

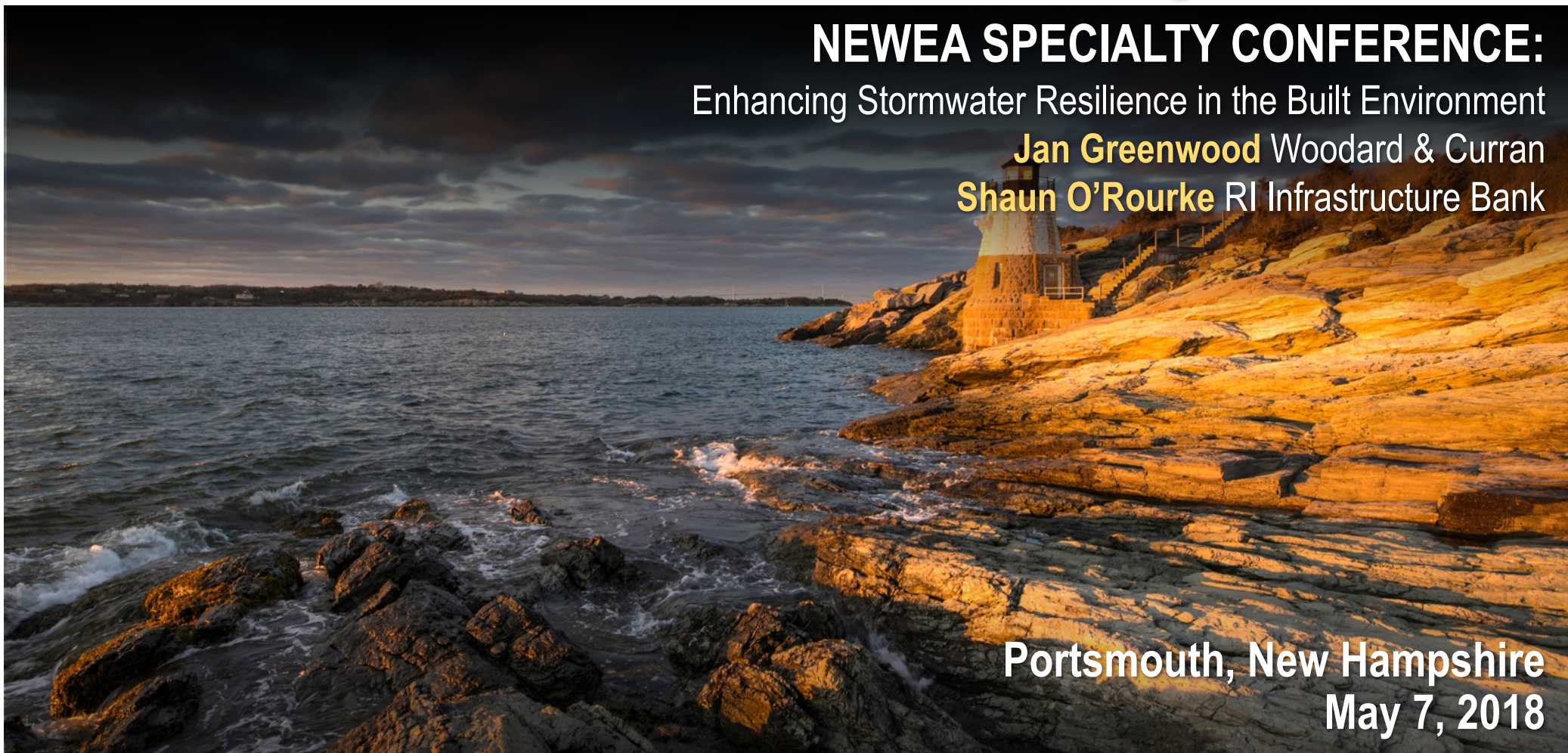


# Rhode Island's Resiliency Efforts

## NEWEA SPECIALTY CONFERENCE:

Enhancing Stormwater Resilience in the Built Environment

**Jan Greenwood** Woodard & Curran  
**Shaun O'Rourke** RI Infrastructure Bank



Portsmouth, New Hampshire  
May 7, 2018





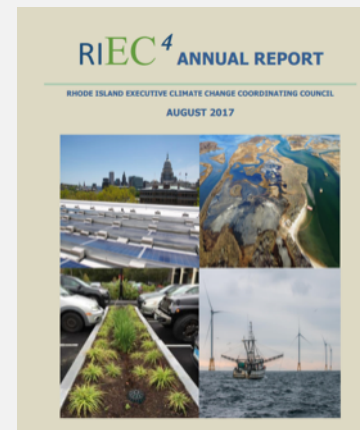
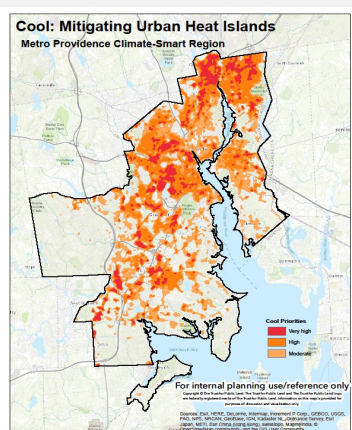
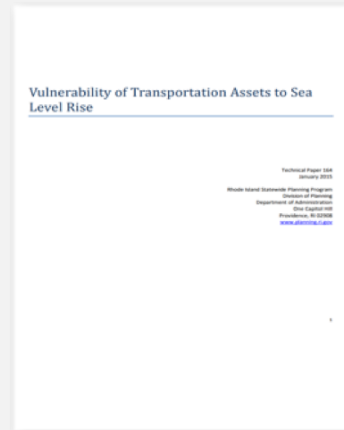
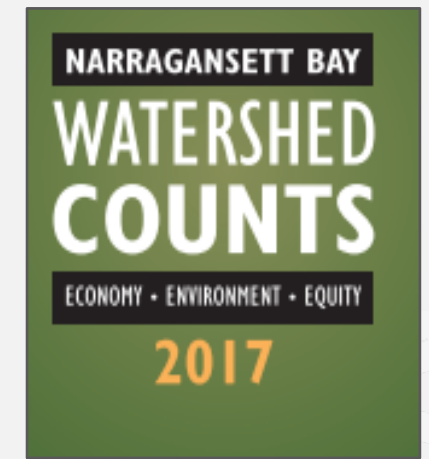
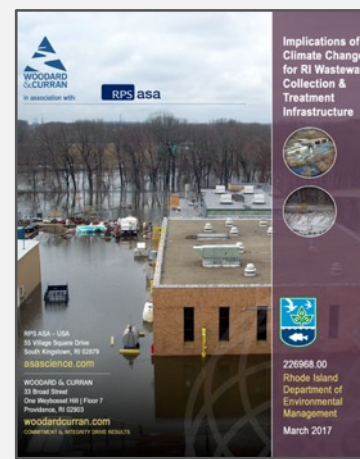
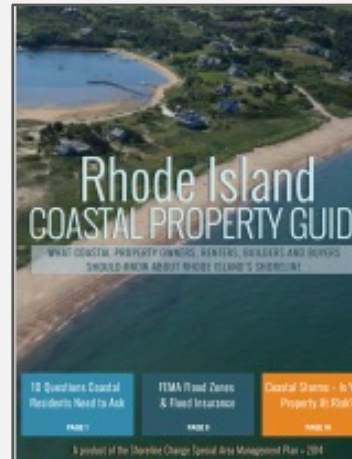
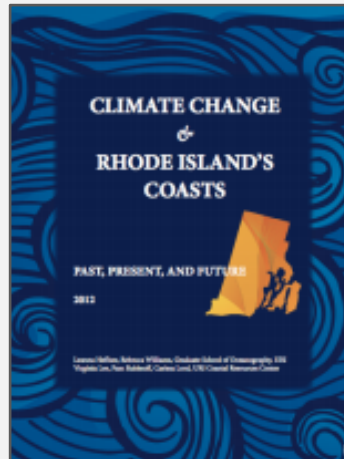
# Resilient Rhody:

## Statewide Climate Resilience Action Strategy





# Statewide Climate Resiliency Action Strategy



Plan	Rhode Island Department of Health Climate Change Adaptation Plan
Vision	Charting a path towards a healthy, equitable, and resilient Rhode Island
Impacts	Improved Physical Health    Improved Mental Health    Reduced Vulnerability    Healthier Environment
Outcomes	<ul style="list-style-type: none"><li>Rhode Island is more resilient to the impacts of climate change and related health impacts through the use of climate change adaptation and planning.</li><li>Climate change is recognized as a threat to human health in planning and decision-making across all sectors.</li><li>Program capacity allows for increased community coordination, and protection of public health.</li><li>Evidence-based interventions and adaptations are authorized and expanded.</li><li>Vulnerable communities and individuals are aware of the risks of climate change and are more prepared.</li><li>Translational research communication and education related to climate change, health, adaptation, and mitigation.</li></ul>
Stakeholders	Rhode Island Residents and Communities    Municipal and State Government    Local, Regional, and National Partners    Educational Institutions, Healthcare, and Business    Public Health Sector
Priorities	Temperature Extremes    Vector-borne Diseases    Air Quality    Storms & Flooding    Food & Water    Sea Level Rise
Interventions	<ul style="list-style-type: none"><li>Policy &amp; Systems Change (policy development, alignment across sectors)</li><li>Community Engagement (enhanced communications and programs)</li><li>Organizational Partnerships (partnership, development, research collaboration)</li><li>Individual Empowerment (education, outreach)</li></ul>
Inputs & Resources	Climate and Health Adaptation Planning Program (CHAPP), Alignment with Rhode Island Climate Change Coordinating Council (CCCC) and RICC Strategic Plan Goals, Program Staff, Partners, Knowledge Base and Data, Learning Experiences

