

# RIEC<sup>4</sup> ANNUAL REPORT

RHODE ISLAND EXECUTIVE CLIMATE CHANGE COORDINATING COUNCIL

AUGUST 2017



## *Cover Images*

*Clockwise from top left:*

- *Solar Panels – RI Department of Health Cannon Building (Providence, RI)*
- *Ninigret Saltmarsh Resiliency Project (Charlestown, RI)*
- *First US Offshore Wind Farm - Block Island Wind Farm*
- *Green Infrastructure Project (Bellevue Ave, Newport, RI)*

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- 1) *EC4 ADVISORY BOARD ANNUAL REPORT (June 2017)*
- 2) *EC4 SCIENCE & TECHNICAL ADVISORY BOARD ANNUAL REPORT (June 2017)*

## EXECUTIVE SUMMARY

As a coastal state vulnerable to the impacts of climate change, the need for Rhode Island to take bold action to reduce greenhouse gas emissions and prepare for coming impacts is clear. Although climate change presents us with formidable challenges, we also face an unprecedented opportunity to capitalize on technology advances, industry growth opportunities, and innovation solutions to lower our carbon footprint and consider a multitude of adaptation measures to protect Rhode Island. It is possible for Rhode Island to achieve climate change goals, while unlocking economic opportunity and improving the environmental and public health of our citizens and communities.

The information provided in this report clearly shows that climate change impacts all aspects of RI's well-being – infrastructure, economy, health, and environment. In 2017, the membership of the Council increased from nine to eleven when the RI Division of Public Utilities & Carriers (DPUC) and the RI Infrastructure Bank (RIIB) were added by Governor Raimondo as standing members. The 2017 Annual Report summarizes the activities of the EC4 and the eleven agencies/offices that comprise the Council in seven key categories.

- **Adaptation** - *Planning for changes that are expected to occur based on scientific projections or calculations.*
- **Vulnerability Assessments** - *An important process oriented tool to help determine asset vulnerability and make informed choices on topics as complex as climate change.*
- **Mitigation** - *Human intervention to reduce impacts on the climate system, including strategies to reduce greenhouse gas sources and enhance greenhouse gas sinks. In the context of emergency preparedness, mitigation encompasses a broad range of efforts to reduce loss of life and property by lessening the impact of disasters.*
- **Leading by Example** - *Using actions to influence others to behave and respond in ways that society deems valuable and appropriate.*
- **Municipal Collaboration** - *Refers to the reality that cities and towns are on the front line of addressing the causes and impacts of climate change. Municipalities can play a significant role in implementing both emission reduction strategies and adaptation plans.*
- **Economic Resilience** - *Goes hand in hand with climate resilience. Thinking creatively about ways to persevere and prosper will require combining public and private sector leadership.*
- **Research and Analysis** - *Improves knowledge of the health and environmental effects of climate change while helping design long-term solutions.*

## EC4 HIGHLIGHTS

### **Governor Raimondo's "1,000 by '20" Clean Energy Goal**

In March 2017, Governor Raimondo announced a [strategic goal to increase the amount of clean energy](#) in the state by 10 times – or a total of 1,000 MW – by the end of 2020. The goal will include energy from a broad portfolio of clean energy resources, including off-shore wind, on-shore wind, and solar. "Every step we take toward a clean energy future is a step toward a stronger, more sustainable environment and economy. Our commitment to expand our clean energy portfolio will help lower energy costs, create jobs and protect the beauty of our state for future generations," said Governor Raimondo.

### **Block Island Offshore Wind Project**

In December 2016, the 30 Megawatt (MW) [Block Island Offshore Wind Project](#) became the nation's first operational offshore wind project – a tremendous clean energy milestone for Rhode Island and the entire country. The RI Coastal Resources Management Council (CRMC), through the development of the [RI Ocean Special Area Management Plan \(Ocean SAMP\)](#), and the RI Office of Energy Resources (OER) played a key role in the development of the project and subsequent permitting responsibilities.

### **Coastal Habitat Resiliency – Ninigret Pond & Sapowet Marsh Wildlife Management Area**

CRMC completed the [Ninigret Pond Saltmarsh Adaptation Project](#) in February 2017 using thin layer deposition techniques to add marsh elevation and the replanting of new saltmarsh vegetation for habitat resiliency to sea level rise (SLR). The navigation channel was dredged with 20,000 cubic yards placed on the marsh and 30,000 cubic yards placed on Charlestown Town Beach to enhance its resiliency to coastal erosion. Similarly, the RI Department of Environmental Management (RIDEM), alongside key partners are coordinating on an improvement project at the [Sapowet Marsh Wildlife Management Area](#) in Tiverton. The project supports efforts to restore this degraded coastal habitat and strengthen the state's resilience against climate change. Sapowet is also a place where significant shoreline erosion is threatening existing infrastructure. As part of the improvement project, the access from Sapowet Avenue will be redesigned, four acres of beach/dune/coastal shrub land will be revegetated, and nine acres of coastal grassland will be restored.

### **WWTF Infrastructure Climate Study**

RIDEM (with CDBG-DR funding from OHCD) recognized the need to begin integrating climate change considerations into wastewater system planning and design. This [study](#), completed in March 2017, is a planning tool intended to help understand the projected implications of climate change on the state's public wastewater treatment systems. It focused on the state's 19 municipal and regional treatment plants and the 240 primary pump stations that help bring flow to those treatment plants. The study assessed the potential for impacts to Rhode Island caused by natural hazards associated with climate change and preliminarily assessed climate change impacts to Rhode Island wastewater infrastructure. The final study developed recommendations for adaptive strategies, compiled the work in a technical report, offered the data used in the study online at no cost, and provided summary outreach materials for local officials.

## **Clean Energy Jobs Report**

Strong state support for energy efficiency and renewable energy policies have stimulated a robust market for clean energy goods and services making Rhode Island home to a new, growing clean energy industry. In June 2017, OER and the RI Executive Office of Commerce released the third annual [Clean Energy Jobs Report](#), which found that since 2014, clean energy employment in the Ocean State has grown by an impressive 66 percent and 11 percent over just this past year. Now more than 15,300 jobs strong, Rhode Island's clean energy economy continues to grow. Energy efficiency remains the largest portion of the state's clean energy employment. It accounts for 59 percent of all clean energy jobs, or almost 9,000 workers.

## **Public Sector “Lead by Example” Clean Energy Awards**

In April 2017, OER recognized eleven state government agencies, quasi-public agencies and municipalities for their renewable energy and energy efficiency achievements at its inaugural [Lead by Example](#) Energy Awards ceremony, held at the Rhode Island State House. Governor Raimondo's Executive Order 15-17, directs state agencies to “Lead by Example” and transition energy supply portfolios and consumption practices to lower-cost, cleaner, low-carbon solutions. State and municipal employees are helping to reduce energy costs, and mitigate greenhouse gas emissions, consistent with Rhode Island's economic, energy and environmental policy goals.

## **RI Greenhouse Gas Emissions Reduction Study**

In December 2016, the EC4 completed the [RI Greenhouse Gas Emissions Reduction Study](#) to evaluate various strategies for reducing greenhouse gas emissions in the state. The purpose of the study is to suggest possible strategies, programs, and actions to meet the [targets](#) for greenhouse gas emissions reductions according to the schedule specified in the Resilient Rhode Island Act. Developed with the guidance of a broad group of public stakeholders, the study recommends three areas of opportunity for decision-makers to consider: building on state success, enabling markets and communities, and leveraging regional collaboration.

## **Commercial Property Assessed Clean Energy (C-PACE)**

The RIIB closed the first two [Commercial Property Assessed Clean Energy \(C-PACE\)](#) projects in March 2017. C-PACE provides commercial property owners with long-term fixed rate financing for energy efficiency and renewable energy projects. These first projects call for the installation of roof-mounted solar panels on two office buildings in Middletown providing 351kW of renewable energy capacity. Over the life of the investment, the property owner will have 7,720 MWh of energy savings which is equivalent to 573 homes' energy usage for one year while also saving the firm an estimated \$226,000 in energy costs. This project will reduce CO<sub>2</sub> emissions by 189 tons per year, equivalent to the emissions of 452,968 miles driven by the average passenger car.

## **Vulnerability of Municipal Transportation Assets to Sea Level Rise and Storm Surge**

Completed by the RI Division of Planning (Planning) in October 2016, this project adapted the methods of a previous study, *Vulnerability of Statewide Transportation Assets to Sea Level Rise*, to incorporate new data, at a [municipal level outlook](#), and a more easy to understand presentation. It utilized the STORMTOOLS data set created by CRMC, which offered the opportunity to bring information about storm surge and an additional sea level rise scenario into the analysis. A broad summary of the results is

presented in factsheets tailored to each municipality threatened by sea level rise and storm surge. These fact sheets are intended to help communicate quickly the basics of sea level rise and storm surge vulnerability, a useful tool for those new to the topic or for fostering conversation. There is a detailed technical report, as well as an online Digital Appendix, available to municipal officials.

### **RI Department of Health – Climate Change Short Documentary**

The film [Rhode Island's Changing Climate: Building Resilience Through Local Solutions](#) was produced by the Rhode Island Department of Health (RIDOH) Climate Change Program, in partnership with Ocean State Video. The film aims to inform Rhode Island residents of the mechanism of climate change and localize the issue by showcasing RI impacts as well as positive adaptation and mitigation efforts happening in the state. Through sharing stories and successes, the video hopes to show Rhode Islanders that our state is leading the way on climate change and that they as individuals can participate and make a difference. The film will be made available to legislators, municipalities, community partners, state agencies, non-profits, and others to use in educating their employees, constituents, and communities.

### **Rhode Island Flood Audit Task Force Feasibility Report**

The RI Emergency Management Agency (RIEMA) and RIDEM coordinated the development of the *Rhode Island Flood Audit Task Force Feasibility Report* in response to H.R. 8267 in May 2016 (sponsored by Representative Lauren Carson, Newport) which called upon the EC4 to “create a task force to study the feasibility and fiscal ramifications, and make recommendations for implementing a flood audit program.” The Task Force met into early 2017 to discuss and develop recommendations pertaining to program structure, intent, deliverables, costs, funding, legal concerns, staffing, outreach, and metrics for success. The report highlights Rhode Island’s economic exposure due to flooding events and sea level rise in the form of damage to publicly and privately owned properties, business interruption, property devaluation, and lost property tax revenue.

