the community that could be exposed to flooding, sea-level rise, and coastal storm surge
- priority issues faced as identified through a preliminary community vulnerability assessment

- **Include**

- goals that embody the State's goals for natural hazards
- policies and implementation actions to achieve goals, address priority issues identified through the vulnerability assessment

Rhode Island Comprehensive Planning and Land Use Act (RIGL 45-22.2)

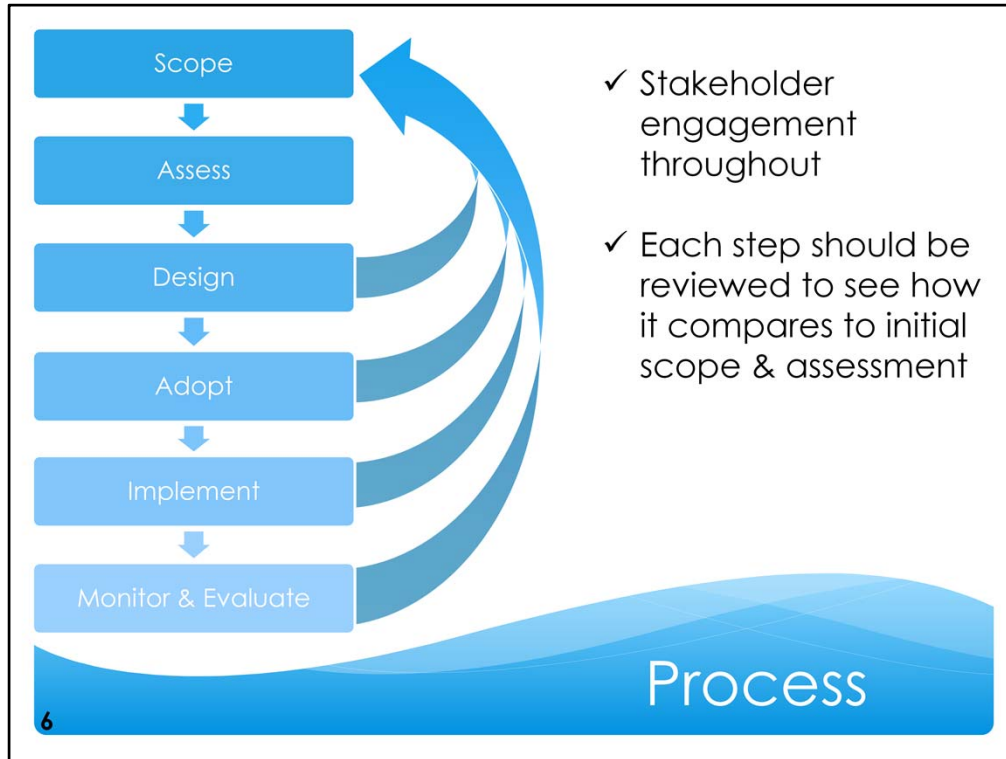
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As a result of the ***Rhode Island Comprehensive Planning and Land Use Act*** (RIGL 45-22.2), by 2016 communities must go through a preliminary assessment process in order to identify:

- What natural hazards and climate change impacts will impact a municipality,
- Where those impacts will occur, and
- Of those impacts, which are the highest priority to address.

Comprehensive plans must then include goals, policies and implementation actions to address these impacts.

The Rhode Island Division of Planning's Statewide Planning Program is currently developing a handbook (***Comprehensive Planning Guidance Handbook #12 | Planning for Natural Hazards & Climate Change***) on incorporating natural hazards and climate change into local comprehensive plans. This guidance is still in draft stage but is anticipated to be available in the summer of 2015. In the meantime, the pilot project conducted in North Kingstown by CRC/SG can provide insights into how to go about identifying and prioritizing impacts, as well as the types of goals, policies and implementation actions that can be adopted to address sea level rise and storm flooding.



The process of assessing vulnerability and incorporating adaptation planning into municipal decision making can be broken down into six steps.

1. **Scope** must be defined including what hazards will be examined and over what time frames.
2. **Assess** impacts using the best available data.
3. **Design** adaptation goals, policies and actions to address impacts.
4. **Adopt** adaptation through comprehensive plans and incorporate into local decision making and procedures.
5. **Implement** actions over both the short and long-term.
6. **Monitor & evaluate** the effectiveness of adaptation actions and policies over time.

Because “scope creep” can often occur during vulnerability assessments and adaptation planning, each step should be reviewed to ensure it matches the initial scope. Otherwise the process may become too large and unwieldy, ultimately reducing its probability of success.

Throughout the entire process stakeholder engagement must be incorporated so that the process is transparent and addresses the thoughts and concerns of the community. Stakeholder engagement includes both public outreach to residents and business owners, but also engagement of all municipal departments and coordination with state agencies.

Each step of this process will be described in greater detail.

SCOPE

- Identify Purpose
- Clarify Assessment Outcome
- Define Scale
- Data Needs and Sources
- Select a Planning Team
- Outline Public Process
- Capacity Building
- Prioritize Moving Forward



7

When defining the scope consider the following:

- **Identify the purpose of the assessment –**
 - *What is your focus?*
 - *What are the hazards you want to examine?*
- **Clarifying Assessment Outcomes –**
 - *Is the outcome an addition and/or revision to your comprehensive plan?*
 - *Changes to standard operating procedures?*
 - *Will ordinances and regulations be examined, or will that be completed afterwards?*
- **Define scale –**
 - *What sectors will be examined?* Natural hazards and climate change impacts can span many or all topic areas within a comprehensive plan, therefore communities should review all goals, policies and actions to ensure consistency.
 - *What is the spatial scale?* The entire municipality? A single neighborhood or business district? The comprehensive plan will require that the vulnerability of whole municipality is assessed, however a city or town may decide that an even more detailed assessment is needed at a particular site.
 - *What is the temporal scale?* For example, when considering the impacts of sea level rise, coastal flooding can occur regularly during the two high tides

or occasionally during storm events.

- **In order to assess these impacts, what data is needed and what currently exists?**
 - Statewide data sets are available to inform local vulnerability assessments, see the Rhode Island Geographic Information System at <http://www.edc.uri.edu/rigis/>
 - What local data is available? Parcel data? Maps of storm drains and culverts? Are they in a common format for use in GIS? Does effort need to be put into collecting new data?
- **Select a planning team –**
 - Who within municipal government will be involved in the assessment and what are their roles? How will Statewide Planning or other state agencies be brought into the process?
 - Is this being done solely in house or is this being done by consultant? Even if the assessment will be conducted by a consultant, a clear scope needs to be defined by the municipality.
- **Outline Public Process –**
 - How and when will the process be shared with the community? Town/city council? Other municipal departments and committees?
- **Capacity Building- for the staff, board members and public**
 - Educating municipal staff, councils, and residents on the impacts and adaptation strategies will be key. Identifying who will be responsible for this outreach is important so it is not forgotten.
- **Prioritizing Moving Forward-** Once the goals, outcomes and scale are defined and compared to the available datasets and team resources, prioritization may be necessary in order to move forward. Ultimately, the planning team should be realistic about what can be successfully accomplished given project constraints.