*Wealth of reports completed to date*





# EC4 Science and Technical Advisory Board (2017)



CHANGES





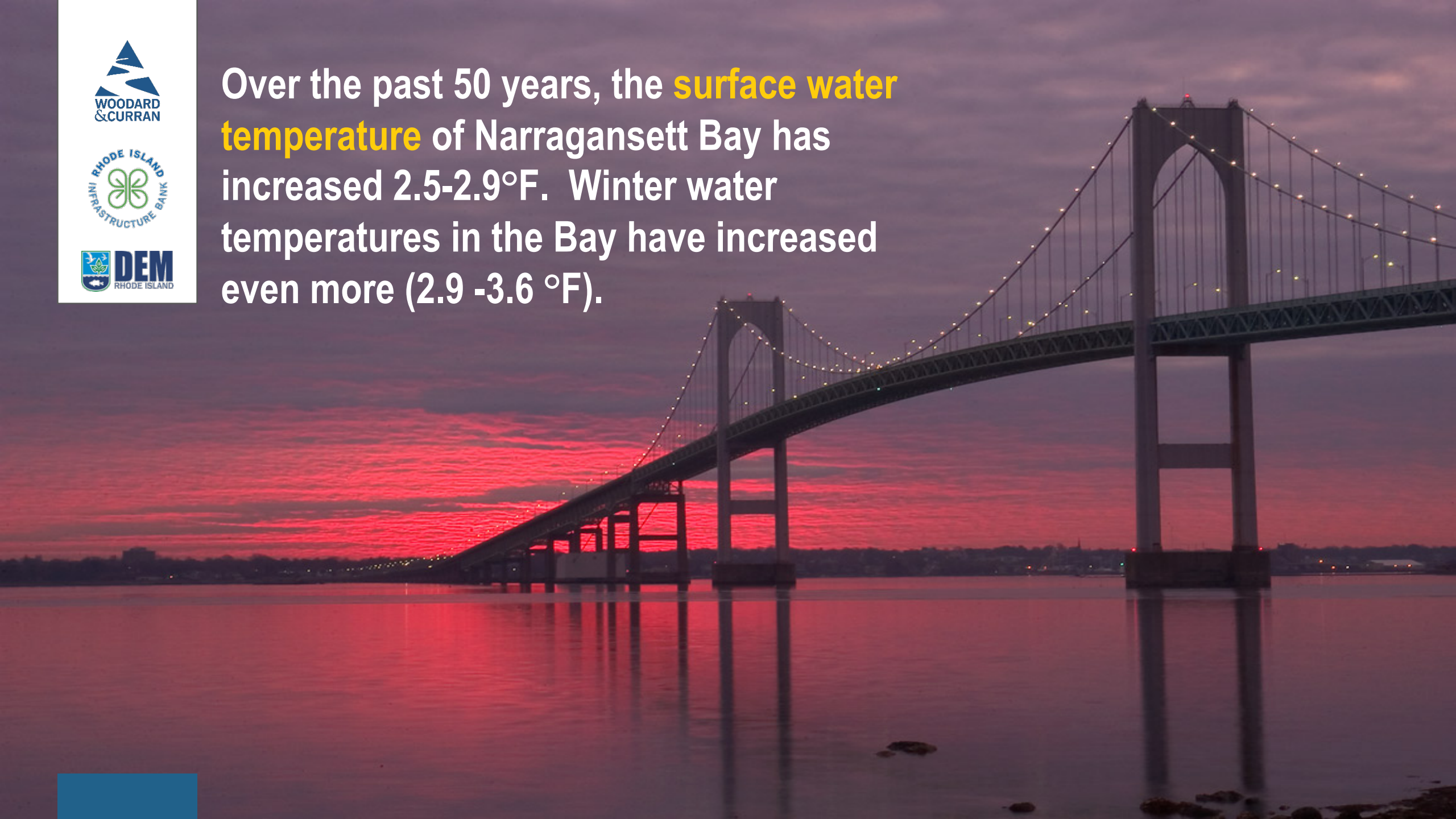


**Temperatures** in Rhode Island have increased by more than 3°F since the beginning of the 20<sup>th</sup> century. 2016 was the warmest year on record globally.





Over the past 50 years, the **surface water temperature** of Narragansett Bay has increased 2.5-2.9°F. Winter water temperatures in the Bay have increased even more (2.9 -3.6 °F).





A photograph of a flooded street at night. The water is dark and reflects the warm yellow lights from the buildings. In the background, there are brick buildings, one of which has signs for 'SEAMEN'S CHURCH INSTITUTE' and 'ALPHA CAFE + LODGING'. A person is kayaking in the foreground. The scene illustrates the impact of sea level rise.

**Sea levels** have risen 10 inches in RI since 1930 (Newport tide gauge). Updated NOAA predictions (Jan. 2017) put sea level rise in RI at close to 1 ft. by 2030 and upwards of 9 ft. by 2100.





**Intense rainfall events** in New England have increased 71% since 1958. RI's average annual precipitation has increased more than 10 inches since 1930.





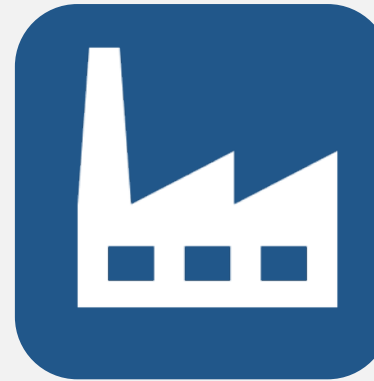
# What's at Risk



15,380 active flood insurance policies covering over \$3.8 billion in **residential and commercial property**



337 miles of **state and municipal roadway** are vulnerable to flooding in a 100 yr. storm surge event



19 **wastewater treatment facilities**, all located in coastal or riverine flood zones



**Salt marshes** provide recreational and commercial fishing activities with an estimated of \$6,417 an acre. Coastal wetlands generate \$2 billion annually.





# How are we defining Climate Resilience?

Climate Resilience is the capacity of individuals, institutions, businesses, and natural systems within Rhode Island to survive, adapt, and grow regardless of chronic stresses and weather events they experience.