# INTRODUCTION

It is our pleasure to submit the 2017 Annual Report of the Executive Climate Change Coordinating Council (EC4) pursuant to RIGL §42-6.2-7. The members of the EC4 approved the submittal of this annual report at its June 2017 council meeting.

The members of the EC4 include the Directors and Commissioners of the following eleven agencies/offices: Department of Environmental Management (RIDEM), Coastal Resources Management Council (CRMC), Department of Administration (DOA), Department of Transportation (RIDOT), Department of Health (RIDOH), RI Emergency Management Agency (RIEMA), Office of Energy Resources (OER), RI Division of Planning (Planning), RI Commerce Corporation (Commerce RI), RI Division of Public Utilities & Carriers (DPUC) and the RI Infrastructure Bank (RIIB). RIDEM Director Janet Coit continues to serve as the EC4 Chair, with RI Division of Planning Associate Director Parag Agrawal acting as Vice-Chair.

In July 2014, the General Assembly approved legislation which formally established the EC4. Known as the [Resilient RI Act](#), it sets specific greenhouse gas reduction targets and incorporates consideration of climate change impacts into the powers and duties of all state agencies. The law emphasizes the concept of resilience and developing practical solutions through reductions in greenhouse gas emissions, making preparations for the effects of current and future changes in the state's climate, and ensuring RI prospers by being at the leading edge of the transition to a lower carbon future. These priorities are similarly emphasized in the [2017 Clean Energy Jobs Report](#), the Governor's [December 2015 Executive Order](#) to RI state agencies on leading by example in energy efficiency and clean energy, the [Governor's June 2017 Executive Order](#) reaffirming Rhode Island's commitment to the principles of the Paris Climate Agreement, and the 2016 [RI Greenhouse Gas Emissions Reduction Study](#).

Two separate advisory bodies, the "EC4 Advisory Board" and the "EC4 Science & Technical Advisory Board" were created by the Resilient RI Act, and significant has been made since last summer by both advisory boards on several projects. Further details about these two important boards are provided in their respective Annual Reports to the EC4 (see attached).

Since the submittal of [2016 annual report](#), the full Council has met nine times. The Council engaged in debate and heard presentations on a wide range of topics including a presentation by members of the EC4 Science and Technical Advisory Board (STAB) on 'Current Climate Science in Rhode Island', RIDEM's Wastewater Infrastructure Climate Study, the just completed Pawtuxet River Watershed Modeling Project, and how RI's transportation infrastructure will be impacted by sea level rise in coming decades. In addition, the members of the Council spent numerous meetings reviewing and providing input on the final RI Greenhouse Gas Emission Reduction Study (completed in December 2016) which evaluates various strategies for reducing greenhouse gas emissions. The Council continuously strives to identify ways in which all RI agencies, offices and arms of government can coordinate to advance the state's carbon reduction efforts and resilience priorities.

The EC4 was pleased to hear directly from Governor Raimondo in November 2016 regarding RI's successful 2016 legislative session and the need to ensure that Rhode Island continues to be a leader in establishing greenhouse gas mitigation and climate change adaptation measures. She acknowledged

the exceptional work that went into making the Block Island Wind Farm a reality, the need to make significant progress on transportation challenges (e.g. emissions reductions, transportation network improvements), and the local jobs that are materializing with RI's focus on efficiency and renewables.

The work of the EC4 continues to be guided by a series of goals and objectives outlined in the June 2014 Executive Climate Change Council (EC3) Report "[A Resilient Rhode Island: Being Practical About Climate Change](#)" and subsequent Executive Orders issued by Governor Raimondo on Leading by Example and reaffirming Rhode Island's commitment to the principles of the Paris Climate Agreement. The goals and objectives outlined in the report will continue to drive the priorities of the EC4 in coming months and years.

# ADAPTATION

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***Adaptation** means planning for climate changes that are expected to occur. These climate changes impact society and ecosystems in a broad variety of ways. For example, climate change can increase or decrease rainfall, influence agricultural crop yields, affect human health, cause changes to forests and other ecosystems, or even impact our energy supply. Climate-related impacts are occurring across regions of the country and across many sectors of our economy. Many state and local governments are already preparing for the impacts of climate change.*

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- Multiple high profile **coastal habitat resiliency** projects have been undertaken in 2016 and 2017 in Rhode Island. CRMC completed the [Ninigret Pond Salt Marsh Restoration and Enhancement Project](#) in February 2017 using thin layer deposition techniques to add marsh elevation for habitat resiliency to sea level rise. The navigation channel was dredged with 20,000 cubic yards placed on the marsh and 30,000 cubic yards placed on Charlestown Town Beach to enhance its resiliency to coastal erosion. Similarly, RIDEM, alongside key partners are coordinating on an improvement project at the [Sapowet Marsh Wildlife Management Area](#) in Tiverton. The project, slated for completion in mid-2017, supports efforts to restore this degraded coastal habitat and strengthen the state's resilience against climate change. Sapowet is also a place where significant shoreline erosion is threatening existing infrastructure. As part of the improvement project, the access from Sapowet Avenue will be redesigned, four acres of beach/dune/coastal shrub land will be revegetated, and nine acres of coastal grassland will be restored.
- RIIB recognizes the importance of coastal infrastructure to the Rhode Island economy and is making stormwater and resiliency its next strategic investment. In June 2017, RIIB hired a **Director of Stormwater and Resiliency** to lead its efforts in accelerating and coordinating infrastructure investment in the stormwater and coastal infrastructure sectors. This position will work with state and local officials and private sector partners to identify and coordinate infrastructure investment that protects the state from extreme weather impacts. Resilient infrastructure investment increases economic development activity, creates local jobs and protects the environment.
- The **Senior Resiliency Project** began as a partnership between the RIDOH Climate Change Program and the Division of Elderly Affairs. Rhode Island's elderly residents can be vulnerable to extreme weather, power outages, and other disasters. RIDOH wants to ensure that Rhode Island's elderly residents are protected from extreme events and able to remain sheltered safely in place whenever possible. Through the Senior Resiliency Project, RIDOH works with a team of partners, stakeholders, and our team of consultants to assist long-term care facilities, assisted living residences, and independent senior housing to prepare for disasters through site-specific energy resiliency audits and the development of all-hazards emergency plans that emphasize sheltering in place rather than evacuation. The project has worked with 15 sites across the state helping to improve their emergency plans and resilience during disasters.

- In 2015, the RI DOH Climate Change Program partnered with Brown University's TRI-Lab (Teaching, Research, Impact), Clean Water Action, and Groundwork Rhode Island to teach a year-long course centered on **Climate Change and Environmental Justice** in Providence. As a part of the course, and with input and feedback from West End residents, the students developed climate change adaptation projects. Dexter Street was identified as key location for improvements, needing stormwater management, more green space, and improved measures for public safety and walkability. To shape an implementable project, several neighborhood-based organizations and residents were involved through meetings and door-to-door surveys. In the spring of 2017, a nature-based project was designed and installed to help reach some of the stakeholders' goals. Working with a crew from Groundwork Rhode Island, the updates to Dexter Street, between Potters Avenue and Cranston Street, featured 13 trees and 32 decorative shrubs and grasses. The project involved the removal of 425 square feet of pavement and the installation of curb cuts to help divert stormwater from storm drains.
- The film [Rhode Island's Changing Climate: Building Resilience Through Local Solutions](#) was produced by RIDOH Climate Change Program, in partnership with Ocean State Video. The film (released in June 2017) aims to inform Rhode Island residents of the mechanism of climate change and localize the issue by showcasing RI impacts as well as positive adaptation and mitigation efforts happening in the state. Through sharing stories and successes, we hope to show Rhode Islanders that our state is leading the way with climate change and that they as individuals can participate and make a difference. The film will be made available to legislators, municipalities, community partners, state agencies, non-profits, and others to use in educating their employees, constituents, and communities. The film was developed in partnership with the EC4 Communications Work Group, including representatives from non-profits, state agencies, elected officials, and university partners.
- The RIDOH Climate Change Program is currently developing an **outreach and education project to reach the medical community in RI**. The Program has partnered with a doctor from RI Hospital to develop a presentation for doctors, nurses, medical students, and administrators to encourage the medical community to speak up about climate change and find ways to use their trusted voices to educate their patients/constituents about the connection between public health and climate change.
- The RI Division of Planning is in the final stages of developing a **new RI Climate Change website** intended to serve as the State of Rhode Island's primary portal for information and resources on climate change and resiliency. It houses resources for a variety of audiences including RI citizens, state agencies, municipalities, non-profit organizations, and the business community. The website addresses how Rhode Islanders are working to reduce greenhouse gas emissions as well as how to adapt to the projected effects of climate change (e.g. coastal hazards, high heat, drought, and inland flooding). It is expected to be launched in Summer 2017.
- Recognizing the connection between climate change and **vector-borne diseases**, the RIDOH Climate Change Program has a comprehensive annual outreach and education plan, specifically targeted

towards tick and mosquito-borne diseases. The Program uses a variety of social media, radio ads, targeted campaigns, and direct outreach opportunities to engage and educate at-risk populations.