SCOPE		
Natural Hazards & Climate Change Component of Local Comprehensive Plan - Used to guide local development and infrastructure decisions - Must take a more holistic view - Should align land use, transportation, infrastructure and other goals and policies with natural hazards considerations - Should consider different aspects of natural hazards and climate change than what is typically found in a local hazard mitigation plan	VS. - Both "identify policies and actions to reduce risk and future losses." - Info contained within HAZ MIT PLAN can serve as the basis for addressing natural hazards in the comprehensive plan - Goals, policies, and implementation program of the comprehensive plan can reinforce the strategies detailed within the hazard mitigation plan.	Local Hazard Mitigation Plan - FEMA focused - More detailed in emergency response & post storm recovery

8

It is often asked how the local comprehensive plan natural hazard and climate change component differs from the local hazard mitigation plan. The two definitely feed off and compliment one another but they should not be considered the same thing. Furthermore, **simply inserting the local hazard mitigation plan into the comprehensive plan may not address all the requirements for State approval.**

From the Rhode Island Statewide Planning Program's ***Comprehensive Planning Guidance Handbook #12: Planning for Natural Hazards & Climate Change*** :

A NOTE ON THE RELATIONSHIP TO THE LOCAL HAZARD MITIGATION PLAN

All communities that wish to avail themselves of Federal Emergency Management Agency (FEMA) money after a disaster occurs must adopt a local hazard mitigation plan, which is a different and distinct document from the local comprehensive plan. The purpose of a local hazard mitigation plan is to "identify policies and actions that can be implemented over the long term to reduce risk and future losses." While this is also one of the purposes of including natural hazards within a comprehensive plan, the local comprehensive plan is used to guide development and infrastructure decisions at the municipal level. Therefore, discussions of natural hazards and climate change impacts within a comprehensive plan must take a more holistic view and should align land use, transportation, infrastructure and other goals and

policies with natural hazards considerations.

The comprehensive plan should consider different aspects of natural hazards and climate change than what is typically found in a local hazard mitigation plan. As you'll see throughout this chapter, there are some things that are typically found in a local hazard mitigation plan that the comprehensive plan doesn't need to discuss and there are some areas where a more detailed or thoughtful discussion of vulnerabilities are warranted. **Therefore, simply inserting the local hazard mitigation plan into the comprehensive plan may not address all the requirements for State approval.**

However, comprehensive plans and hazard mitigation plans can benefit each other. If your municipality has a hazard mitigation plan, the information contained within it can serve as the basis for addressing natural hazards in the comprehensive plan. Conversely, the goals, policies, and implementation program of the comprehensive plan can reinforce the strategies detailed within the hazard mitigation plan.

Natural Hazards

Flood-Related	Riverine flooding Coastal flooding Flash, urban and stormwater- based flooding Storm surge Coastal erosion and shoreline change Sea Level Rise
Heat- Related	Drought; Wildfire; High Heat Days; Extreme Heat Waves
Wind-Related	Hurricanes; Tornadoes; Thunderstorms/Wind-Storms; Hail; Lightning
Winter-Related	Heavy Snow; Ice Storms; Blizzards; Extreme Cold
Earthquakes	

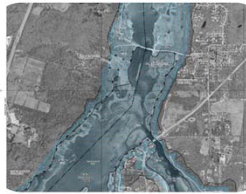
When scoping the assessment, Rhode Island Statewide Planning Program recommends that a community identify which natural hazards will affect their communities: flood, heat, wind, winter-related hazards, or earthquakes, and how those relevant natural hazards will impact the infrastructure, assets, resources and populations present in the municipality.

While a community will likely need to assess the impacts of multiple hazards in their local comprehensive plan, the remainder of the presentation will focus on one flood-related hazard, sea level rise and walk through an example of how North Kingstown analyzed this particular natural hazard.

Flood Risk:



1% and 0.2% storm
(also known as the
100 and 500 year
storm event) &
hurricane surge
maps



Special Flood
Hazard Areas using
the most recent
Federal Emergency
Management
Agency's Flood
Insurance Rate
Maps



Projected areas
inundated due to
sea-level rise:
1 foot
3 feet
5 feet

10

The types of flooding impacts that should be mapped at the local level include:

- 100 and 500 year storm events & hurricane surge maps
- Special flood hazard areas
- Areas flooded due to 1, 3 and 5ft sea level rise

It is important to remember that the 1% and .2% storm events and flood zones depicted by FEMA flood insurance rate maps are based on past events and do not project future conditions or take into account sea level rise.

Links to where this data is available are provided later on in this presentation.

Differentiating between :

Storm Flooding

(Periodic/Infrequent)

- Coastal & Storm Surge Driven
- Precipitation Driven

Sea Level Rise Flooding

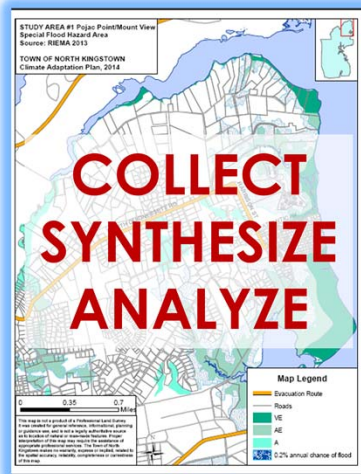
(Daily; 2 times each day at high tide)



It is important to look at storm flooding as well as sea level rise because the types of impacts they produce will vary. Storm events may be infrequent but can inundate an area quickly and produce greater damage as a result of wave action and storm surge. Sea-level rise scenarios represent what areas will be regularly underwater on a daily basis twice a day at high tide. As a result, there may be some roadways or areas of a municipality where infrequent inundation may be acceptable, especially if there are alternative routes available. However, a roadway that is underwater twice a day due to sea-level rise may be a much higher priority because it results in chronic problems in the community.

***Important to note that storm flooding and sea-level rise impacts should be considered together. Storm events will occur even as sea-level rises, therefore in order to truly understand areas at risk municipalities should assess flooding of sea-level rise scenarios plus a storm event (e.g. 1 ft sea-level rise + a 1% storm event, etc.) Maps have already been developed to aid in this type of analysis, links are provided in the following slides of this presentation.

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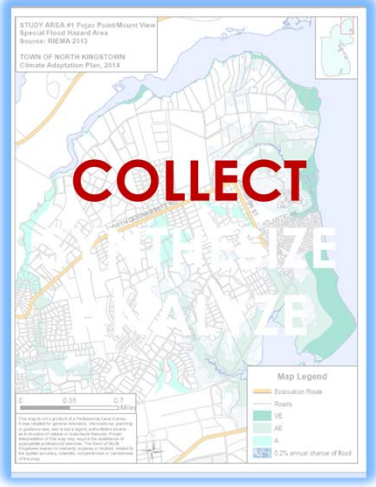
- Compile Data and Maps
- Identify Exposed Assets
- Determine the Vulnerability of Exposed Assets
- Identify Priority Impacts
- Compare Results to Other Planning Efforts
- Stakeholder Review

12

Once the scoping process is complete, the assessment phase can begin. While the methodology of an assessment can vary, generally it begins with collecting the relevant data and maps; synthesizing that information down to identify exposed assets, resources and populations, and then analyzing the information to determine what the are the highest priority impacts and reviewing that analysis with others.

Planners will likely need to assess the impacts of multiple hazards (drought, flooding, heat, etc.) in their local comprehensive plan, however the following slides will go through each of these steps in greater detail with a focus particularly on assessing the potential risk posed by sea level rise. Though, a similar process can be conducted for any hazard or impact of climate change.

ASSESS



- **Compile Data and Maps**
- Identify Exposed Assets
- Determine the Vulnerability of Exposed Assets
- Compare Results to Other Planning Efforts
- Stakeholder Review

13

Existing statewide data sets are available for municipalities to use for their assessments. These data sets have either been developed by or their use has been accepted by state agencies.