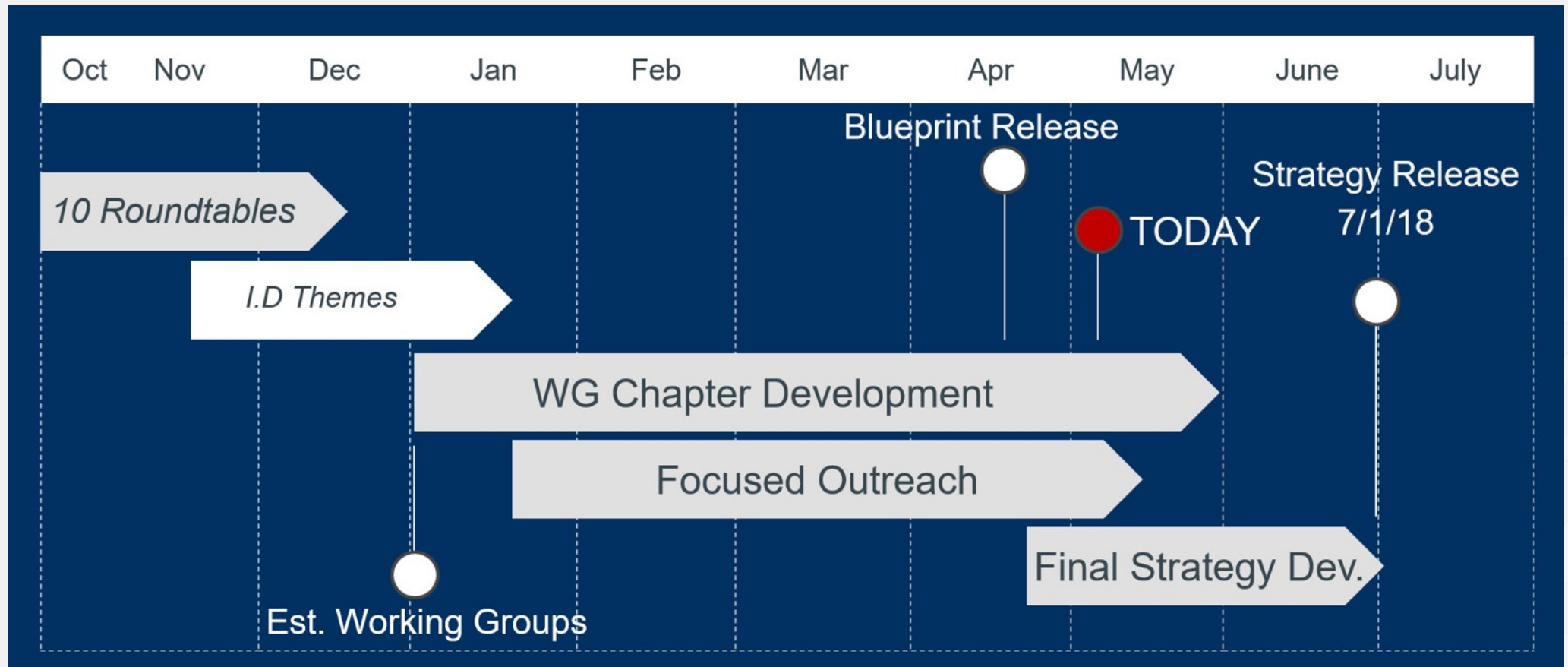
# Statewide Climate Resilience Action Strategy Goals

- Catalyze the planning and vulnerability studies already developed and move towards implementation
- Identify and prioritize resiliency actions the State can control to demonstrate progress and implementation
- Prioritize actions that promote cross-agency collaboration and support municipalities in resilience planning and project implementation





# Climate Resilience Action Strategy Timeline



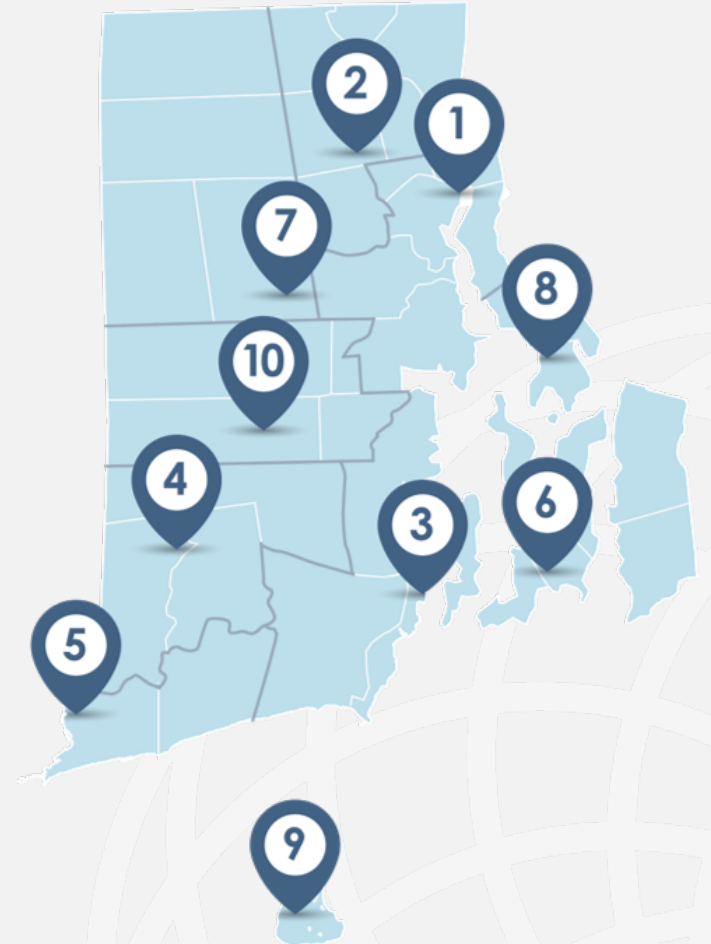


# Statewide Resilience Roundtable Series

*10 Roundtables over 2.5 months*

*350 Attendees*

- Municipal Planners/Staff
- Environmental Orgs
- Community Orgs  
(Chambers, Faith-based groups,  
Historic districts)
- Business Owners
- State agency employees
- Residents