- The RI Division of Planning, in coordination with CRMC and RIDEM, examined how climate change will have a significant impact on aquatic habitats and water quality management across Rhode Island when it completed the [Water Quality 2035](#) State Guide Plan Update. This new guide plan element consolidates policies and actions targeting water quality and aquatic habitat protection and restoration in one comprehensive plan.
- CRMC continues work on the [Shoreline Change Special Area Management Plan](#) (SAMP), better known as the Beach SAMP, developing scientifically-based data and tools to aid in coastal hazard adaptation planning. CRMC has developed a draft Coastal Hazard Application process for applicants as part of the Beach SAMP and it will become a regulatory requirement to evaluate sites for coastal hazard vulnerability from sea level rise, coastal erosion, and storm surge. The process will provide recommended design elevations, inform project modification as needed and applicants will acknowledge the coastal hazard risks for their projects. The process will apply to projects only within CRMC jurisdiction, however, the analysis and review process can be transferable to coastal communities for implementation at the local level. CRMC is now vetting the process with key stakeholders for further refinement with the expectation of implementation later this year.
- CRMC has adopted newly revised **NOAA sea level rise (SLR) projections** as issued in January 2017. NOAA projects an extreme SLR scenario for New England of 9.2-11.5 feet by 2100 along with a substantial increase in the frequency of nuisance tidal flooding. Importantly, due to the growing evidence of accelerated ice loss from Greenland and Antarctica, NOAA recommends considering worst-case [scenarios](#) in coastal risk management. 10 and 12 foot SLR [layers](#) are now integrated into STORMTOOLS.
- In May 2017, RIDEM announced a new [grant round](#) (\$6.4 million) to help communities strengthen climate resilience and address stormwater, flooding, and climate resilience. The funding comes from the 2014 Clean Water, Open Space, and Healthy Communities Bond (\$3 million), the 2016 Green Economy Bond (\$3 million) and the federal Clean Water Act Section 319 program (\$400,000).
- The **Rhode Island Department of Transportation (RIDOT)** has undergone a broad and intensive reorganization to move toward a Project Management structure. As part of the reorganization, Divisions have been developed with a clear focus on a comprehensive, coordinated approach to planning, design, construction, and maintenance of projects - a true life-cycle look at projects and resources. The Division of Planning within RIDOT includes a Scoping Office, Coordination of Local and State Planning (CLASP), and the Office of Sustainability, Autonomous Vehicles, and Innovation (SAVI). Climate change, sustainability, resilience, and a fully coordinated process to address environmental challenges and concerns and their relationship to transportation infrastructure are a core focus of Planning at RIDOT.

- The **RIDOT Office of Stormwater** is staffed by 10 full time employees (FTEs) and two interns, with one additional staff person anticipated before July 2017. The office has inventoried 45,000 drainage assets that include over 29,000 catch basins, 1,000 outfalls, 150 stormwater treatment units and 65 miles of pipe. It has completed and submitted one Stormwater Control plan, solicited and selected four consultants to start design of the completed plan, and started three more Stormwater Control Plans. As of May 2017, RIDOT and its vendors have completed 11,000 catch basins inspections. In the face of more frequent heavy rain events in Rhode Island affecting stream flow and run-off, inventorying, maintaining and improving the state's drainage system is a critical step in RIDOT's resilience efforts.
- The newly established Division of Planning at RIDOT is engaged with the **Transportation and Climate Initiative** (TCI) at Georgetown, and RIDOT staff chair some of TCI's working group initiatives. The Division is also involved with the **Infrastructure and Climate Network** (ICNet) at University of New Hampshire, a National Science Foundation funded group that strives to bring academics and practitioners in transportation infrastructure together. In addition, the Division has incorporated several climate change studies into the work program for the coming year, not least of which is a look at climate costs.
- RIEMA and RIDEM coordinated the development of the **Rhode Island Flood Audit Task Force Feasibility Report** in response to H.R. 8267 in May 2016 (sponsored by Representative Lauren Carson, D-Newport) which called upon the EC4 to "create a task force to study the feasibility and fiscal ramifications, and make recommendations for implementing a flood audit program." The Task Force met into early 2017 to discuss and develop recommendations pertaining to program structure, intent, deliverables, costs, funding, legal concerns, staffing, outreach, and metrics for success. The report highlights Rhode Island's economic exposure due to flooding events and sea level rise in the form of damage to publicly and privately owned properties, business interruption, property devaluation, and lost property tax revenue.

# VULNERABILITY ASSESSMENTS

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*A **Vulnerability Assessment** is an important process oriented tool to help make informed choices on topics as complex as climate change. Climate change vulnerability assessments convey critical, scientifically based information on how sensitive infrastructure, resources, and populations are to climate change, as well as their capacity to adapt to change.*

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- The RI Division of Planning has completed a [Vulnerability of Municipal Transportation Assets to Sea Level Rise and Storm Surge](#) project that builds upon a previous climate analysis of RI's state transportation assets. This analysis incorporates new data, a municipal-level outlook, and a simplified presentation style. It utilized the STORMTOOLS data set created by CRMC, which offered the opportunity to bring information about storm surge and an additional sea level rise scenario into the analysis. A broad summary of the results are presented in factsheets tailored to each municipality threatened by sea level rise and storm surge. These fact sheets are intended to help communicate the basics of sea level rise and storm surge vulnerability.
- The [Socioeconomics of Sea Level Rise Project](#) by the RI Division of Planning incorporates the best available data in an effort to identify the social, economic and demographic characteristics of the populations located within the 1, 3, 5 and 7 foot Sea Level Rise inundation zones in the state's 21 coastal communities. Housing characteristics were also evaluated. While many sea level rise projects in the state focus on structural vulnerability, the Socioeconomics of Sea Level Rise project is uniquely focused on people, and serves as a complementary data piece for sea level rise projects of various concentrations. The RI Division of Planning completed this project in February 2017.
- RIDEM (with CDBG-DR funding from OHCD) recognized the need to begin integrating climate change considerations into wastewater system planning and design. The [WWTF Infrastructure Climate Study](#) completed in March 2017, is a planning tool intended to help understand the projected implications of climate change on the state's public wastewater treatment systems. It focused on the state's 19 municipal treatment plants and the 240 major pump stations that help bring flow to those treatment plants. The study assessed the potential for impacts to Rhode Island caused by natural hazards associated with climate change and preliminarily assessed climate change impacts to Rhode Island wastewater infrastructure. The final study developed recommendations for adaptive strategies, compiled the work in a technical report, and offered the data used in the study online.
- CRMC, in collaboration with URI, has completed the [Coastal Environmental Risk Index \(CERI\)](#) pilot project to assess damage to structures from coastal erosion, storm surge, SLR and waves. CERI provides recommended alternative base flood elevation (BFE) to account for climate change and increase the resiliency of new or improved structures. The Charlestown & Warwick projects are completed (technical papers published in the Journal of Marine Science & Engineering (JSME) - [Charlestown](#) & [Warwick](#)). The CERI project is now funded and underway for the East Bay

communities of Barrington, Warren and Bristol. In addition, a hurricane wind damage component is under development for integration into CERI.

- CRMC, in collaboration with URI, has completed the [Rhode Island e911 Exposure Assessment](#) for Rhode Island's 21 coastal communities. The study assessed structures and infrastructure exposed to various singular and combined storm surge and sea level rise scenarios using STORMTOOLS. Downloadable Excel spreadsheets for individual municipalities and the state cumulative total are available on the CRMC's [Beach SAMP](#) webpage.

# MITIGATION

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**Mitigation** is human intervention to reduce impacts on the climate system; it includes strategies to reduce greenhouse gas sources and emissions, and enhance greenhouse gas sinks. It is important to note that the term “mitigation” has a different meaning in the context of emergency preparedness, where “hazard mitigation” encompasses a broad range of efforts to reduce loss of life and property by lessening the impact of disasters.

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- The RIIB closed the first two [Commercial Property Assessed Clean Energy \(C-PACE\)](#) projects in March 2017. C-PACE provides commercial property owners with long-term fixed rate financing for energy efficiency and renewable energy projects. These first projects call for the installation of roof-mounted solar panels on two office buildings in Middletown providing 351kW of renewable energy capacity. Over the life of the investment, the property owner will have 7,720 MWh of energy savings which is equivalent to 573 homes’ energy usage for one year while also saving the firm an estimated \$226,000 in energy costs. This project will reduce CO<sub>2</sub> emissions by 189 tons per year, equivalent to the emissions of 452,968 miles driven by the average passenger car.
- RIDOT continues to work closely with Statewide Planning, RIDEM, OER, and other agencies on a wide variety of clean energy initiatives designed to reduce agency energy consumption and costs, and address emissions from the transportation sector. These efforts include installation of additional LED lights on highway corridors and at park and ride lots throughout Rhode Island, transportation infrastructure and sea level rise challenges, support for the Long Range Transportation Plan and the Transit Master Plan, transit initiatives such as Trains to Planes (free trains to the Rhode Island Air Show), and ongoing efforts to develop other clean energy pilot projects.
- Commerce RI administers the [Renewable Energy Fund \(REF\)](#) which is dedicated to increasing the role of renewable energy throughout Rhode Island. The REF provides grants and loans for renewable energy projects with the potential to produce electricity in a cleaner, more sustainable manner, while stimulating job growth in the green technology and energy sectors of Rhode Island's economy. The REF *Commercial Scale and Small Scale Programs* are available as a rebate for Rhode Island property owners to go with renewable (such as solar, wind, hydro, etc.) The REF *Pre-Development Feasibility Studies loan program* is for prospective renewable energy projects with promising and obtainable outcomes. Examples of projects include, but are not limited to, energy storage, microgrids, anaerobic digestion, brownfield projects and hydroelectricity studies. The REF *Early Stage Commercialization loan program* is for projects with the ability to transform the renewable energy business sector and produce or aid in electricity usage. In 2016, the REF awarded over \$8.6 million in funding.
- In March 2017, Governor Raimondo announced a strategic goal of "**1,000 by '20**" **Clean Energy Goal** to increase the amount of clean energy in the state by 10 times – or a total of 1,000 MW – by the end of 2020. The goal, which builds on the strong policy and legislative leadership set by Governor

Raimondo and the General Assembly, will include energy from a broad portfolio of clean energy resources, including off-shore and on-shore wind and solar. Homeowners, municipalities, institutions and private commercial and industrial enterprises can all contribute to the goal with smart investments in clean energy, including those opportunities made available through the Rhode Island Infrastructure Bank, the Renewable Energy Growth Program, and the Renewable Energy Fund.