- **The Rhode Island Geographic Information System (<http://www.edc.uri.edu/rigis/>) houses all the state accepted data files that cities and towns can download and use in their analysis.** RIGIS currently hosts the following GIS layers that can be used in assessing impacts:
 - Roads
 - Bridges
 - Buildings (E-911 data)
 - Dams
 - Current wetlands and conservation lands
 - Sea Level Affecting Marshes Model (SLAMM): Maps of how coastal wetlands will be impacted by sea level rise (more info on this data is also available here: http://www.crmc.ri.gov/maps/maps_slamm.html)
 - FEMA Flood Zones and Digital Flood Insurance Rate Map -Most recent FEMA flood rate maps
 - Hurricane Surge (Worst Case) Inundation Areas
 - Sea Level Rise: RIDOP- Results of coastal inundation analyses conducted by the NOAA Coastal Services Center and the RI Division of Planning. This dataset represents the sum of 1, 3, or 5 feet potential sea level rise scenarios, and

average daily high tide (Mean Higher High Water (MHHW)).

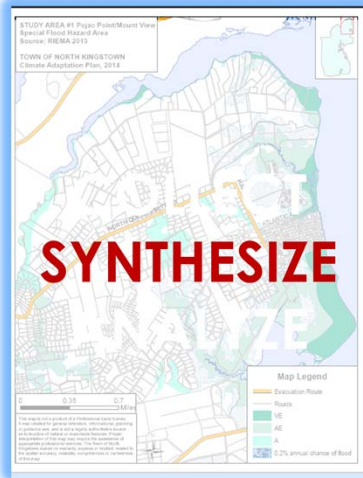
Additionally, web-based viewers are available illustrating the **impact of storm surge plus sea level rise in Rhode Island** at:

- **Maps of storm surge plus sea-level rise are available here:**
<http://edc.maps.arcgis.com/home/search.html?q=scaled%20slr&t=content>
- **Water depth of storm surge plus sea-level rise are available here:**
<http://edc.maps.arcgis.com/home/search.html?q=scaled%20slr&t=content>
- For **socioeconomic data** on resources, assets and populations in the flood zone visit:
 - **Climate Central**- web-based tool that summarizes the # and value of impacted facilities, impacted population statistics:
<http://sealevel.climatecentral.org/ssrf/rhode-island>

Local data sets, if available, will also be needed. For the North Kingstown Climate Change Adaptation mapping effort in addition to the statewide datasets listed above, the following local data were compiled:

- Parcel boundaries
- Evacuation routes
- Culverts
- Tax valuation data (to quantify the value of exposed parcels)

ASSESS



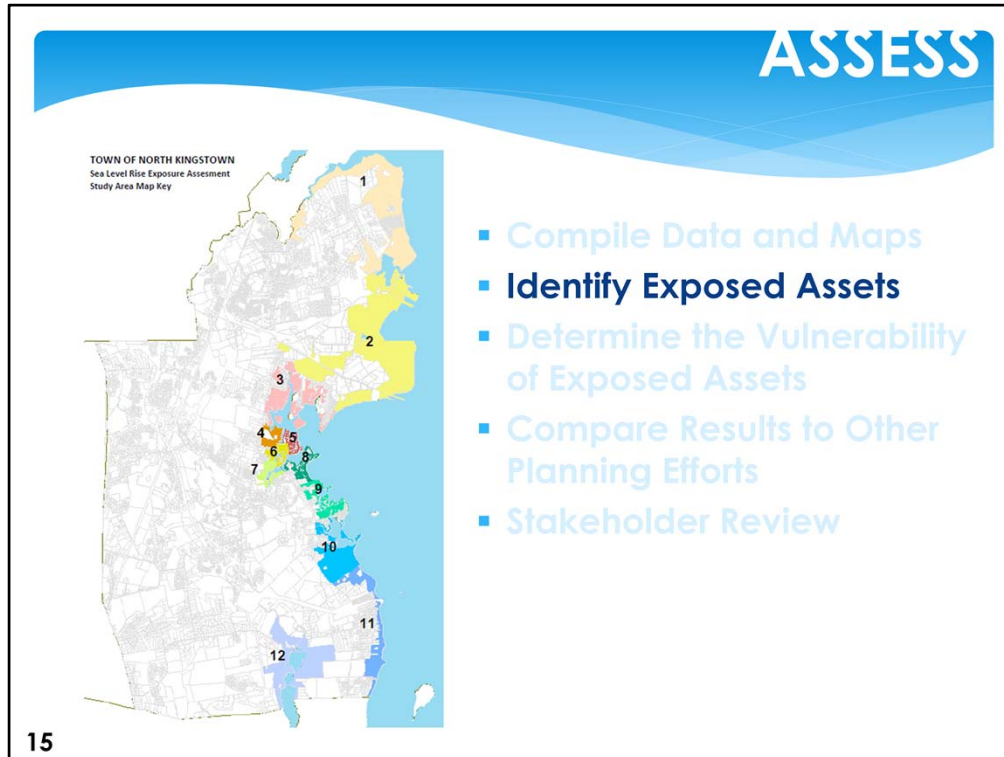
- Compile Data and Maps
- **Identify Exposed Assets**
- Determine the Vulnerability of Exposed Assets
- Compare Results to Other Planning Efforts
- Stakeholder Review

14

First, communities should overlay the maps of the areas that will be exposed to sea level rise and flooding to determine what components of the city or town are potentially at risk.

Second, communities should consider the full list of infrastructure, assets, resources and populations and how sea level rise or storm related flooding will impact these.

****It is important to consider the design life of infrastructure in order to fully understand the potential exposure an asset may experience. For example, if a piece of infrastructure is being designed to last 50-75 years, the 3 and 5 foot sea level rise scenario should be examined closely as those increases are expected to occur within the design life of the facility or asset. In addition, infrastructure may actually be used well beyond its designed lifetime, so the realistic time period in which the infrastructure will actually be used should also be considered.**

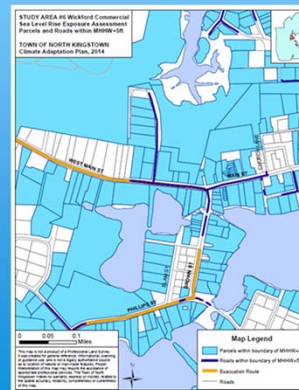


In the North Kingstown Climate Change Adaptation Project, the town was subdivided into 12 study areas to make the assessment process more manageable. This also helped with examining impacts on a neighborhood level.

Study areas do not need to be of similar size, but rather represent an area (e.g. neighborhood, historic or business district) where it makes sense to examine impacts and adaptation strategies as a whole. In addition, by tailoring the study area sizes to a neighborhood or district there may already be established neighborhood or stakeholder groups that can be used to engage residents or property owners and help to facilitate efficient communications and community input.

One potential process to identify vulnerable properties

- Creating a series of sea level rise maps for each study area
- Lighting up the parcels that are flooded under each scenario



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For each study area a series of maps was produced.