# Feedback

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*The statewide strategy needs to recognize that municipalities are on the front lines of dealing with the impacts of a changing climate*

*We are glad you ventured to the inland communities for the Roundtable discussion as we often feel left out of the process since we aren't on the coast*

*Rhode Island has done a lot of planning and vulnerability studies, this strategy needs to drive investment where it's needed most*

*How are we going to pay for all these needed infrastructure upgrades?*



# Resiliency Themes

## “Prioritize to Optimize”

- Critical Infrastructure Assets
  - Clean Water, Roads and Bridges
- Utilities
  - Drinking Water, Electric Grid
- Natural Systems
  - Coastal & Upland
- Emergency Response and Preparedness
- Local Community Resilience / Education
- Paying for Climate Resilience Projects







# Strategy Outline & Chapter Leads

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- Making the Case for Climate Resilience: EC4 Science and Technical Advisory Board (STAB)
- Critical Infrastructure and Utilities: (RIDEM), (OHCD), (RIEMA)
  - Water - (RIDEM), (WRB)
  - Power - (OER), (DPUC)
  - Transportation - (RIDOT), (SPP)
  - Food – (GOV), (RIDEM)
- Natural Systems: (CRMC) & (DEM)
  - Coastal – (CRMC)
  - Inland - (RIDEM)
- Emergency Preparedness: (RIEMA)
- Community Resilience: (RIDOH)
- Paying for Climate Resilience Projects: (RIIB)



# Types of Actions

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## Projects

Projects and processes that can be accelerated now and in the future with existing resources

## Policies

Policies in state control to drive climate adaptation across agencies

## Programs

Programs and initiatives developed by state agencies to assist municipalities and communities become more climate resilient

## Financing

Highlight existing and emerging financing mechanisms



# CLIMATE RESILIENCE ACTION STRATEGY

» Climate Resilience is the capacity of individuals, institutions, businesses, and natural systems within Rhode Island to survive, adapt, and grow regardless of chronic stresses and weather events they experience.

## STRATEGY GUIDING PRINCIPLES:

- 1 Prioritize actions and investments the state can make today
- 2 Leverage planning work already done by state agencies and organizations
- 3 Identify actions and investments ready for implementation in the near-term
- 4 Identify competencies that are shared among multiple state agencies
- 5 Provide resources and tools to municipalities across the state
- 6 Understand the impacts of climate change in environmental justice communities across the state

Findings from 10 roundtable meetings led to the development of six main themes highlighting key climate resilience issues for coastal and upland communities.

## STRATEGY FRAMEWORK

### RHODE ISLAND'S CHANGING CLIMATE

#### CLIMATE CHANGES

- Sea level rise
- Warming air temps
- Warming water temps
- Storm frequency and intensity
- Biodiversity
- Increased precipitation

#### CHALLENGE / VULNERABILITY

- Impacts across RI that are putting our residents, economy, and infrastructure at risk

#### RESILIENCE OPPORTUNITY

- Communicate up-to-date data and climate projections to ensure consistent use across all state agencies

### CRITICAL INFRASTRUCTURE & UTILITIES

#### SECTORS

- Food
- Power
- Transportation
- Water

#### CHALLENGE / VULNERABILITY

- Critical assets and utilities in low-lying coastal and flood-prone areas
- High impact to the economy and quality of life at time of disruption

#### RESILIENCE OPPORTUNITY

- Identify collaborative projects and goals across agencies to stretch resources
- Align useful life of infrastructure investments with climate change projections

### NATURAL SYSTEMS

#### GEOGRAPHY

- Coastal
- Upland

#### CHALLENGE / VULNERABILITY

- Contributions of natural resources to flood protection, water quality, and healthy communities
- Economic impact of loss of recreation areas and coastal access

#### RESILIENCE OPPORTUNITY

- Work across agencies to manage statewide natural resources for ecosystem services
- Work in collaboration with municipalities and private landowners to effectively manage contiguous natural areas

### EMERGENCY PREPAREDNESS

#### THEMES

- Preparedness systems and processes
- Critical facilities

#### CHALLENGE / VULNERABILITY

- Safety of residents across the state during a severe weather event
- Lack of proactive local hazard mitigation planning

#### RESILIENCE OPPORTUNITY

- Continue to merge preparedness and long-term resilience planning
- Align municipal hazard mitigation planning with statewide initiatives

### COMMUNITY RESILIENCE

#### THEMES

- Critical community assets
- Community resilience teams
- Environmental justice

#### CHALLENGE / VULNERABILITY

- The impacts of climate change are experienced differently across communities, with unequal rates of recovery

#### RESILIENCE OPPORTUNITY

- Develop locally based leadership on community resilience issues
- Align community resilience investments with statewide initiatives such as school upgrades and public housing

### PAYING FOR CLIMATE RESILIENCE PROJECTS

#### THEMES

- Barriers to financing
- Established financing mechanisms
- Emerging financing mechanisms
- Conceptual financing mechanisms

#### CHALLENGE / VULNERABILITY

- Multiple funding/financing mechanisms often required for resilience projects
- Financing options that are not well known and often complicated

#### RESILIENCE OPPORTUNITY

- Explore established, conceptual, and emerging funding and financing mechanisms for climate adaptation projects
- Project costs are reduced if resilience projects are implemented before a severe weather event