- In 2016, OER and RIDEM continued their collaboration to implement [The Regional Greenhouse Gas Initiative \(RGGI\)](#), a market-based cap and trade program among nine northeastern and Mid-Atlantic states (RI, CT, DE, MA, ME, MD, NH, NY, VT) to reduce emissions of carbon dioxide (CO<sub>2</sub>), the principal gas that contributes to climate change. The program establishes a regional budget (cap) of CO<sub>2</sub> allowances and each state's allocation of CO<sub>2</sub> allowances under the budget. Rhode Island primarily invests CO<sub>2</sub> allowance proceeds in energy efficiency and conservation, and renewable energy technologies. RGGI is one of the critical tools Rhode Island is utilizing to meet state, regional, national, and international commitments to reduce carbon emissions from the power sector.
- RIDEM's [Energy-Saving Trees Program](#) helps homeowners conserve energy, reduce utility costs, and aesthetically improve their neighborhood. Financial support is being provided by the Regional Greenhouse Gas Initiative (RGGI) over a three-year timespan. When planted properly, a single mature tree can save \$30 annually in heating and cooling costs. In the fall of 2016 and the spring of 2017, a total of 1292 trees were planted as part of the latest round of the Energy-Saving Trees Program.
- In December 2016, the EC4 completed the [RI Greenhouse Gas Emissions Reduction Study](#) to evaluate various strategies for reducing greenhouse gas emissions in the state. The purpose of the study is to suggest possible strategies, programs, and actions to meet the targets for greenhouse gas emissions reductions according to the schedule specified in the Resilient Rhode Island Act. Developed with the guidance of a broad group of public stakeholders, the study recommends three areas of opportunity for decision-makers to consider: building on state success, enabling markets and communities, and leveraging regional collaboration.
- RIDEM has been working since 2015 on an updated [Regional Climate Change Action Plan](#) alongside all six New England states and the five eastern Canadian provinces. The updated Plan is being developed at the direction of the [New England Governors/Eastern Canadian Premiers \(NEG/ECP\)](#) as part of a regional climate change initiative that began as far back as 2001. The Plan is to be submitted to the NEG/ECP for approval at its 41<sup>st</sup> Conference in late August 2017.
- In 2016, OER continued its partnership with the Renewable Energy Fund at Commerce RI and non-profit SmartPower to implement the state's third year of [Solarize Rhode Island campaigns](#) across selected municipalities. Solarize Rhode Island seeks to increase the adoption of small-scale solar through targeted marketing and education campaigns. Solarize initiatives educate residents and small businesses about solar and use a four-pronged strategy to reduce prices and drive participation: partnership with individual municipalities and community-driven outreach; limited time offer; competitively-selected solar installer; and a tiered pricing structure that lowers the price as

participation increases. The municipalities of Providence, Warren, and Bristol were chosen for the Spring 2016 campaign. A campaign in Warwick took place in the Fall 2016. To date, the three program years have accumulated 479 signed contracts for about 3,371 kW of solar capacity. Additionally, hundreds of our citizens have been educated about the economic and environmental benefits of solar electricity, energy efficiency and other clean energy technologies. A fifth Solarize Rhode Island campaign kicked off in June 2017 and focuses on the communities of Charlestown and Cranston.

- The [Renewable Energy Growth \(REG\) Program](#), which launched in June 2015, continues to support the deployment of locally-based wind, solar, anaerobic digestion and small scale hydropower projects. The REG Program is administered by National Grid with oversight by OER and the Distributed Generation Board, and provides 15 or 20 year tariff payments to finance renewable energy systems for homeowners, businesses and municipalities. In turn, the construction and operation of these new clean energy resources reduce and stabilize consumer energy costs, create job opportunities for clean energy workers, and help offset demand for more carbon-intensive energy resources. In the first 2 years of the REG program, there have been over 1,000 tariffs awarded to homeowners across the state, dozens of tariffs awarded to medium and commercial scale solar systems, and several tariffs to large scale solar systems.
- In December 2016, the 30 Megawatt (MW) [Block Island Offshore Wind Project](#) became the nation's first operational offshore wind project – a tremendous clean energy milestone for Rhode Island and the entire country. CRMC (through the development of the [RI Ocean Special Area Management Plan](#)) and OER played a key role in the development of the project and subsequent permitting responsibilities.
- In 2016, OER launched the state's first electric vehicle rebate program to support adoption of electric vehicles by Ocean State drivers: [Driving Rhode Island to Vehicle Electrification \(DRIVE\)](#). DRIVE provides qualified Rhode Island residents that are interested in purchasing or leasing an electric vehicle (EV) with a financial rebate of up to \$2,500, based upon vehicle battery capacity. As of May 1, 2017, the program has issued or reserved 201 rebates to Rhode Island EV drivers, totaling \$456,000. To date, sixteen models of EVs have been funded through the program, with fifteen different dealerships participating. The availability of DRIVE rebates has helped increase EV adoption by approximately 30 percent.
- **Clean transportation** continues to be supported through community events that connect consumers with new, cleaner alternatives. The RI DRIVE Clean Campaign is a consumer engagement campaign which builds on the commitment made by Rhode Island through its participation in the 8-state ZEV MOU as well as the Rhode Island Zero Emission Vehicle Action Plan. The 2016 campaign led by OER, RIDEM, Ocean State Clean Cities and Plug-in America hosted two events giving over 160 people the ZEV experience. The 2017 campaign expansion continues as RIDOH and RIDOT join the ranks to share information about climate and clean transportation programs to our targeted audiences.

- During the 2016 Legislative session, the General Assembly passed R.I Gen. Laws §31-47.3-5.1, which established the [Rhode Island Clean Diesel Fund](#). The Clean Diesel Fund was created to enable RIDEM to receive annually appropriated funding (\$1.9 million for FY 2017) and provide reimbursement grants to companies for the purpose of reducing emissions from heavy duty diesel vehicles operating on Rhode Island roads. Applications were due to RIDEM in May 2017, and an announcement on the release of the funding to applicants will be made later this summer.
- RIEMA works proactively with communities and stakeholders to [mitigate the risks of flooding](#), which are often intensified by the effects of climate change. There are currently nine communities (as of May 2017) participating in the [Community Rating System \(CRS\)](#), a voluntary incentive program that recognizes and encourages community floodplain management activities and saves policy holders money on their annual flood insurance premiums. With RIEMA's support, there will be another community joining CRS, in October 2017. RIEMA offered training to realtors through Continuing Education Classes in partnership with the Rhode Island Association of Realtors to provide them an overview of the National Flood Insurance Program (NFIP) as well as specifics on mapping, regulations, and insurance implications.
- RIEMA administers the Federal Emergency Management Agency's (FEMA) **Hazard Mitigation Assistance (HMA) programs**. The state is currently overseeing 42 awards totaling over \$8 million in federal dollars granted to sub-recipients statewide. Project funding to implement long-term mitigation actions is contingent on mitigation planning efforts and, with 18 approved local hazard mitigation plans, the state continues to provide technical assistance to municipalities developing or updating their mitigation plans. Mitigation planning is a core component of a municipality's resiliency efforts.
- The **State Interagency Hazard Mitigation Committee (SIHMC)** reconvened in September 2015 to begin the update process of the 2019 Rhode Island State Hazard Mitigation Plan Update. The SIHMC will consider climate change in the identification of vulnerabilities and feasible mitigation actions associated with the hazards that face Rhode Island.

## LEADING BY EXAMPLE

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*Leading by Example commonly means our actions influence others to behave and respond in ways that society deems valuable and appropriate. In Rhode Island, Governor Raimondo established a Lead by Example program within the Office of Energy Resources (via Executive Order in Dec. 2015) to coordinate efforts across state agencies to reduce energy consumption and GHG emissions.*

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- In April 2017, OER recognized eleven state government agencies, quasi-public agencies and municipalities for their renewable energy and energy efficiency achievements at its inaugural [Lead By Example Energy Awards](#) ceremony. Governor Raimondo's Executive Order 15-17, directs state agencies to "Lead by Example" and transition energy supply portfolios and consumption practices to lower-cost, cleaner, low-carbon solutions. State and municipal employees are helping to reduce energy costs and mitigate greenhouse gas emissions, consistent with Rhode Island's economic, energy and environmental policy goals. This year's award winners included the RI Department of Administration's Division of Capital Asset Management and Maintenance, the City of Providence, and the Narragansett Bay Commission for their demonstrations of clean energy innovation and leadership. Other organizations recognized included the Rhode Island Division of Public Utilities & Carriers, Rhode Island Army National Guard, Rhode Island Department of Environmental Management, Rhode Island Housing, City of Cranston/Cranston Public Schools, Town of Narragansett, Town of Bristol, and Town of Barrington
- With 9 solar PV systems/2 wind turbines and commitments to reducing carbon footprint through energy efficiency improvements (e.g. 1,000+ LED fixtures/bulbs/retrofit kits at 6 RIDEM facilities in 2016), **RIDEM's renewable energy and efficiency projects** continue to yield energy savings. RIDEM's projects range in size from 3KW to 100KW with a total energy savings of nearly \$400,000 (as of March 2017). In all, 1,182 interior and exterior LED fixtures, bulbs, or retrofit kits have been installed at the six RIDEM locations which are projected to save an estimated 356,370 kilowatt-hours per year and generate nearly \$50,000 in annual energy cost savings. RIDEM expects the measures will be paid off in 2.3 years (avoided cost of the energy savings).
- RIDEM released an updated [FY2018-FY2022 Strategic Plan](#) which will guide the agency's work over the next several years. The Plan includes 7 key strategic goals, one of which is "Continue to Act on Climate Change". It addresses both mitigation and adaptation priorities ranging from continued leadership in RGGI to institutionalizing climate considerations (e.g. regulatory amendments) to promoting green infrastructure. To ensure RIDEM is tracking progress against the objectives outlined, a data dashboard is under development.
- The **Division of Capital Asset Management and Maintenance (DCAMM)** is currently installing a roof mounted photovoltaic (solar) array on (3) buildings at the Capitol Hill campus. The DOA, DOT, and DOH office buildings will provide a combined 299 megawatt hours of electricity annually connected

to the utility grid. The project will be commissioned Summer 2017. Similarly, the Division has successfully completed installation of a geothermal heating and cooling system at the historic Old State House in Providence. The new system relies on underground geothermal wells and water source heat pumps for both heating and cooling, and the energy efficient system is controlled by a new building management system aiding in thermal comfort and controllability. The Division is replacing the exterior lights at the State House with energy efficient color changing LEDs. A computerized lighting control system will allow programmable lighting schemes to be coordinated with holidays and special events. The new system will greatly reduce energy consumption and provide an aesthetically pleasing image on one of the state's iconic structures. DCAMM also went above and beyond code in achieving overall efficiency improvements at the recently renovated Virks building, a former institutional hospital and historic structure that was transformed into offices for the R.I. Executive Office of Health and Human Services.