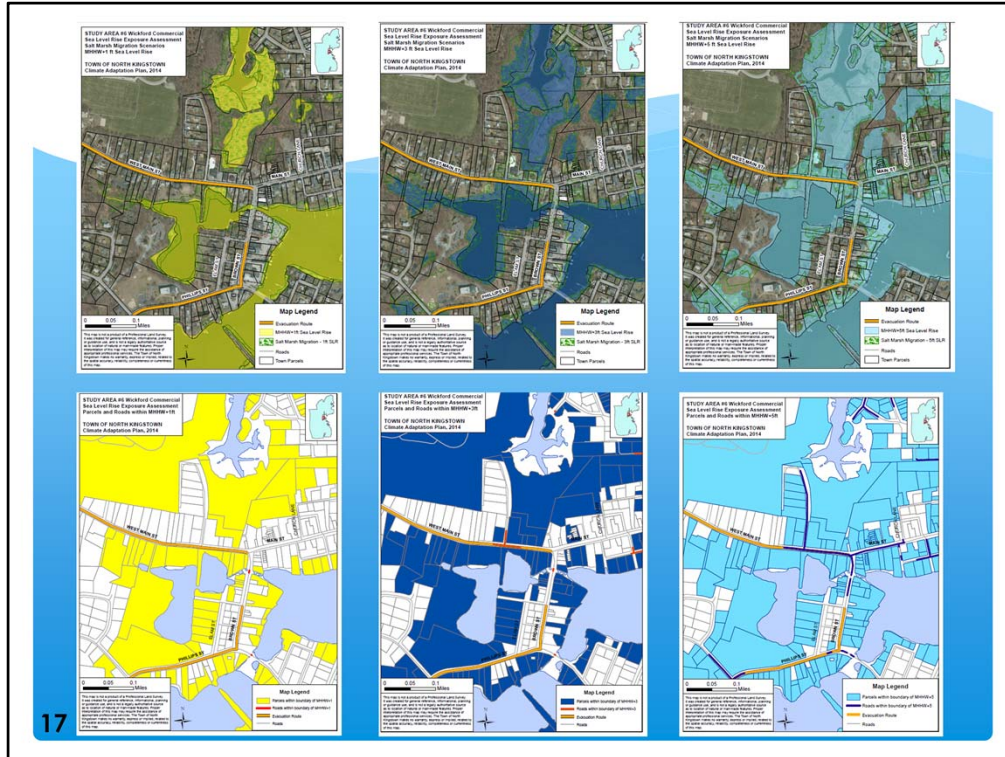
One set of maps shows the flooding that is projected under 1, 3 or 5ft of sea level rise, as well as the marsh migration that would be expected under those conditions. This set of maps shows where the water and wetlands are expected to go as sea level rises.

*** **Important caveats** here are that these maps do not show what the depth of water will be at these locations, only where flooding is likely to occur due to lower elevation. Also, remember that these maps only show what high tides will look like as sea level rises, they do not include wave action or storm surge. While this data was not available during the timing of the North Kingstown project, since then STORMTOOLS has been developed and now allows storm surge and sea level rise impacts to be viewed together, and also provides information on the depth of flooding at particular locations under various scenarios, see <http://edc.maps.arcgis.com/home/search.html?q=scaled%20slr&t=content>.

A second set of maps then highlighted, using the town's parcel data, which actual parcels and road segments are impacted under those scenarios. The focus of these maps is to identify the actual properties with some level of impact from sea level rise. These maps may be particularly useful for municipal planning or zoning departments when reviewing future permit decisions.

*** **Important caveat** here is that these maps show any impact to a parcel, even if it is only minor flooding, therefore it was necessary to use the first set of maps to understand the

severity of the flooding at a certain location.



Therefore each study area or neighborhood would get a series of maps to help identify which parcels, roadways, etc. are impacted under which sea level rise scenario.

ASSESS

PRELIMINARY IMPACT EVALUATION MATRIX - SAMPLE

RESOURCES/INFRASTRUCTURE/POPULATIONS	HAZARDS											COMMENT
	Sea Level Rise	Storm Surge	Riverine Flooding	Extreme Cold	Heat Waves	High Heat Days	Drought	Hurricanes	Coastal Erosion	Flash Flooding	Heavy Snow	
"The Point" Residential Neighborhood	X	X					X	X	X	X	X	High density
"Bayview Industrial Park"	X	X		X	X	X	X	X	X	X	X	
"River Landing" Town Center			X	X	X	X			X			
Police Station		X	X			X			X	X		Needs insulation
Fire Station 1	X	X	X			X	X	X				Has new roof
Fire Station 2			X				X					
Senior Center			X	X					X			Flood prone area
Elementary School				X	X	X						
Middle School				X	X	X						
High School				X	X	X						
Wastewater Treatment Facility	X	X					X	X	X			

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The Statewide Planning Program provides another example of how to assess exposure in their guidance handbook called a Preliminary Impact Evaluation Matrix. To use the matrix, simply list the natural hazards and climate change trends that are priorities for the municipality along the top (the columns) and list the pieces of the community to be assessed along the side (the rows). Then simply mark off those components that seem likely to be impacted by the priority trends, based on previous experience, general knowledge of the community, exposure mapping and any public input received.

This matrix provides a systematic and straightforward way to assess exposure without needing to engage in an extensive mapping exercise.

ASSESS	
Natural Hazards	
Flood-Related	Riverine flooding Coastal flooding Flash, urban and stormwater- based flooding Storm surge Coastal erosion and shoreline change Sea Level Rise
Heat-Related	Drought; Wildfire; High Heat Days; Extreme Heat Waves
Wind-Related	Hurricanes; Tornadoes; Thunderstorms/Wind-Storms; Hail; Lightning
Winter-Related	Heavy Snow; Ice Storms; Blizzards; Extreme Cold
Earthquakes	
Infrastructure, Assets, Resources and Populations	
Building and Infrastructure	Residential neighborhoods & homes Commercial & Industrial areas & businesses Historic and cultural sites or structures Public or Emergency facilities Healthcare facilities, nursing homes & assisted living facilities Municipal buildings Major roads and evacuation routes Public Transportation routes, stops or hubs Rail lines and stations; Airports Water supply infrastructure Wastewater infrastructure Stormwater drainage Natural Gas, Electricity or Energy Production infrastructure Marine Facilities; Dams Solid waste transfer stations Telecommunication infrastructure
Natural Resources	Parks and recreation facilities Lakes, rivers and other water bodies Reservoirs Wetlands (coastal and freshwater) Coastal barriers (dunes, marshes, coastal ponds) Wildlife and endangered species Forests; Undeveloped and/or conservation lands
Special Populations	Senior citizens; Disabled; Households without cars Young children Low-income, unemployed or under-employed Renters; Limited English speaking

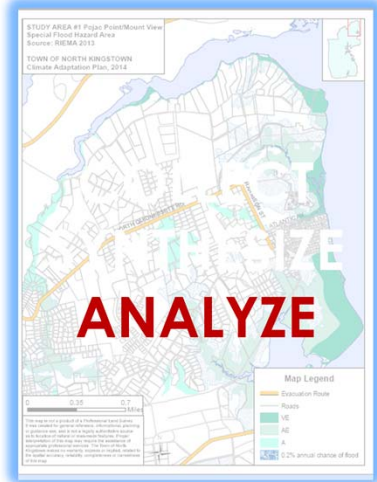
19

How natural hazards will affect the infrastructure, assets, resources and populations present in the municipality will vary but the table above provides a starting point of things to consider when assessing vulnerability.

Additional sources of information to understand **how** natural hazards and climate change may impact infrastructure, assets, resources and populations see:

- Rhode Island Statewide Planning Program's Resources:
<http://www.planning.ri.gov/statewideplanning/localplanning/planguidelines.php>
- RI Executive Climate Change Coordinating Council Resources:
<http://www.planning.ri.gov/statewideplanning/climate/resources.php> and
<http://www.planning.ri.gov/statewideplanning/climate/meetings.php>
- Rhode Island Shoreline Change Special Area Management Plan: www.beachsamp.org
- Rhode Island Sea Grant: <http://seagrant.gso.uri.edu/projects-2/topics/community-resilience/>

ASSESS



- Compile Data and Maps
- Analyze and Identify Exposed Assets
- **Determine the Vulnerability of Exposed Assets**
- Compare Results to Other Planning Efforts
- Stakeholder Review

20

Once the exposed assets and parcels are identified, the vulnerability of each needs to be determined.