Fields Point Wastewater Treatment Facility



Goddard Memorial State Park Boat Ramp



Providence River

## ACTION TIME HORIZONS

NOW

2-5 years

5-10 years

ACTIONS THE STATE  
CAN TAKE NOW WITH  
EXISTING RESOURCES

PRIORITY ACTIONS  
TO ACCELERATE IN  
THE NEAR TERM

LARGE PROJECTS THAT  
REQUIRE INCREASED  
COLLABORATION  
AND INVESTMENT



# [www.climatechange.ri.gov](http://www.climatechange.ri.gov)

State of Rhode Island  
Climate Change

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HOME / RESILIENT RHODY

Executive Order

"Rhode Island is a leader. We're the only state with an offshore wind farm, and we're committed to upholding the principles of the Paris Climate Agreement. By aggressively working to combat climate change and protect our coastal state from its effects, we're creating a stronger, safer, and greener Rhode Island for future generations."  
—Governor Gina M. Raimondo

## Resilient Rhody

*Rhode Island's First Comprehensive Climate Preparedness Strategy*




On September 13, 2017, Governor Gina M. Raimondo signed an Executive Order appointing a Chief Resiliency Officer to drive climate resiliency efforts across the state, both within government and in collaboration with business, academic, and nonprofit partners, with the mission to develop a statewide Climate Resiliency Action Strategy to be submitted to the Governor by July 1, 2018.

The goal of this Strategy is to identify actions - e.g., projects, policies and legislation, funding and financing opportunities, etc. - that the state can take to better prepare for a changing climate. Rhode Islanders are seeing the impacts of climate change in our communities already, and the time to take action is now. So the actions included in the Strategy prioritize things we can begin work on now.

## Resiliency Roundtables

These investments will leverage the extensive work that many around the state, from environmental organizations to academic institutions to state agencies, have already been doing. We're building upon efforts, so the first step for the Chief Resiliency Officer was to hold a series of Resiliency Roundtables across the state, to listen to local and regional leaders, learn what has been done, and hear their priorities for local climate resilience in the future.

### COMMUNITY ROUNDTABLE LOCATIONS



### ROUNDTABLE CO-HOSTS

1. Providence: Save the Bay
2. Smithfield: Audubon Society and Westchester Valley Northern Council
3. Narragansett: Coastal Resource Center, OR GAO
4. Aquidneck: Wood-Partridge Watershed Association
5. Westerly: Town of Westerly, Ocean Community Chamber, and Westerly Education Center
6. Newport: Aquidneck Island Planning Commission and COB Newport
7. Johnston: Northern RI Conservation District
8. Bristol: Audubon Environmental Education Center, Southern RI Conservation District, and Town of Westerly
9. Block Island: The Nature Conservancy
10. Coventry: Town of Coventry



Throughout the state, we heard many concerns, both coastal and upland. Here are our biggest takeaways from these roundtable meetings, which we used to shape the main themes of the working Climate Resiliency Action Strategy.

## COASTAL

Stressors  
Needs

- Shocks
- Severe Weather Events (e.g. hurricanes)
    - High Wind
    - Flooding
- Stressors
- Sea level rise
  - Aging infrastructure
  - Spread of invasive species
  - Coastal erosion
  - Development pressure and assets in floodplains

"The statewide strategy needs to recognize that municipalities are on the front lines of dealing with the impacts of a changing climate"

"Rhode Island has done a lot of planning and vulnerability studies, this strategy needs to drive investment where it's needed most"

## UPLAND

Stressors  
Needs

- Shocks
- Severe Weather Events (hurricanes, etc.)
    - High Wind
    - Flooding
  - Forest Fires
- Stressors
- Aging infrastructure
  - Spread of invasive species / forest pests
  - Drought
  - Temperature swings
  - Development pressure and assets in floodplains

"We are glad you ventured to the inland communities for the Roundtable discussion as we often feel left out of the process since we aren't on the coast"

"How are we going to pay for all these needed infrastructure upgrades?"

If you are engaged on this issue, this is the place to interact with us as we continue to work toward climate resilience here in Rhode Island. Send us your feedback!



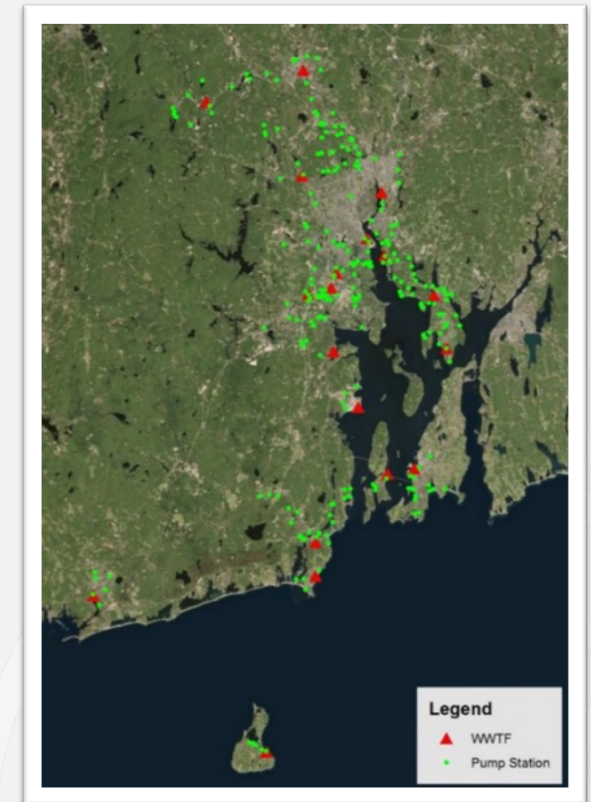


# Implications of Climate Change for Rhode Island Wastewater Collection and Treatment Infrastructure



# RI Wastewater Collection & Treatment Infrastructure

- Goal to **improve WWTF reliability** under changing climate conditions
- Major modifications to WWTFs require **long term planning**
- Benefit to **collaborative partnership** among state agencies and local communities
- Resulting Scope:
  - Statewide assessment of 19 WWTFs and major collection components
  - Identify vulnerabilities
  - Identify short-term and long-term adaptive strategies