- In June 2017, DCAMM, in coordination with OER, State Purchasing, and other entities, issued a request for proposals to provide [State Fleet Leasing and Rental Management services](#). As part of this request, prospective vendors are directed to Governor Raimondo's *Executive Order 15-17: State Agencies to Lead by Example in Energy Efficiency and Clean Energy*, which requires strategies for reducing fossil fuel use and greenhouse gas emissions from the State Fleet with the goal of ensuring that a minimum of 25 percent of new light-duty State Fleet leases will be zero-emission vehicles (ZEVs) by 2025. In addition, vendors will be required to design and implement a fleet management strategy that achieves a 40 MPG average or higher across all light-duty fleet vehicles and develop baseline information (such as vehicle composition, utilization rates, energy consumption, and emissions profile) against which future economic, energy, and environmental progress will be measured.
- OER launched the [Rhode Island Charge Up!](#) Public Sector Vehicle Electrification Incentive Program in July 2016. Charge Up! offers incentives to state agencies and municipalities interested in installing electric vehicle supply equipment (EVSE or charging stations) and supports the purchase or lease of electric vehicles (EVs) for integration into public sector fleets. Qualified public sector applicants are eligible to receive a total award of up to \$75,000 to support their adoption of clean transportation solutions. Participants to date include the Rhode Island Public Utilities Commission, the Rhode Island Department of Administration, and the Towns of Coventry and West Warwick.

## MUNICIPAL COLLABORATION

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***Municipal Collaboration** refers to the reality that cities and towns are on the front line of addressing the causes and impacts of climate change. Municipalities can play a significant role in implementing greenhouse gas emission strategies and adaptation plans. Identifying ways the state, the planning community, and university/research programs can further collaborate to provide assistance to cities and towns is critical.*

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- Through two of RIIB's programs, the Bank helped the **City of Newport** increase the resiliency of their wastewater treatment facility from impacts of extreme weather events. The Bank provided \$42 million in financing to Newport to increase the wastewater treatment plant's capacity to manage increase wet weather flows while hardening pump stations throughout the city. The City of Newport used the Bank's Efficient Buildings Fund to make a solar investment at the facility, becoming the first wastewater treatment plant in Rhode Island to have onsite solar, increasing the resiliency of the plant from power outages due to extreme weather events. The investment, which will provide 296 kW, includes on-site solar carports.
- The RIIB, working with Commerce RI and the **Town of North Kingstown**, brought two programs together to protect water quality in Wickford Village while promoting local economic development. Community Development Block Grant Disaster Recovery (CDBG-DR) funds and CWSRF funds were combined to extend a sewer line to the economic center in Wickford Village. CDBG-DR funds were used in this project to sewer an area that serves low income residents while Clean Water funds were used to sewer the commercial corridor of Wickford Village, allowing small businesses to tie into the sewer and close failing septic systems.
- RIDEM and RIEMA continue to collaborate on the administration of the **State's Dam Safety Program**. RIEMA reviews and approves dam Emergency Action Plans (EAPs) for high and significant dams statewide identified by RIDEM. Each plan establishes activation thresholds and identifies threats, impacts and the appropriate official(s) to contact in case of a dam failure. With increased precipitation and intense rain events, coordination among RIDEM, RIEMA, dam owners, and municipalities remains a priority.
- In July 2016, the [Efficient Buildings Fund \(EBF\)](#) provided \$17.2 million in financing for six municipalities to invest in energy efficiency and renewable energy projects. Cumulatively, these projects saved local governments enough energy to meet the average energy needs of 832 Rhode Island households while reducing CO2 emissions equivalent to 19 million miles driven by the average passenger car. The Efficient Buildings Fund provides attractive long-term financing to local governments, school districts and quasi-state agencies for investments in energy efficiency and renewable energy projects. Projects financed resulted in a reduction in energy usage of 35% while saving municipalities almost \$20 million in energy costs and maintenance expenses after paying debt service. Projects include comprehensive energy retrofits at Edgewood Highland School in Cranston

including HVAC and thermostat replacement and upgrading ventilation, and renewable energy projects in Newport, Westerly, and West Warwick. Providence and Pawtucket also undertook comprehensive energy efficiency retrofits to public buildings. OER and RIIB are currently working together to finalize Round 2 and Round 3 project eligibility for financing by late summer of 2017.

- OER undertook a review of Rhode Island's current large scale [land based wind siting guidelines](#) to support municipalities interested in wind development with the latest, up-to-date information on siting issues. The review resulted in the drafting of a new document with updated information and recommendations to assist municipalities as they develop their own wind siting ordinances. The guidance document includes information on safety setbacks, noise, shadow flicker, and wind-specific environmental impacts. After the completion of a stakeholder engagement and public comment process, the final document was release in January of 2017.
- In May of 2016, the RI Division of Planning Completed a [Zero Emission Vehicle Handbook: A Land Use Guide for Cities and Towns](#) which provides municipalities with a variety of policy options that can be used together to provide drivers and land owners with the incentives needed to continue the expansion of Rhode Island's charging infrastructure. Rhode Island's cities and towns are uniquely positioned to plan for the continuing expansion of the Zero Emission Vehicle market. Though issues like building codes and utility regulation require state level action, the cities and towns of Rhode Island have a disproportionate impact on the market uptake of ZEVs simply because local governments control parking and land use. By removing obstacles and setting standards for parking design, land use, and driver behavior, the cities and towns of Rhode Island can begin to enjoy the economic and environmental benefits of ZEV use.
- Throughout 2016 and into 2017, OER continues to support municipalities in their adoption of cost-effective, energy efficiency LED streetlights through an incentive program supported by state RGGI auction proceeds. The [Municipal LED Streetlight Energy Efficiency Incentives Program](#) offers qualified cities and towns up to \$300,000 to support the purchase and installation of LED fixtures and controls. These enhanced incentives are offered in addition to any applicable National Grid-administered incentives and represent a unique project cost savings opportunity for first-movers and early adopters. Depending on the type of fixture installed and dimming strategy utilized, streetlight LEDs can reduce energy usage from anywhere between 50 to 65 percent – reductions that translate into cost savings for public sector entities and taxpayers. As of June 2017, seven Ocean State communities have applied for or received incentives through this program, representing approximately 36 percent of all municipal streetlights in Rhode Island.

## ECONOMIC RESILIENCE

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***Economic Resilience** goes hand in hand with climate resilience. Thinking creatively about ways to persevere and prosper in a changing climate will require combining public and private sector leadership. Engineering, architecture, green infrastructure and renewable energy are just some of the fields that play a role in furthering resiliency.*

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- In June 2017, OER and the RI Executive Office of Commerce released the third annual [Clean Energy Jobs Report](#), which found that since 2014, clean energy employment in the Ocean State has grown by an impressive 66 percent and 11 percent over just this past year. Strong state support for energy efficiency and renewable energy policies have stimulated a robust market for clean energy goods and services, making Rhode Island home to a new, growing clean energy industry. Now more than 15,300 jobs strong, Rhode Island's clean energy economy continues to grow. Energy efficiency remains the largest portion of the state's clean energy employment. It accounts for 59 percent of all clean energy jobs, or almost 9,000 workers.
- In the Spring of 2017, The RI Division of Planning was awarded a \$320,000 CDBG-DR grant to **assess job-producing economic assets along the vulnerable coastline of Rhode Island**. These assets include ports, major manufacturers, tourist attractions, small business clusters, hospitals, educational institutions and the networks of roads and utilities that support their operations. As evidenced by Hurricanes Irene and Sandy, impacts to businesses range from temporary closure to complete destruction. The work will commence in FY 18 and is expected to be completed by FY 19. It is expected that substantial benefits can be achieved, such as the creation of a dynamic public-private stakeholder process focused on economic resiliency, an understanding of the vulnerability of Rhode Island's job-producing assets and a quantification of potential losses, the creation of strategies that will build resiliency for the state's job-producing assets and infrastructure, and a pilot project demonstrating methods to protect the state's job-producing assets.

## RESEARCH & ANALYSIS

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*Research and Analysis improves knowledge of the health and environmental effects of climate change and helps provide long-term solutions to effectively manage and reduce the impacts of a changing climate. Often times this research is conducted in close collaboration with federal agencies and other states in the region.*

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- CRMC has teamed with URI Ocean Engineering to develop the **Pawtuxet River Modeling Project** which is an operational spatially distributed hydrological/hydraulic model for the Pawtuxet River watershed. The project/modeling are now complete and are integrated within the STORMTOOLS platform. Further, the modeling methodology can be extended to other watersheds with additional funding. The Warwick Sewer Authority new levee design elevations were obtained and incorporated into the model and demonstrate flood resiliency of the levee design for the 500 year event flood.
- The **Northeast Regional Heat Collaborative** was started by the RIDOH Climate Change program. Joined by public health agency partners from Maine, New Hampshire, and Vermont, the group has analyzed data across the region to inform public health policy. Assessing the impacts of heat on hospitalizations and deaths in the region, the Collaborative has partnered with the National Weather Service (NWS) to address heat impacts and improve regional communications. The group has successfully changed the NWS Heat Advisory Policy for all of New England to more appropriately address health risk. The RIDOH Climate Change Program trains stakeholders from across New England, including news meteorologists, emergency managers, and other public health partners, on the new policy and provides resources to assist with heat communications and outreach.
- The **Science & Technical Advisory Board (STAB)** to the EC4 was charged in the fall of 2015 to prepare a synopsis of the 'state of knowledge' of the following manifestations of climate change in Rhode Island. The STAB completed its research in April 2016, and submitted a science climate update to the full EC4. The synopsis has now been updated by the STAB as part of its 2017 Annual Report (see STAB report attached herein).
- RIEMA is partnering with the United States Army Corps of Engineers (USACE) and the United States Geological Survey (USGS) for an **inundation modeling project for areas along the Pawtuxet River**. The study and flood inundation maps are being reviewed by USGS, USACE, National Weather Service and RIEMA. The online flood-inundation mapper will provide government officials and residents with a tool to support future planning and mitigation efforts.
- FEMA and United States Geological Survey (USGS) have successfully completed **modeling along the Pawcatuck River** and developed work maps for the study area, which were released to community officials in June 2016 for review/comment. The preliminary maps will be released in early summer 2017. RIEMA and other agencies aim to incorporate the findings of this study into other modeling projects focusing on other riverine systems in RI.