Determining vulnerability relates to HOW the property, infrastructure or asset will be impacted, and what harm may result for the residents of the community.

Assessing Impact Severity:

- Permanence of the impact (permanent, temporary, temporary until repaired, etc.)?
- Number of people and/or businesses impacted?
- Special populations impacted?
- Impacts to community functions and/or values (i.e. public health and safety, education, tourism) ?

IMPACT SEVERITY TOOL - SAMPLE

Impact Statement: *"Bayfront Park" will be impacted by coastal erosion.*

IMPACTS	PERMANENCE	POPULATIONS DISRUPTED	COMMUNITY FUNCTIONS/ VALUES DISRUPTED	OVERALL IMPACT SEVERITY (high, medium, low)
<i>Loss of bayfront walkway</i>	<i>Permanent until fixed</i>	<i>All</i>	<i>Public health, quality of life</i>	<i>Medium</i>
<i>Loss of fishing area</i>	<i>Permanent until fixed</i>	<i>All</i>	<i>Quality of life</i>	<i>Low</i>
<i>Interrupted use of only park in neighborhood</i>	<i>Temporary</i>	<i>Neighborhood population</i>	<i>Public health, quality of life</i>	<i>Medium</i>

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The severity of impacts should be based on several considerations:

- The permanence of the impact (permanent, temporary, temporary until repaired, etc.);
- The number of people and/or businesses impacted;
- Whether any special populations (as defined by the community, e.g. elderly, low income, etc.) will be unduly harmed by the impact; and
- Whether any community functions and/or values (i.e. public health and safety, education, tourism) will be impacted.

Here is a sample tool for assessing impact severity.

Assessing impact severity to community functions and values consider :

Community Functions & Values	
Government Continuity	Conservation
Emergency Services	Mobility and Transportation Access
Public Safety	Education
Public Health	Quality of Life
Business Continuity	Social Services
Housing Access	Ecological Function
Economic Activity	Tourism
Employment & Job Access	Recreation
Food Security	

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When completing the impact severity tool, a list of community function and values to consider include:

- Government Continuity
- Conservation
- Emergency Services
- Mobility and Transportation Access
- Public Safety
- Education
- Public Health
- Quality of Life
- Business Continuity
- Social Services
- Housing Access
- Ecological Function
- Economic Activity
- Tourism
- Employment & Job Access
- Recreation
- Food Security

Example- Synthesis of Exposed Assets:	
ASSESS	
SECTOR	Example of Quantitative or Qualitative Description of Impacts from Coastal Storm Flooding or Sea Level Rise Scenarios
Land Use	• # of properties impacted and % residential, commercial, vacant land, etc.
Transportation	• X linear feet (Y miles) of roadway • Evacuation Routes vulnerable include...
Publically Owned Properties	• # of properties impacted (federal; state; municipal)
Emergency Management Facilities	• Description of how emergency shelters, evacuation routes, police and fire stations are impacted
Wastewater	• Description of how sewers, onsite wastewater systems, wastewater outfalls are impacted
Stormwater Management	• Description of how catch basins, culverts or stormwater basins will be impacted
Drinking Water	• Impacts to municipal & residential wells, distribution systems. contamination of water table
Wetlands	• Acreage of wetlands lost, gain or shifted with sea level rise
Historic and Cultural	• # and type of sites impacted
Contaminated Sites	• # and type of sites impacted
Energy	• Summary of the # and type of critical utilities located in at risk areas

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The North Kingstown Climate Change Adaptation Project used GIS datasets to quantify and describe the characteristics of what assets were potentially at risk and how those exposed assets would impact the people of North Kingstown. That information was then used to create a summary table listing the impacts by sector which corresponded to North Kingstown's comprehensive plan. The sectors included:

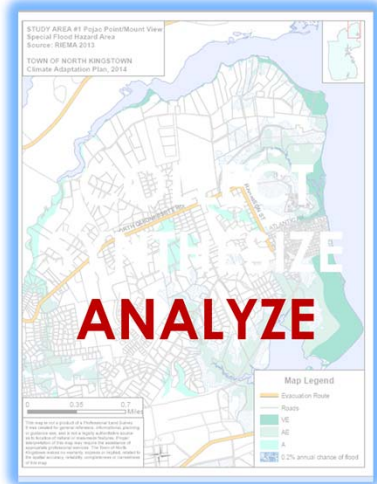
- Land Use
- Transportation and Circulation
- Building Stock
- Publically Owned Properties
- Emergency Management Facilities
- Wastewater
- Stormwater Management
- Drinking Water
- Groundwater
- Wetlands
- Habitat
- Historic and Cultural
- Contaminated Sites
- Open Space, Recreation & Public Access
- Vulnerable Populations
- Energy

Some impacts can be described quantitatively using information such as the number of

properties or linear feet of road impacted under a certain storm or sea level rise scenario. Alternatively, there are some sectors where spatial or quantitative data is not available, therefore it may only be possible to provide a qualitative description of how a sector may be impacted.

Municipalities may decide to synthesize the information on exposed assets in a different format for inclusion in the comprehensive plan.

ASSESS



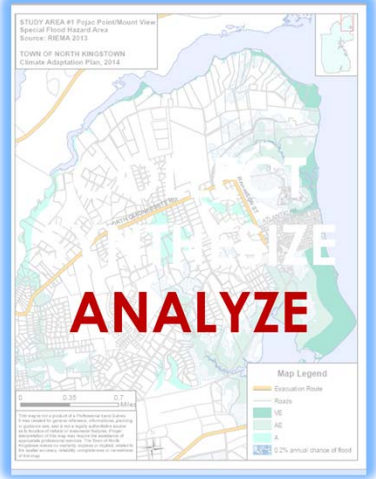
- Compile Data and Maps
- Analyze and Identify Exposed Assets
- Determine the Vulnerability of Exposed Assets
- Compare Results to Other Planning Efforts
- Stakeholder Review

24

To ensure your comprehensive plan coincides with other statewide assessments and doesn't duplicate effort consider comparing local assessment results to the following:

- **Rhode Island Coastal Resources Management Council et al. Study on Sea Level Affecting Marshes:** http://www.crmc.ri.gov/maps/maps_slamm.html
- **Rhode Island Department of Health SafeWater RI:** <http://www.health.ri.gov/materialbyothers/SafeWaterRIReport.pdf>
- **Rhode Island State Hazard Mitigation Plan:** <http://www.riema.ri.gov/prevention/mitigation/RI%20SHMP%2011-26-2013.pdf>
- **Rhode Island Statewide Planning Program's Resources:** <http://www.planning.ri.gov/statewideplanning/localplanning/planguidelines.php>
- **RI Executive Climate Change Coordinating Council Resources:** <http://www.planning.ri.gov/statewideplanning/climate/resources.php> and <http://www.planning.ri.gov/statewideplanning/climate/meetings.php>
- **Rhode Island Sea Grant:** <http://seagrant.gso.uri.edu/projects-2/topics/community-resilience/>

ASSESS



- Compile Data and Maps
- Analyze and Identify Exposed Assets
- Determine the Vulnerability of Exposed Assets
- Compare Results to Other Planning Efforts
- Stakeholder Review

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Once it has been identified which areas of a municipality may be impacted by a natural hazard or climate change, it is important to share those findings with stakeholders within other municipal departments to obtain feedback and ground-truth the findings of the analysis.

For example, roadways, bridges or culverts that have been identified as being at risk to sea level rise should be shared with staff from the local department of public works who likely have an in depth understanding of what areas already experience flooding during storm events or extreme high tides. In particular they would be able to correct areas that are mistakenly show up as vulnerable to flooding due to their elevation, when in reality there is no connection point to a water body that would cause flooding.