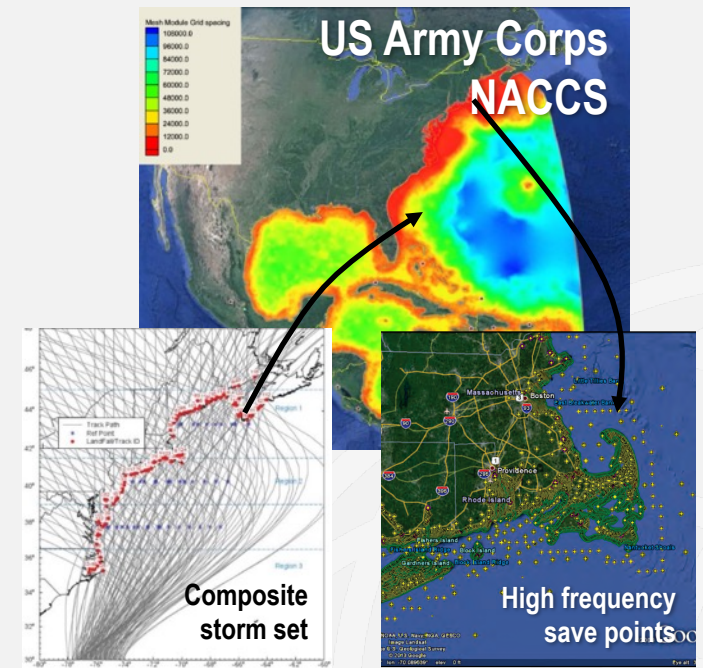






# Statewide Models Provided Consistent Criteria

- Sea Level Rise
- Storm Surge
- Shoreline Change
- Wave Action
- Riverine Flood Elevations





# Facility Operators Provided Site Specific Data



Rhode Island Wastewater Collection and Treatment Infrastructure  
Emergency Management and Climate Change Study Information  
Return by February 20, 2015

GENERAL INFORMATION

Contact Name: JOSE DASILVA  
Work Phone: 202 8877  
Cell Phone: (401) 480-7201

Facility Name and Main Address:	Design Flow Capacity (MGD)	Average Daily Flow (MGD)	Year Constructed	Most Recent Upgrade Date
Bleed WWT	3.8	2.8		2015 Bleed WWT Upgrade
2 Park Street				
Bleed, RI 02809				
Pump Stations & CSDs - List Locations:	Capacity	Average Daily Flow	Year Constructed	Most Recent Upgrade Date
08 Ferry Road, RI 02883				
09 Main Street PSM				
01 Constitution PSM				
04 Cat 3 PS				
05 Cat 2 PS				
06 Silver Creek PSM				
07 Cat 1 PS				
70 Little Jean Drive PSM				
72 Mount Hope PSM				
73 Peter Drive PSM				
80 Kilmarnock PSM				
81 Brook Farm PSM				

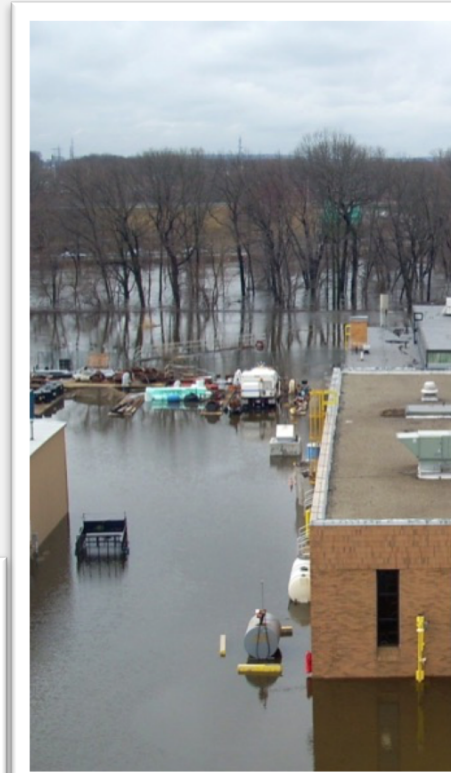
QUESTIONS

- Attached is a listing of reported non-standard events from 2009 to present that have occurred at your facility or collection system.
  - Please identify those events that were caused or complicated by a natural event—flooding, freezing, storm surge, excessive heat, etc.—and include any additional information that would be helpful to explain the challenges you faced.
  - Also, please note those events that you feel could recur under conditions related to natural hazards.
  - Then please add other events that occurred in that time at your WPCF, pumping stations, or CSDs where there was direct damage or the threat of damage from natural events. Please provide as much detail as possible. This can include an approximate costs to repair the damage or other information.
- Attach a listing of wastewater pumping stations that the state and CDMA have on file in our GIS database. Also, a GIS map of those stations can be found at: [http://www.dem.state RI.us/gis/riwast/gis/riwast.asp](#). Please review and make any additions, corrections or that we may update our records for the project and future efforts.
- Does your facility or pumping station have underground fuel storage tanks that are subject to flooding?
- Has access to the WPCF, pumping stations, or CSDs ever been restricted during storm events due to flooding or other obstacles? If so, what access roads have been affected and by what obstacle? If rain-related, please estimate (if you can) how much rain (or how fast it falls) that has caused such problems.
- Are any parts of the facility or pumping stations protected by a berm or other means to prevent floodwaters from entering?
- What process constraints are you aware of that have been (or may be) worsened by natural events, such as increased precipitation, drought, etc?
- Have any site mitigation projects been done at your facility or pump stations? If so, roof replacement, storm windows/shutters, moving electrical equipment to higher locations, etc.) in response to the March 2010 floods or other events? If so, please summarize.
- How would you like to improve standby power capabilities at your plant or stations?
- Do you have access to spare pumps, generators, or other support from other utilities for use in an emergency? Have you had to acquire and use such equipment in the past?
- What are some other major issues that your facility is facing or has faced in the past? In other words, what worries you the most about maintaining the ongoing operations at your plant? List other information that you feel is important to share.