## LOOKING AHEAD

Rhode Island's new climate policy efforts will continue to build on the state's strong actions on resiliency, while fostering investments in renewable energy, efficiency, and adaptation projects. The members of the EC4 are thankful to Governor Raimondo and the General Assembly for helping to make Rhode Island a leader in clean energy and continuing to foster growth across this sector of our local economy. We are excited to see what continued leadership and commitment on prioritizing resiliency planning brings for our state and its citizens.

Rhode Island's new Chief Resiliency Officer within the RI Infrastructure Bank will provide an important link between the members of the EC4 and key municipal, business and non-profit leaders equally dedicated to implementing strategic resiliency measures.

In transforming our energy systems and working alongside municipal leaders and the private sector, we can achieve climate change goals, while unlocking economic opportunity and improving the environmental and public health of our citizens and communities.



**Rhode Island Executive Climate Change Coordinating Council  
Advisory Board**

June 9, 2017

Director Janet Coit  
Chair, Executive Climate Change Coordinating Council  
Rhode Island Department of Environmental Management  
235 Promenade Street  
Providence, RI 02908

Dear Director Coit & Members of the Executive Climate Change Coordinating Council:

I am respectfully submitting the Annual Report on behalf of the Advisory Board to the Executive Climate Change Coordinating Council (EC4) pursuant to RIGL §42-6.2-4. The following is a report of the Advisory Board's meetings and activities since the Board submitted its last annual report in May 2016.

Under RIGL §46-6.2, the Advisory Board shall meet at least quarterly or at the call of the Chairperson of the EC4. It was unanimously decided that the Advisory Board should aspire to meet monthly. The following are the dates on which the Advisory Board convened:

May 20, 2016	December 8, 2016
July 15, 2016	February 23, 2017
September 29, 2016	March 30, 2017
October 27, 2016	

The Board made a general commitment to request report outs from EC4 agency staff who were present at the Advisory Board's meetings. The purpose of the report outs was to allow for an open dialogue about ongoing projects within each agency relative to the priorities and activities of EC4.

The Advisory Board appreciates and is grateful for agency staff participation in our meetings as it provides valuable insight and information on their respective agency's programs. For example, the RI Division of Planning presented and solicited feedback on the development of a new RI climate change website. We have been informed that the website will be live sometime in the Summer 2017. The Board believes this will be a great communications tool linking the EC4 with municipalities, businesses and residents.

The following is an update on the Advisory Board's progress in relation to the purposes and duties listed in its enabling legislation (RI Resilient Rhode Island Act) as contained in Attachment A:

**Progress:**

- Initiated participation for EC4 agency staff in the RI League of Cities and Towns Annual Conference. The members of the Board provided input on two session proposals (one on energy efficiency/renewable energy and the other on municipal resiliency), one of which was ultimately accepted by the League for the January 2017 conference. DEM, OER and RIIB coordinated presentations for municipal participants to learn



## **Rhode Island Executive Climate Change Coordinating Council *Advisory Board***

about a wide variety of state offered energy efficiency, renewable energy and clean transportation programs. The session was very well attend by municipal representatives.

- At the Board's March 2017 meeting, it was unanimously decided that the Board would focus its efforts to educate and encourage the building of municipal capacity to address stormwater challenges. Leveraging the programs of several state agencies, this is intended to promote a larger dialogue around the challenges municipalities face from increased precipitation events and the benefits of green infrastructure.
- The Board conducted initial planning to distribute a municipal survey regarding climate change needs. However, the Board was unable to finish this task as it lacked the resources and staff capacity necessary to administer such a comprehensive project.
- The Board was represented on the RI GHG Emissions Reduction Technical Committee. The Technical Committee provided feedback on the development of the RI GHG Emissions Reduction Plan.

### **Presentations/Informational Sessions:**

The Advisory Board invited several agency staff members to present on a variety of climate change topics and programs. These sessions were intended to educate the Board on state initiatives and programs of importance to the EC4, and allows the members of the Board to share this information with their various professional networks.

Sessions included:

- DEM's Wastewater Treatment Facility Climate Study
- OER presented on its municipal/residential energy efficiency & renewable energy programs
- URI Coastal Resources Center presented on municipal capacity building for resilience
- RI GHG Emissions Reduction Plan as submitted to the General Assembly/Governor in Dec. 2016
- Scituate Reservoir/Pawtuxet River Modeling Project

As you are aware, we have experienced some turnover in Board membership in recent months. Chair Fred Presley has departed Rhode Island for a position outside New England, and new members Sue Mara (Pawtucket), Laura Bozzi (Southside Community Land Trust) and Tim Sweeney (Bristol) have joined the Board. Fred's leadership will be greatly missed, and we look forward to identifying a qualified replacement for him in coming months.

We continue to support efforts to increase capacity within the Administration to coordinate the State's overall resiliency efforts and programs. The members of the Board look forward to our continued collaboration with the members of the EC4, various agency staff (existing and new), in a coordinated effort to move Rhode Island's climate priorities forward.

Sincerely,

A handwritten signature in black ink that reads 'Brigid Ryan'.

Brigid Ryan, Rhode Island Housing Energy Specialist and Liaison  
EC4 Advisory Board, Secretary



**Rhode Island Executive Climate Change Coordinating Council  
Advisory Board**

**Attachment A**

- (1) Advise the council on all matters pertaining to the duties and powers of the council, including evaluating and making recommendations regarding plans, programs and strategies relating to climate change mitigation and adaptation;*
- (2) Assist the council in improving public access to, and understanding of, the best available, scientific, technical and other information about climate change, mitigation, adaptation, etc., so as to build public support for, and participation in, initiatives to make communities more resilient;*
- (3) Serve as a conduit for communicating information from the council to communities and constituencies, as well as vice versa, for input from the community level to the council;*
- (4) Assist the council in meeting its own transparency and accountability obligations;*
- (5) Report to the council at each regular council meeting;*
- (6) Prepare an annual report, to be included in the annual report of the council, that specifically addresses the state of public awareness and engagement, the effectiveness of mitigation, adaptation and public information programs from the community perspective, the ability of the council to attain its goals and objectives, including effective interagency coordination and public-private partnerships, and actions that would further the purposes of the council and this legislation.*



## ***Annual Report from the EC4 Science and Technical Advisory Board (STAB) to the EC4***

***June 2017***

In 2016 the EC4 Science and Technical Advisory Board (STAB<sup>1</sup>) was charged by the EC4 to prepare a brief synopsis of the state of knowledge of the following manifestations of climate change in Rhode Island.

1. Sea level rise
2. Warming air temperatures
3. Warming water (marine and fresh) temperatures
4. Storm frequency and intensity
5. Biodiversity (changes in species and habitats)
6. Precipitation and inland flooding

Our synopsis of climate change impacts was submitted to the EC4 in our 2016 Final Report.

Since we filed our synopsis last year, a number of important new publications/reports have been published. We wish to take this opportunity to amend our 2016 report with important, recently published materials.

### **General**

- Climate Solutions of New England at The University of New Hampshire has prepared a simple overview of the magnitude of climate change impacts in Rhode Island. A copy is included as Appendix 1. Summaries for specific locations in Rhode Island are provided in Appendix 2.
- [HTTPS://STATESUMMARIES.NCICS.ORG/RI](https://statesummaries.ncics.org/ri): The NOAA National Centers for Environmental Information published an excellent overview of the magnitude of various climate change impacts in Rhode Island.
- <http://www.dem.ri.gov/programs/benviron/water/pdfs/wwtfcilmstudy.pdf>: Assessment of the vulnerability of RI's wastewater treatment infrastructure to climate change.

### **Sea Level Rise**

- [https://tidesandcurrents.noaa.gov/publications/techrpt83\\_Global\\_and\\_Regional\\_SLR\\_Scenarios\\_for\\_the\\_US\\_final.pdf](https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf): In January of this year, the National Oceanic and Atmospheric Administration (NOAA) published revised projections for sea level rise (SLR) globally and in the U.S. regionally. NOAA projects an extreme SLR scenario for New England of 9.2-11.5 feet by 2100 along with a substantial increase in the frequency of nuisance tidal flooding. Importantly, due to the growing evidence of accelerated ice

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<sup>1</sup> STAB members are: Peter August, URI (Chair); Todd Bianco, PUC; James Boyd, CRMC (Secretary); Kelly Knee, RPS/ASA; Jason Osenkowski, RI DEM; Ronald Pitt, RIC; Timmons Roberts, Brown Univ.; Carol Thornber, URI; Henry Walker, US EPA (Vice-chair); Julia Gold, DOH (technical advisor)

loss from Greenland and Antarctica, NOAA recommends considering worst-case scenarios in coastal risk management.

- [https://www.nytimes.com/2017/04/18/magazine/when-rising-seas-transform-risk-into-certainty.html?\\_r=0](https://www.nytimes.com/2017/04/18/magazine/when-rising-seas-transform-risk-into-certainty.html?_r=0): New York Times article on sea level rise.
- [http://www.planning.ri.gov/documents/sea\\_level/2016/TP167.pdf](http://www.planning.ri.gov/documents/sea_level/2016/TP167.pdf)  
[http://www.planning.ri.gov/documents/sea\\_level/2015/TP164.pdf](http://www.planning.ri.gov/documents/sea_level/2015/TP164.pdf)  
RI Division of Planning assessments of the vulnerability of transportation assets to sea level rise.