Ultimately, this review process ensures that moving forward the most accurate information is used in adaptation planning efforts.

Outlining the process for how and who engage in this stakeholder review should be determined during the initial scoping of the project. See slide #7.



- **Craft Adaptation Goals, Policies & Strategies**
- **Prioritize Actions**
- **Integrate Adaptation into Planning Programs**
- **Stakeholder Review**

Designing adaptation strategies for areas at risk can often seem like a daunting task. However, prioritizing actions and mainstreaming adaptation into existing planning programs and decision making processes can make it more manageable.



■ Craft Adaptation Goals, Policies & Strategies

- Review Adaptation Options
- Identify Opportunities to Mainstream Adaptation into Municipal Processes
- Select Strategies and Actions

■ Prioritize Actions

■ Integrate Adaptation into Planning Programs

■ Stakeholder Review

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It may be helpful to begin with articulating what the overarching goals are for dealing with the impacts of natural hazards and climate change before identifying specific policies or strategies. For example:

- *Our community will act in an integrated manner to implement a standard of resilience from natural hazards; or*
- *Systems will be put in place to minimize impacts from natural hazards in our vulnerable areas.*

In the North Kingstown Climate Change Adaptation Project the process followed included:

1. *What are other places doing?* Since so many other communities in the U.S. are struggling with how to adapt to sea level rise and storm surge, it was important to not try and recreate the wheel and learn from what others have tried.

Some useful resources to consult include:

- Rhode Island Shoreline Change Special Area Management Plan - www.beachsamp.org
- StormSmart RI- <http://ri.stormsmart.org/before/planning/creating-a-community-master-plan/>
- The Federal Emergency Management Agency (FEMA) has a variety of publications related to flood hazard mitigation measures, including *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards*, which includes actions to mitigation risks from storm surge, flood, and sea level rise. <http://www.fema.gov/library/viewRecord.do?fromSearch=fromsearch&id=6938>
- The Georgetown Climate Center has a searchable Adaptation Clearinghouse

<http://www.georgetownclimate.org/adaptation/clearinghouse>

- ICLEI Local Governments for Sustainability- <http://www.iclei.org/>
- Boston's Climate Plan: <http://www.cityofboston.gov/climate/bostonsplan/>
- Town of Guilford, CT –Community Coastal Resilience Plan
<http://www.ci.guilford.ct.us/pdf/Coastal%20Resilience%20Plan,%20Report%20&%20Options.pdf>
- Annapolis, Maryland- <http://www.futurecoast.info/reports/external-resources>

1. *What are the opportunities for mainstreaming adaptation into existing municipal processes?*

- Physical adaptation measures and retrofitting infrastructure for sea level rise or flooding impacts can be expensive. Therefore, it may be more feasible to find ways to incorporate adaptation incrementally into municipal processes and programs.
 - For example, funding from the Annual Capital Improvement Program could be applied to retrofitting a building, raising or rerouting a road or redesigning a stormwater system.
 - Including adaptation needs into the local Hazard Mitigation Plan allows any future mitigation funding from FEMA to be used to implement those actions.
- Some adaptation actions may not require funding, but rather incorporating the consideration of natural hazard or climate change impacts into Standard Operating Procedures, planning or zoning board reviews, procedural town level directives.
- Furthermore, there may be ongoing local planning initiatives (i.e. sewer planning) that can be informed by the vulnerability assessment.

2. *Select strategies and actions that make sense for your community*

- Strategies chosen may be a mix between those that:
 - Reduce your sensitivity in the future (e.g. elevating utilities or flood proofing municipal building located in flood prone areas)
 - Lessen your exposure (e.g. not allowing any new development in at risk areas; or building a flood gate)
 - Increase your adaptive capacity (e.g. establish economic or tax incentives for adaptation)

SAMPLE GOALS, POLICIES AND IMPLEMENTATION ACTIONS FOR NATURAL HAZARDS AND CLIMATE CHANGE

SAMPLE GOALS

- Our community will act in an integrated manner to implement a standard of resilience from natural hazards.
- Systems will be in place to minimize impacts from natural hazards in our vulnerable areas.

SAMPLE POLICIES

- Plan to accommodate a base rate of 3 to 5 foot rise in sea level by 2100 in the siting, design, and implementation of public and private coastal activities.
- Require municipal departments to incorporate climate change in all long-range planning and critical public infrastructure projects.
- Ensure that the local Hazard Mitigation Plan is up-to-date and utilizes the most recent available technical data for natural hazards and climate change.
- Ensure consistency between the Hazard Mitigation Plan, the Comprehensive Plan, SAMP plans, the city's land use regulations and the local Harbor Management Plan.
- Ensure that existing critical facilities are protected or otherwise improved to function in hazard and disaster situations.
- Ensure that new facilities are sited in areas that are not prone to flooding or other hazards.
- Improve the municipality's stormwater management system to enhance infiltration and expand stormwater retention areas.
- Ensure that there is adequate funding and administrative support to implement the recommendations in the local Hazard Mitigation Plan.
- Educate the public to better understand

the concept of community resilience and the meaning of probabilities and risk, especially for stream and coastal flooding.

- When making improvements to parks, playgrounds and other open spaces, include improvements so that these areas can function as stormwater retention areas.
- Encourage stormwater drainage improvements that reduce runoff and increase the permeability of the built environment.
- Expand the tree canopy in urbanized areas of the community to reduce heat impacts.
- Continue to improve community resilience in order to maintain the municipality's Community Rating System score.
- Encourage reduction of carbon emissions in the municipality through improved transportation efficiency, reduction of traffic congestion, encouragement of alternative transportation options (rail, bike, pedestrian infrastructure), and implementation of an anti-idling ordinance for trucks, buses, and other vehicles.
- Ensure that public facility improvements necessary for increasing resiliency have priority placement on the municipal Capital Improvement Program.

SAMPLE IMPLEMENTATION ACTIONS

- Define areas of the municipality that fall within these categories: **Protection Zones** that may be hardened to prevent or minimize floodwater intrusion; **Accommodation Zones** that are designed to be temporarily flooded with a high tide or storm event; **Retreat Zones** that have a master plan for managed retreat of

structures and residents permanently out of the area; and **Preservation Zones** that have an established management plan for natural or cultural resource preservation.

- Provide incentives for achieving a higher level of flood protection when designing and constructing municipal infrastructure.
- Update the local Hazard Mitigation Plan on a minimum of every 3 years and as needed after natural hazard events.
- Complete vulnerability assessments of all municipal infrastructure to determine priorities for adaptation.
- Complete an assessment to identify the vulnerability of all critical public facilities such as police and fire stations, hospitals and schools, and other services.
- Develop a priority list of facilities that need to be hardened or otherwise improved and seek funding for improvements.
- Determine an appropriate funding source for acquisition of properties in the municipality's most vulnerable areas.
- Revise local subdivision and land development regulations to require the incorporation of natural drainage systems, such as rain gardens and other small water management infrastructure, in private development.
- Design all new public buildings to include stormwater management best practices including the use of pervious materials, green roofs, and natural drainage systems.
- Undertake a study, working with the local land trust, to identify high priority water-adjacent land that could be designated as permanently protected open space.
- Review land uses in exposed areas to determine whether restrictions are necessary to prevent or lessen potential losses during large storm events.
- Develop design guidelines with examples of attractive design solutions for elevating existing buildings and for development of new elevated buildings.