# Recommended Adaptive Strategies

- Hardening
- Relocation
- Readily Repairable/Replaceable
- Redundancy
- Wet Weather Bypass





# Budgetary Implementation Costs

Help communities plan and budget for climate change resiliency projects

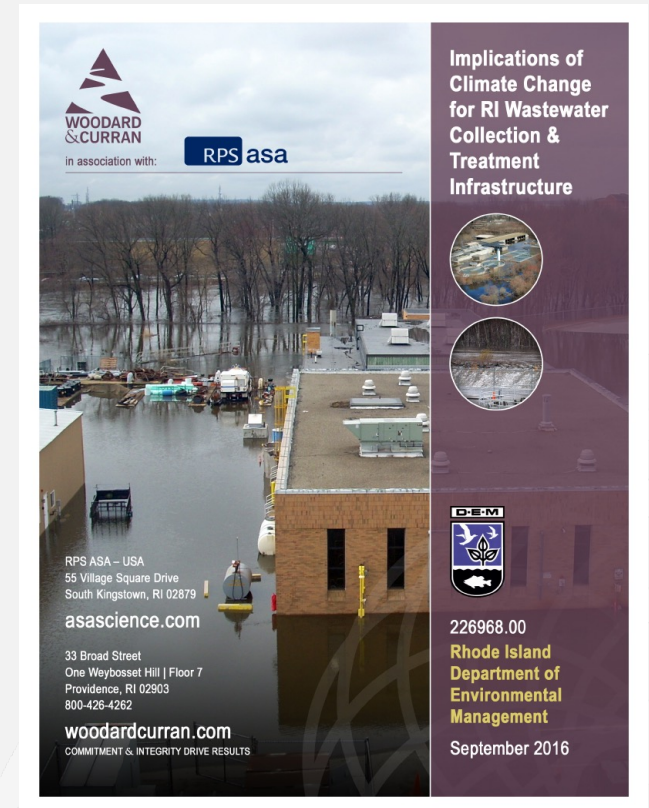
ADAPTIVE STRATEGIES					
SYSTEM	Hardening	Relocating	Readily Repairable/ Replaceable	Redundancy	Mitigation Strategy
Influent Pump Station (Screw Pumps)	D		B		Raise and extend perimeter berm. <sup>1</sup> Store replacement pump components on-site.
Primary Clarifiers	D		B		Raise and extend perimeter berm. <sup>1</sup> Pumps may be easily augmented. Replace sludge pumps with submersibles. Store replacement drive components on-site.
Disinfection System	D	B		B	Raise and extend perimeter berm. <sup>1</sup> Relocate critical components to high ground. Back-up temporary chemical storage and pumping.
Effluent Pump Station	D	B			Raise and extend perimeter berm. <sup>1</sup> Relocate drive systems to high ground.
Saylesville PS	A				Protect building with flood barriers, and seal penetrations.
<p>1. Raising and extending the perimeter berm will address multiple systems under one project. A = &lt; \$50,000    B = \$50,000 to \$250,000    C = \$250,000 - \$1,000,000    D = &gt; \$1,000,000</p>					





# RIDEM Actions Resulting from this Study

- Issued state-wide guidance to address climate change in WWTF planning and design
- Established a cost-benefit analyses approach to implement adaptation measures
- Implemented a requirement for all RIPDES permit renewals to prepare a Climate Resiliency Plan





# Clean Water Financing / Funding for Resiliency Projects

## Rhode Island Programs







# RI Clean Water SRF Financed Resiliency Projects

- Program administered in partnership between Rhode Island Infrastructure Bank and RI Dept. of Environmental Management
  
- Project Examples:
  - WWTF Upgrade and Flood Mitigation, City of Warwick – backstopped FEMA funding of the raising of existing flood berm to the 500 year storm elevation
  
  - WWTF Upgrade, Town of Warren – Elevating drive motors and electrical equipment above projected flood elevation; replacing some pumps with submersible pumps



# Bay & Watershed Restoration Fund Grants

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- Bond funds made available through statewide ballot referendum.
- Grants up to 75% of total project cost.
- Funds flood mitigation/prevention projects that have an ecological co-benefit. Initial (2017) grant round awarded 11 grants totaling \$2.6M.
- The Nature Conservancy – Maidford River Restoration: replacing undersized culverts to reduce flooding, improve tidal flow and restore saltmarsh sparrow habitat.





# Final Thoughts

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- RI is moving planning to implementation
- Collaboration across the region is critical
- Projects require technical expertise and a funding quilt
- Need for increased awareness of available funding / financing programs
- 2018 Green Economy and Clean Water Bond – \$48.5M
  - 20.5 for climate resilience investments



# Rhode Island's Resiliency Efforts

**Jan Greenwood** Woodard & Curran

**Shaun O'Rourke** RI Infrastructure Bank

**Jay Manning** RIDEM