### **Warming Air Temperatures**

- *Wellenius, G. A., Eliot, M. N., Bush, K. F., Holt, D., Lincoln, R. A., Smith, A. E., & Gold, J. (2017). Heat-related morbidity and mortality in New England: evidence for local policy. Environmental research.* An excellent paper was published on morbidity and mortality of heat-related deaths in New England. This shows the public health ramifications of warming air temperatures.
- *Santer, B. D., Solomon, S., Wentz, F. J., Fu, Q., Po-Chedley, S., Mears, C., & Bonfils, C. (2017). Tropospheric Warming Over the Past Two Decades. Scientific Reports, 7(1), 2336.*  
<https://www.nature.com/articles/s41598-017-02520-7>  
Assessment of trends in global air warming. In two out of three recent satellite datasets, the tropospheric warming from 1979 to 2016 is unprecedented relative to internally generated temperature trends on the 38-year timescale.

### **Biodiversity (changes in species and habitats)**

- Hale, S.S., H.W. Buffum, J.A. Kiddon, & M.H. Hughes. 2017. Subtidal benthic invertebrates shifting northward along the US Atlantic coast. *Estuaries and Coasts*.  
<https://link.springer.com/article/10.1007/s12237-017-0236-z>  
This study examined 20 years (1990–2010) of occurrence and abundance data of soft-bottom, benthic invertebrates along the Atlantic coast of the USA, and documents poleward shifts in marine species ranges.

### **Precipitation & Inland Flooding**

- <http://edc.maps.arcgis.com/home/webmap/viewer.html?webmap=d025e9fc58ae440a88b5ce590ddf a4cd>  
The Pawtuxet River Modeling Study project to evaluate climate change induced flooding (2010 flood modeled) within the Pawtuxet River watershed has just been completed. The project is a collaboration between CRMC and URI and was funded with a HUD grant administered by the RI Office of Housing and Community Development. The model assesses the impact on flood extent due to debris and effects of dam removal.

**Appendices:** Appendix 1. Climate Solutions of New England (UNH) Summary for Rhode Island.  
Appendix 2. Climate Grids for Rhode Island. Climate Solutions of New England (UNH).

# Rhode Island's Climate

## PAST AND FUTURE CHANGES



Climate has changed throughout the Earth's history and will continue to change. However, analysis of climate data\* shows that the rate of change in Rhode Island has increased significantly over the last four decades, with the region getting warmer and wetter. And with rising levels of heat trapping gases in the atmosphere, these trends are expected to continue for the foreseeable future.

### TEMPERATURES

#### WHAT HAVE WE SEEN SINCE 1970?

- Average maximum temperatures have warmed by 2.2°F (annual) and 3.0°F (winter)
- Average minimum temperatures have warmed by 2.2°F (annual) and 3.4°F (winter)

#### WHAT CAN WE EXPECT BY 2020-2099?

- Warmer winters: 22-45 fewer days below 32°F
- Hotter summers: 13-44 more days above 90°F



### RAINFALL AND FLOODING

#### WHAT HAVE WE SEEN SINCE 1970?

- Annual precipitation has increased 6-11%
- Both the frequency and magnitude of extreme precipitation events has increased

#### WHAT CAN WE EXPECT BY 2020-2099?

- More precipitation (annual averages will increase by 18-20%)
- A two-fold increase in extreme precipitation events
- More frequent and severe flooding

### SNOW AND ICE

#### WHAT HAVE WE SEEN SINCE 1970?

- Fewer days with snow cover
- Lake ice-out dates are occurring earlier

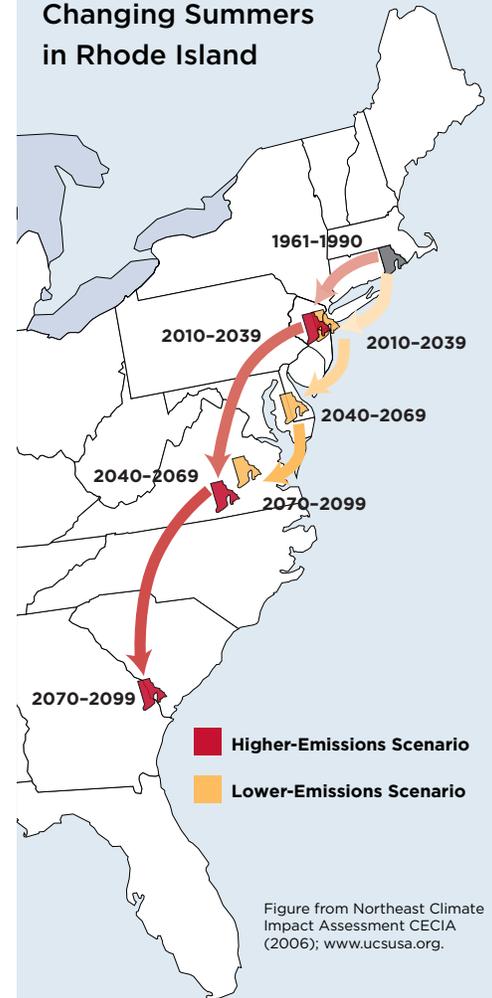
#### WHAT CAN WE EXPECT BY 2020-2099?

- Less snow and more rain
- Less snow cover: 20-32 fewer snow covered days



### CLIMATE ON THE MOVE

#### Changing Summers in Rhode Island



Yellow arrows track what summers are projected to feel like under a lower emissions scenario, while red arrows track projections for a higher emissions scenario. For example, under the higher emission scenario, by late this century residents of Rhode Island would experience a summer climate more like what occurs in South Carolina and Georgia.

\*Detailed results of climate data analysis and methods used to analyze meteorological data and climate model output are available at: [ClimateSolutionsNE.org/assessments](http://ClimateSolutionsNE.org/assessments)

## CLIMATE GRID

The table below includes historical and projected future thirty-year averages of daily measures for minimum and maximum temperature (annual, seasonal, extremes), length of the growing season, precipitation (annual, seasonal, extremes), and snow-covered days. The projected values were derived from four Global Climate Models, which used historical input data from meteorological stations, provided by Global Historical Climatology Network-Daily.

RHODE ISLAND	30 YEAR AVERAGE* 1980-2009	CHANGE FROM 30 YEAR AVERAGE 1980-2009 (+ OR -)					
		SHORT TERM 2010-2039		MEDIUM TERM 2040-2069		LONG TERM 2070-2099	
		LOW EMISSIONS	HIGH EMISSIONS	LOW EMISSIONS	HIGH EMISSIONS	LOW EMISSIONS	HIGH EMISSIONS
INDICATORS	1980-2009	LOW EMISSIONS	HIGH EMISSIONS	LOW EMISSIONS	HIGH EMISSIONS	LOW EMISSIONS	HIGH EMISSIONS
<b>MINIMUM TEMPERATURE (°F)</b>							
Annual TMIN	40.4	1.6	1.8	2.7	4.7	3.5	8.1
Winter TMIN	21.6	1.8	2.0	3.0	4.5	4.1	7.6
Spring TMIN	37.0	2.7	1.4	4.3	3.8	5.4	6.8
Summer TMIN	59.7	1.6	2.1	2.8	5.7	3.5	9.7
Fall TMIN	43.6	0.3	1.8	0.6	5.3	1.1	8.8
<b>MAXIMUM TEMPERATURE (°F)</b>							
Annual TMAX	59.5	1.6	1.6	2.8	4.6	3.8	7.9
Winter TMAX	38.9	1.5	1.4	2.3	3.3	3.3	5.7
Spring TMAX	57.0	2.4	1.5	4.6	4.5	6.2	8.2
Summer TMAX	78.9	1.6	2.0	3.2	5.5	4.0	9.4
Fall TMAX	62.7	0.9	1.6	1.3	5.0	1.5	8.0
<b>TEMPERATURE EXTREME (DAYS PER YEAR)</b>							
<32°F	121	-10	-11	-16	-26	-22	-45
<0°F	3	-1	-1	-2	-2	-2	-3
>90°F	3	3	4	8	18	13	44
>95°F	0	1	1	1	4	3	16
TMAX on hottest day of the year	91.5	1.8	1.4	3.4	5.3	5.1	9.6
TMIN on coldest day of the year	-2.7	3.2	3.9	5.3	8.4	6.7	14.3
<b>GROWING SEASON (DAYS)</b>							
	206	11	12	16	28	23	44
<b>PRECIPITATION (IN.)</b>							
Annual Mean	48.3	5.5	4.7	6.8	6.1	8.6	9.5
Winter Mean	12.0	1.3	1.1	1.9	1.4	2.3	3.4
Spring Mean	12.6	1.4	1.8	1.6	2.2	2.4	3.6
Summer Mean	10.6	2.1	1.3	2.1	1.5	2.3	1.3
Fall Mean	13.1	0.7	0.5	1.1	0.8	1.5	1.3
<b>EXTREME PRECIPITATION (EVENTS PER YEAR)</b>							
1" in 24 hours	13.9	2.2	1.6	2.4	2.2	3.4	3.9
2" in 48 hours	8.0	2.0	1.5	2.9	2.6	3.8	4.7
<b>EXTREME PRECIPITATION (EVENTS PER DECADE)</b>							
4" in 48 hours	8.6	2.5	2.8	6.2	6.2	8.1	11.0
<b>SNOW COVERED DAYS</b>							
	48	-13	-13	-17	-25	-20	-32

\*There were significant gaps in the daily data from some sites for the period 1980-2009. Instead, the historical values in these tables were derived from the downscaled GCM model output.

# Climate Grids for Rhode Island

Tables detailing projected change in 26 climate indicators over three 30 year time periods (2010-2039; 2040-2069; 2070-2099) for two different global greenhouse gas emission scenarios (high [A1fi] and low [B1]) compared to the historical period (1980-2009) for Rhode Island.

The 4 Climate Grids included are for the Global Historical Climatology Network-Daily (GHCN-Daily) meteorological weather stations that had both temperature and precipitation data recorded.

