Planning for Community Climate Change Adaptation

Held on Thursday, October 28, 2010
Location: RI Department of Environmental Management, Providence, RI
Audience: * Planners and other municipal staff and officials
*5.0 AICP CM credits offered

The CTP and partners held a workshop for planners and other target audiences on Climate Change Impacts to Rhode Island; Fundamental Concepts in Planning for Climate Change; RI's Climate Change Programs & Implications for Local Planning Efforts; and Tools and Resources.
The workshop covered how to plan for climate change, how to conduct vulnerability assessments, how current state regulations address climate change, and how other governments are taking on the challenge of preparing for climate change. Participants became familiar with key data sources and learned specific strategies for engaging stakeholders in climate change preparedness and took part in exercises designed to help them consider possible climate vulnerabilities and adaptation strategies in their communities.

Presenters included experts from: ICLEI- Local Governments for Sustainability; National Weather Service's Northeast River Forecast Center; RI Coastal Resources Management Council; and RI Sea Grant.

Attendees heard case studies on specific adaptation actions and public and policy-maker engagement efforts from the following communities: Providence, RI; Hull, MA; Dennis, MA; Cambridge, MA; and Groton, CT.

The workshop was co-sponsored by the RI Coastal Resources Management Council, RI Sea Grant, and ICLEI- Local Governments for Sustainability.

For more information please contact Jennifer West, CTP Coordinator, at jennifer@nbnerr.org, or 401-222-4700, x 7413.

Documents

- Agenda
- Speaker Biographies
- Climate Change Adaptation Resources
- Confronting Climate Change in the U.S. Northeast_RI Chapter
- Groton ex. of Methodology for Prioritization of Qualified Capital Projects
- Worksheet_A Quick Assessment of Your Community
- Planning for Community Climate Change Adaptation Attendee List

Power Points

- Climate Change Impacts to RI & Supporting Science_Janet Freedman
- Observed & Future Impacts of Increased Rainfall & Flooding_Dave Vallee
- Fundamental Concepts in Planning for Climate Change_Daniella Hirschfeld
- Community Case Study_Groton, CT_Mike Murphy
- Community Engagement & Addressing Barriers to Adaptation_Daniella Hirschfeld
- Panel_Planning for Climate Change in Providence_Dave Everett
- Panel_Planning for Community Climate Change Adaptation_Hull, MA_Anne Herbst
- Tools & Resources_Daniella Hirschfeld
- Resources for Local Officials_Pam Rubinoff
- RI Climate Change Programs & Implications for Local Planning Efforts_Jim Boyd

Planning for Community Climate Change Adaptation

October 28, 2010
8:30 a.m. to 4:00 p.m.
Room 300, RI Department of Environmental Management
235 Promenade St., Providence, RI, 02908

AGENDA

8:30 a.m. **Sign-In and Continental Breakfast**

9:00 a.m. **Welcome and Overview**
Jennifer West, Coastal Training Program Coordinator, Narragansett Bay Research Reserve

9:15 a.m. **Climate Change Impacts to Rhode Island and Supporting Science**
Janet Freedman, Geologist, RI Coastal Resources Management Council

9:35 a.m. **Observed and Future Impacts of Increased Rainfall and Flooding**
Dave Vallee, Hydrologist-in-Charge, Northeast River Forecast Center, National Weather Service

10:05 a.m. **Fundamental Concepts in Planning for Climate Change**
Daniella Hirschfeld, Program Officer, Climate Programs Division, ICLEI-Local Governments for Sustainability

10:30 a.m. **Break**

10:45 a.m. **Community Case Study:** Groton, CT.
Michael J. Murphy, AICP, Director of Planning and Development, Town of Groton, CT

11:15 a.m. **Community Engagement and Addressing Barriers to Adaptation**
Daniella Hirschfeld, Program Officer, Climate Programs Division, ICLEI-Local Governments for Sustainability

11:30 a.m. **Panel:** Examples of local communities involved in adaptation planning.