- Develop and implement a street tree program in the municipality's most urbanized areas.
- Identify tree species that will be most resilient to climate change and use these species in public landscaping projects.
- Develop and disseminate an educational campaign for the public on reducing risks to private property.
- Create an Emergency and Disaster Preparedness section on the municipal website with information on minimizing risk to private property and on general preparedness.
- Work with the state and FEMA to make brochures and other information available on the City website, in the library, and at other city destinations, such as community centers.
- Hire a Community Rating System (CRS) coordinator to assist in implementing measures to increase the community's rating for the CRS program.
- Implement use restrictions within the Special Flood Hazard Area (SFHA) as well as in coastal areas projected to be inundated by future sea level rise scenarios.
- Create a Sea Level Rise Overlay Zone in a defined area along the coast that restricts or prohibits development of new structures and outlines plans for managing parcels and properties after storm events (i.e. debris management, removal requirements of damaged/abandoned structures, etc.).
- Establish a process to reexamine the science and sea level rise projections and estimated timeframes for rise to maximize protection of assets and public safety within impacted areas.
- Coordinate with RI CRMC and RI DEM to establish clear and consistent setback requirements from boundaries of projected sea level rise scenarios or salt marsh migration areas for any structure proposed within the Special Flood Hazard Areas.

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The North Kingstown pilot project did a lot of the groundwork for municipalities to build off of, the list of comprehensive plan goals, polices and implementation actions developed through this project can be found in the forthcoming handbook being drafted by the Rhode Island Division of Planning's Statewide Planning Program and here <http://rhody.crc.uri.edu/accnk/>

New Federal Flood Risk Management Standard

Executive Order 11988 as amended by Executive Order 13690

- Requires federal projects be constructed to a higher vertical elevation to address current and future flood risk and ensure that projects funded with taxpayer dollars last as long as intended.
- Draft standard - out for public comment until May 2015
- Applies to federal projects, including projects using federal funding
- **Projects will need to comply with one of the following:**
 - Conducting a full vulnerability assessment (using best available science);
 - Adding 2 or 3 feet of elevation/freeboard, (depending on criticality), above the 100-year, or 1% annual chance, flood elevation; or
 - Designing to the 500-year, or 0.2% annual chance, flood elevation.

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One side note on a recently-announced federal executive order which may have implications for future local projects using federal funds is the new Federal Flood Risk Management Standard.

On January 30th, 2015, President Obama signed a new Executive Order and establishes the Federal Flood Risk Management Standard (FFRMS) which requires federal projects be constructed to a higher vertical elevation to address current and future flood risk and ensure that projects funded with taxpayer dollars last as long as intended.

While this standard and its accompanying regulations are still out for public comment through May 2015, this standard may have implications for future local projects that are constructed using federal funds.

The relevant federal funding or permitting agency will likely determine how

- Designing to the 500-year, or 0.2% annual chance, flood elevation.



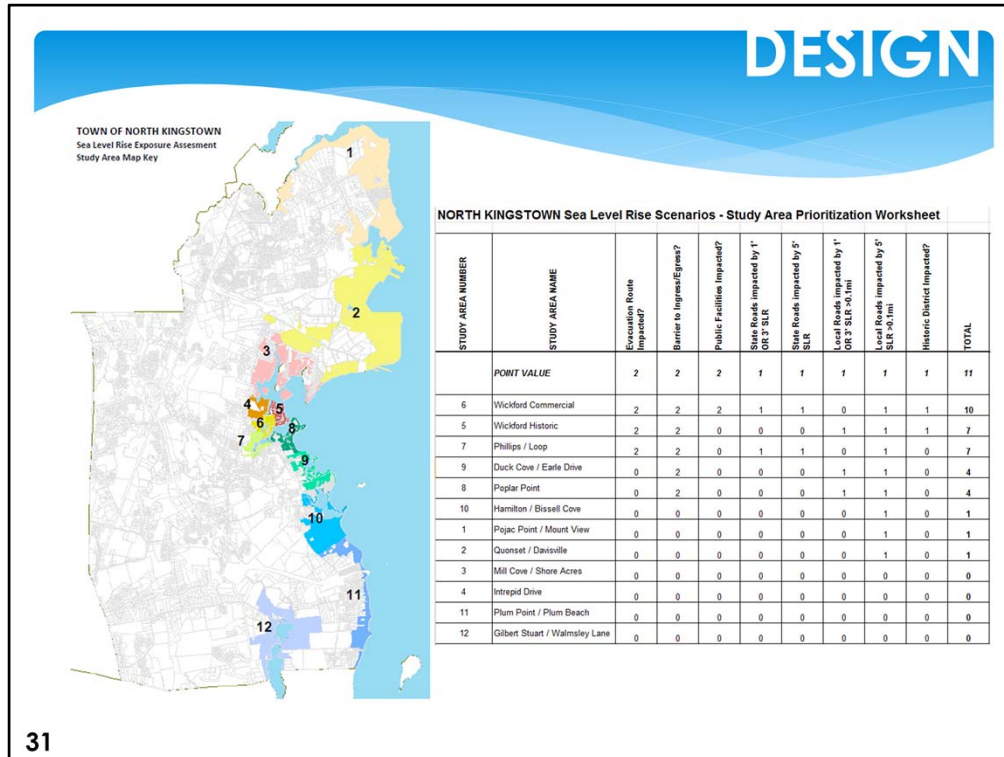
- Craft Adaptation Goals, Policies & Strategies
- Prioritize Actions
 - **Given time & resource constraints**
- Integrate Adaptation into Planning Programs
- Stakeholder Review

Prioritize strategies/actions-

Given the reality of time and resource constraints, a municipality will not be able to adapt to all the impacts posed from natural hazards or climate change. As a result, a selection process based on the highest priority impacts helps to focus in on those impacts which most need attention and action.

There are multiple ways to prioritize actions, the following slides present 2 methods for prioritizing.

Alternate options can be the **STAPLEE** method used by FEMA, a cost/benefit analysis tool and includes considerations for **S**ocial, **T**echnical, **A**dministrative, **P**olitical, **L**egal, **E**nvironmental and **E**conomic issues; or identifying no regret actions (as low hanging fruit) or things that can easily be done and have little to no downside.



In the North Kingstown Study, prioritization of study areas was conducted by identifying relevant questions, placing a weighted value on their importance, and calculating the results for each neighborhood study area identified:

1. Is there an evacuation route impacted?
2. Do flooding impacts create a barrier to ingress/egress?
3. Are public facilities impacted?
4. Will sea level rise impact state or local roads in the near future (i.e. are they impacted under the 1 or 3 ft scenario)?
5. Will local roads be impacted over the long-term by 5ft of sea level rise?
6. Are historic districts impacted?

*** Note: Because some of these impacts deal with public health, safety and welfare, a municipality may want to weight these questions differently. Therefore, the question regarding an impacted evacuation route may be seen as more important than the length of local roads impacted.

IMPACT SEVERITY TOOL - SAMPLE

Impact Statement: *"Bayfront Park" will be impacted by coastal erosion.*

IMPACTS	PERMANENCE	POPULATIONS DISRUPTED	COMMUNITY FUNCTIONS/ VALUES DISRUPTED	OVERALL IMPACT SEVERITY (high, medium, low)
Loss of bayfront walkway	Permanent until fixed	All	Public health, quality of life	Medium
Loss of fishing area	Permanent until fixed	All	Quality of life	Low
Interrupted use of only park in neighborhood	Temporary	Neighborhood population	Public health, quality of life	Medium

SEVERITY OF THE IMPACT	High	Medium Need	High Need	High Need
	Medium	Low Need	Medium Need	High Need
	Low	Low Need	Low Need	Medium Need
		High	Medium	Low

ADAPTIVE CAPACITY

ONSET OF THE IMPACT	Near-term	Medium Need	High Priority	High Priority
	Mid-term	Low Priority	Medium Priority	High Priority
	Long-term	Low Priority	Low Priority	Medium Need
		Low	Medium	High

LEVEL OF NEED

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Rhode Island Statewide Planning Program outlines one systematic approach for prioritizing impacts and actions using:

- The severity of the impact;
- The adaptive capacity of the community or facility to deal with the impact;
- The level of need at the local level to address the impact; and
- The relative timeframe or onset of need.