These climate grids were prepared by Climate Solutions New England through the work of Cameron Wake and Sarah Large. For more information please visit [www.climatesolutionsne.org/assessments](http://www.climatesolutionsne.org/assessments)

## Greenville, RI

Indicators	Historical* 1980-2009	Change from Historical (+ or -)					
		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions

### Minimum Temperature (°F)

Annual TMIN	39.3	1.5	1.8	2.6	4.8	3.5	8.2
Winter TMIN	19.7	1.7	2.1	2.8	4.6	3.9	7.7
Spring TMIN	36.0	2.9	1.2	4.6	3.8	5.8	6.9
Summer TMIN	61.4	1.5	2.2	2.7	5.8	3.3	9.9
Fall TMIN	42.8	0.0	2.0	0.3	5.4	0.8	8.9

### Maximum Temperature (°F)

Annual TMAX	59.3	1.7	1.7	3.0	4.8	4.0	8.2
Winter TMAX	36.6	1.5	1.6	2.2	3.5	3.3	6.0
Spring TMAX	57.4	2.8	1.4	5.3	4.7	7.1	8.8
Summer TMAX	80.1	1.7	2.0	3.2	5.5	4.0	9.0
Fall TMAX	62.8	0.8	2.0	1.2	5.6	1.5	8.8

### Temperature Extreme (days per year)

<32°F	132	-9	-11	-14	-24	-19	-41
<0°F	3	-1	-2	-2	-3	-2	-3
>90°F	5	5	5	12	21	18	50
>95°F	1	1	0	2	3	6	16
TMAX on hottest day of the year	92.7	2.0	0.9	3.8	4.5	5.4	8.4
TMIN on coldest day of the year	-4.3	3.2	4.0	5.0	8.5	6.3	14.4
<b>Growing Season (days)</b>	201	12	12	19	29	20	51

### Precipitation (in.)

Annual mean	43.5	4.2	3.9	5.4	5.1	7.5	8.2
Winter mean	9.9	1.3	1.3	1.9	1.5	2.3	3.7
Spring mean	10.0	0.7	1.7	0.9	2.4	1.8	3.4
Summer mean	10.7	2.0	0.8	2.0	1.1	2.4	0.6
Fall mean	12.9	0.2	0.2	0.5	0.0	1.0	0.5

### Extreme Precipitation (events per year)

1" in 24 hours	12.8	1.9	1.3	1.7	2.0	3.2	3.7
2" in 48 hours	7.8	0.9	1.2	1.7	2.5	2.5	4.3

### Extreme Precipitation (events per decade)

4" in 48 hours	9.7	0.4	1.7	5.3	2.9	4.8	6.2
<b>Snow Covered Days</b>	58	-13	-13	-17	-27	-22	-34

# Kingston, RI

Indicators	Historical* 1980-2009	Change from Historical (+ or -)					
		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions

## Minimum Temperature (°F)

Annual TMIN	39.6	1.8	2.0	3.0	5.2	3.9	8.9
Winter TMIN	21.2	2.0	2.1	3.2	4.8	4.5	8.2
Spring TMIN	36.5	2.8	1.5	4.5	4.1	5.7	7.2
Summer TMIN	60.9	1.5	2.1	2.6	5.6	3.2	9.4
Fall TMIN	42.1	0.4	2.0	0.7	6.0	1.4	9.9

## Maximum Temperature (°F)

Annual TMAX	60.9	1.5	1.6	2.8	4.4	3.7	7.7
Winter TMAX	40.9	1.5	1.4	2.2	3.2	3.3	5.6
Spring TMAX	58.1	2.3	1.5	4.4	4.4	6.0	8.2
Summer TMAX	80.0	1.5	1.9	3.1	5.4	3.9	9.4
Fall TMAX	64.2	0.9	1.6	1.3	4.8	1.6	7.8

## Temperature Extreme (days per year)

<32°F	128	-11	-12	-18	-29	-24	-52
<0°F	3	-2	-2	-2	-3	-3	-3
>90°F	4	3	4	9	21	15	49
>95°F	0	1	1	1	6	3	22
TMAX on hottest day of the year	92.2	1.6	1.5	3.0	5.2	4.5	9.8
TMIN on coldest day of the year	-5.6	3.6	4.3	6.1	9.3	7.7	15.8
<b>Growing Season (days)</b>	186	10	14	20	30	21	52

## Precipitation (in.)

Annual mean	50.2	5.8	5.6	7.1	6.6	9.0	9.9
Winter mean	12.5	1.2	1.1	2.1	1.4	2.2	3.6
Spring mean	13.8	1.5	2.3	1.6	2.6	2.7	3.9
Summer mean	10.5	2.3	1.5	2.3	1.5	2.4	1.2
Fall mean	13.5	0.8	0.7	1.0	0.9	1.6	1.2

## Extreme Precipitation (events per year)

1" in 24 hours	14.8	2.3	1.9	2.7	2.4	3.4	4.2
2" in 48 hours	8.9	2.2	1.8	3.3	2.6	4.1	4.9

## Extreme Precipitation (events per decade)

4" in 48 hours	8.4	2.9	4.9	6.7	7.7	10.0	12.3
<b>Snow Covered Days</b>	43	-8	-10	-14	-27	-21	-51

## Newport Rose, RI

Indicators	Historical* 1980-2009	Change from Historical (+ or -)					
		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions

### Minimum Temperature (°F)

Annual TMIN	43.7	1.4	1.6	2.4	4.2	3.1	7.2
Winter TMIN	25.7	1.7	1.8	2.7	4.0	3.7	6.8
Spring TMIN	39.4	2.3	1.2	3.7	3.3	4.7	5.8
Summer TMIN	58.3	1.6	2.0	2.7	5.3	3.4	9.2
Fall TMIN	47.9	0.3	1.7	0.5	4.8	1.0	7.9

### Maximum Temperature (°F)

Annual TMAX	58.9	1.4	1.5	2.5	4.2	3.4	7.3
Winter TMAX	40.6	1.4	1.2	2.1	3.0	3.0	5.1
Spring TMAX	55.1	2.0	1.2	3.8	3.8	5.2	7.1
Summer TMAX	76.8	1.5	1.9	3.1	5.5	4.0	9.8
Fall TMAX	62.9	0.9	1.4	1.2	4.5	1.5	7.4

### Temperature Extreme (days per year)

<32°F	91	-11	-10	-16	-24	-22	-42
<0°F	1	-1	-1	-1	-1	-1	-1
>90°F	1	1	2	4	12	7	35
>95°F	0	0	1	1	2	2	12
TMAX on hottest day of the year	89.4	2.0	1.9	3.9	6.2	5.9	11.2
TMIN on coldest day of the year	3.4	3.0	3.6	4.9	7.6	6.2	13.1
<b>Growing Season (days)</b>	241	9	13	19	30	21	51

### Precipitation (in.)

Annual mean	45.0	4.8	4.0	5.5	5.5	7.3	8.9
Winter mean	11.8	1.0	1.0	1.4	1.4	1.7	3.4
Spring mean	12.3	1.2	1.7	0.9	2.1	2.0	3.3
Summer mean	9.1	2.0	0.7	2.0	0.6	2.1	0.1
Fall mean	11.8	0.6	0.7	1.0	1.3	1.4	2.1

### Extreme Precipitation (events per year)

1" in 24 hours	12.7	1.8	1.2	2.0	1.7	3.1	3.5
2" in 48 hours	6.5	1.8	1.5	2.8	2.4	3.1	4.3

### Extreme Precipitation (events per decade)

4" in 48 hours	6.6	2.7	1.2	2.6	5.9	6.1	9.0
<b>Snow Covered Days</b>	43	-13	-13	-17	-24	-20	-30

## North Foster, RI

Indicators	Historical* 1980-2009	Change from Historical (+ or -)					
		Short Term 2010-2039		Medium Term 2040-2069		Long Term 2070-2099	
		Low Emissions	High Emissions	Low Emissions	High Emissions	Low Emissions	High Emissions

### Minimum Temperature (°F)

Annual TMIN	39.0	1.6	1.8	2.7	4.7	3.6	8.2
Winter TMIN	19.7	1.9	2.0	3.1	4.5	4.3	7.7
Spring TMIN	36.3	2.6	1.5	4.3	4.0	5.4	7.1
Summer TMIN	58.3	1.9	2.3	3.3	6.1	4.1	10.2
Fall TMIN	41.6	0.4	1.6	0.7	5.0	1.2	8.5

### Maximum Temperature (°F)

Annual TMAX	58.7	1.7	1.7	3.0	4.8	4.0	8.2
Winter TMAX	37.3	1.7	1.5	2.6	3.5	3.7	6.2
Spring TMAX	57.2	2.5	1.7	4.8	5.0	6.6	9.0
Summer TMAX	78.7	1.6	2.1	3.2	5.7	4.0	9.6
Fall TMAX	61.0	1.0	1.6	1.4	5.0	1.7	8.2

### Temperature Extreme (days per year)

<32°F	133	-10	-10	-16	-25	-21	-44
<0°F	3	-2	-2	-2	-3	-3	-3
>90°F	3	3	3	7	17	12	43
>95°F	0	0	1	1	4	2	15
TMAX on hottest day of the year	91.4	1.5	1.5	2.7	5.2	4.5	9.0
TMIN on coldest day of the year	-4.5	3.0	3.5	5.2	8.0	6.6	13.9
<b>Growing Season (days)</b>	197	6	10	17	29	21	51

### Precipitation (in.)

Annual mean	53.3	6.7	5.1	8.0	6.3	9.7	9.6
Winter mean	13.4	1.6	0.9	2.0	1.3	2.6	2.9
Spring mean	14.0	1.8	1.7	1.9	1.8	2.6	3.5
Summer mean	11.8	2.4	2.2	2.5	2.6	2.5	2.5
Fall mean	14.1	1.0	0.3	1.6	0.4	1.9	0.8

### Extreme Precipitation (events per year)

1" in 24 hours	15.3	2.8	1.9	3.0	2.3	4.0	4.0
2" in 48 hours	9.1	2.5	1.8	3.3	2.8	4.6	5.0

### Extreme Precipitation (events per decade)

4" in 48 hours	10.4	4.1	2.6	8.8	7.8	10.8	13.8
<b>Snow Covered Days</b>	59	-15	-15	-19	-30	-24	-37