*This builds off of the Preliminary Impact Evaluation Matrix presented in Slide #18. For more information see the Rhode Island Statewide Planning Program's handbook on planning for natural hazards and climate change.

After brainstorming about the range of potential impacts a community may face from a particular hazard, and qualitatively ranking the impact severity (high, medium or low), the capacity of the impacted property, facility, etc. to adapt to the impact (high, medium or low), and the time horizon for the onset of those impacts (near-term, mid-term, or long-term) a planner can use the two matrices provided here to identify the level of need and the appropriate priority level for future action.



- Craft Adaptation Goals, Policies & Strategies
- Prioritize Actions
- **Integrate Adaptation into Planning Programs**
 - Plan Implementation Timeline and Identify Responsible Party
 - Day-to-Day, and Long-Term
- **Stakeholder Review**

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Adaptation can't all be done at once, so there needs to be a process in place for what adaptation actions need to happen in the short-term vs. the long-term.

After the project team has developed and prioritized its strategies for adapting to the impacts of climate change and natural hazards, the timeline for implementing those strategies must be considered in the local comprehensive plan.

Rhode Island Statewide Planning states that a timeline must be given for implementation of adaptation actions, but that there is no rule about what type of timeline must be used. For example, a municipality may categorize actions in terms of short (0-5 years), medium (5-10 years), and long-term (20+ year), or actions to be done in 1 year, 2 years, 5 years, 10 years, etc.

In addition to a timeline, identifying who the responsible party is within town/city hall is important to ensure the action gets implemented.

INTEGRATE ADAPTATION INTO PLANNING PROGRAMS

- Plan Implementation Timeline and Identify Responsible Party
- Day to day, and long term
- Share with Stakeholders

Maintenance Schedule



Photo credit: Melissa Devine, Rhode Island Sea Grant

Infrastructure Design Life



Photo credit: Brian Bruchard

Assigning both day-to-day tasks (such as maintaining a database of all building permits granted in at risk areas) and long-term actions (such as determining the long-term viability of public facilities located within areas at risk from sea level rise) is necessary so that adaptation strategies and actions are not lost among the many daily and yearly activities of municipal departments.

Sharing adaptation actions with stakeholders both internally (with departments, councils and commissions) and externally (with residents and business owners) is vital to ensuring success. The more input that is gathered throughout the adaptation design and prioritization phase, the more buy-in there will be during adoption of these practices.

Local Adoption :

- Formal Adoption
- Guidance
- Incorporation into Standard Operating Procedures



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Local adoption of vulnerability assessments and adaptation measures can occur across varying degrees.

Formal adoption of goals, policies and actions in the local comprehensive plan can also be complimented by other municipal plans and procedures such as subdivision or zoning regulations, flood ordinances, local capital improvement program project selection or prioritization, or the hazard mitigation plan.

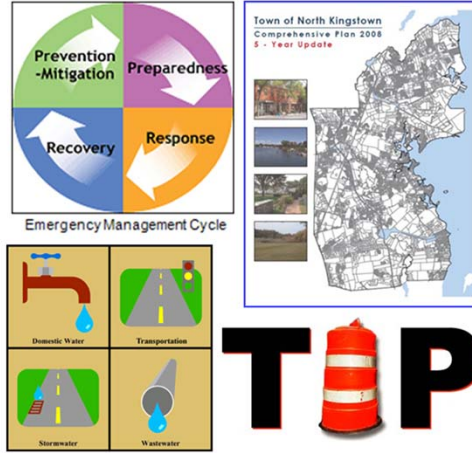
Adaptation actions and strategies can also be adopted through optional processes such as in municipal guidance documents that promote or incentivize best practices for individual permits (e.g. low impact design), or green infrastructure. This more informal method helps to encourage adaptation measures that may be too difficult to impose through regulation or formal plans.

Incorporating good practice and techniques into municipal operations can be one avenue to lead by example. Requiring that natural hazard and climate change impacts be considered at the departmental level, and when permitting or budgeting decisions are made can aid in mainstreaming.

IMPLEMENT

Implementing Adaptation Measures:

- Adaptation Funding
- Governance
- Leadership
- Local Capacity Building
- Modify Municipal Operations, Departmental Duties & Processes



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Success in implementing adaptation measures can rely on funding, local governance and decision making, having leadership at the local level, and building the capacity of staff as well as residents.

Funding adaptation, especially retrofitting municipal infrastructure or facilities, may be possible through annual budgets, local Capital Improvement Programs, or state Transportation Improvement Programs. Post-storm hazard mitigation funding may also be a possibility to advance adaptation measures. Other adaptation efforts may require active pursuit of grant funding or grass roots fundraising within the community.

Implementing adaptation policy requires integrating climate change impacts through the review process for permitting, variance decision making and policy creation across the comprehensive plan, zoning, open space priorities, and the hazard mitigation plan.

Leadership is key, in particular clarifying who will be in charge of overall adaptation planning and implementation. This individual can assist in ensuring adaptation efforts are not disjointed, but rather are cohesive and effective, as well as taking the lead in building local capacity. Municipal staff will need to be trained in why adaptation measures are necessary and what actions or practices are going to help better prepare the community for climate change and natural hazards.

MONITOR & EVALUATE

- **Mainstream Into Annual/Regular Updates**
 - Annual CIP or Biannual TIP, Hazard mitigation priorities
 - 5 year Comprehensive Plan Implementation Report
 - Hazard Mitigation Review
 - NFIP Community Rating System (CRS) Audit
- **Capture Lessons Learned**
- **Compare to State Policy**
- **Create database of impacts & losses**

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Regular monitoring and evaluation will be necessary to evaluate the effectiveness of adaptation policies and actions. Mainstreaming this type of review into existing review, reporting and evaluation initiatives will help to ensure it is done regularly. For example:

- Every year priorities will be revisited through budgeting and improvement programs (e.g. the annual capital improvement program (CIP) or biannual transportation improvement program (TIP)).
- The 5 year Comprehensive Plan Implementation Report serves as an opportunity to evaluate the effectiveness of local goals, policies and actions, as well as revise the timelines for implementation and apply lessons learned.
- Reviewing hazard mitigation plans regularly and particularly after storm to reassess impacts and adaptation priorities.
- Communities involved in the National Flood Insurance Program's Community Rating System (CRS) annual audits provide an opportunity to monitor and evaluate adaptation measures and how they have improved community resilience overall.

Consider generating annual lessons learned so that procedures can be refined over time to be more effective and efficient. Address shifting priorities or criteria that result from lessons learned in each fiscal year.

State policy with regard to adaptation planning will continue to evolve and climate change impacts will be updated as new science and information is available. Municipalities should regularly check the status of state policy, to see if local goals, policies and actions need to be revised. Currently, the best source of this information in Rhode Island is the **RI**

Executive Climate Change Coordinating Council :

<http://www.planning.ri.gov/statewideplanning/climate/resources.php> and

<http://www.planning.ri.gov/statewideplanning/climate/meetings.php>

Developing a database of impacts and losses, including capital improvements to determine the costs and benefits of adaptation.

Contact:

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401-874-6626

Resources

<http://rhody.crc.uri.edu/accnk/>