- Dave Everett, Principal Planner, City of Providence, RI
- Anne Herbst, Conservation Administrator, Town of Hull, MA
- Rosalie Anders, Project Administrator, Environmental and Transportation Planning Division, City of Cambridge, MA

Moderator: Jared Rhodes, Chief, RI Statewide Planning Program

12:30 p.m. **Lunch** (provided)

1:15 p.m. **Tools and Resources**
Daniella Hirschfeld, Program Officer, Climate Programs Division, ICLEI-Local Governments for Sustainability
and
Pam Rubinoff, Coastal Management Extension Specialist, RI Sea Grant

2:00 p.m. **Exercise: A Quick Assessment of Your Community**
Daniella Hirschfeld, Program Officer, Climate Programs Division, ICLEI-Local Governments for Sustainability

2:20 p.m. **Break**

2:35 p.m. **Exercise, con't.**

3:15 p.m. **Summary of RI's Climate Change Programs and Implications for Local Planning Efforts**
Jim Boyd, Coastal Policy, Coastal Resources Management Council

3:45 p.m. **Conclusion and Evaluations**
Jennifer West, Coastal Training Program Coordinator, Narragansett Bay Research Reserve

4:00 p.m. **Adjourn**

Speaker Biographies

Rosalie Anders

Rosalie Anders is a planner for the City of Cambridge, working on energy and transportation issues. She came to the City after cofounding and leading the Sustainable Cambridge Coalition, a grassroots environmental organization. She is interested in helping people move through some of the emotional and social barriers around dealing with climate change. Her first career was as a family therapist and community organizer.

James Boyd

James Boyd is a Coastal Policy Analyst for the Rhode Island Coastal Resources Management Council, (CRMC) the State's coastal zone management agency. He has been employed with the CRMC for 10 years and is responsible for the development and implementation of the Council's Special Area Management Plans. He is also developing policy to address emerging coastal zone management issues such as climate change and sea level rise impacts on the coastal environment. Mr. Boyd has a graduate degree in Natural Resources Science from the University of Rhode Island and has over 20 years of environmental policy and regulatory experience specializing in watershed management. He has previously worked for the Rhode Island Department of Environmental Management, the State of Vermont Environmental Board and the New England Onsite Wastewater Training Program at the University of Rhode Island. He was also a RI-licensed commercial fisherman for over a decade in Narragansett Bay.

Dave Everett

Dave Everett is a Principal Planner for the City of Providence, concentrating largely on environmental issues and neighborhood, institutional, arts, and comprehensive planning. He has been a professional planner, writer and environmental advocate for over twenty years. Before returning to his hometown of Providence, Dave did planning work in a variety of settings in New England and New York, from small towns to big cities to a regional planning agency, as both staff and consultant. An environmentalist at heart, over the past few years he has become increasingly involved in policy and planning relating to reducing the amount of paved surface; supporting and enabling urban agriculture and composting; promoting green design, energy efficiency and improved stormwater management; and other sustainability initiatives. Dave is also a painter of real and imagined landscapes, seascapes, treescapes, and other things, and is really into birds. He holds a Master's in City Planning from MIT.

Janet Freedman

Janet Freedman is a coastal geologist at the RI Coastal Resources Management Council. Ms. Freedman holds an M.S. in Geology (1998) from the University of Rhode Island. She works on coastal hazard issues, mapping, and habitat restoration, emphasizing science based approach to coastal policy and planning. She coordinates with federal, state, local and non-government partners on issues dealing with erosion control technologies, the beneficial re-use of dredged materials, climate change impacts and habitat restoration. She is currently partnering with several state agencies on developing

and implementing climate change and sea level rise regulations for the Rhode Island Coastal Resources Management Program. Ms. Freedman serves on the board of the Rhode Island Flood Mitigation Association, and is a member of the Rhode Island State Hazard Mitigation Committee, the NERACOOS Coastal Resiliency Workgroup, the Northeast Regional Ocean Council Coastal Hazards Committee, the Mapcoast Steering Committee and the NOAA Restoration Center Steering Committee for the development of guidelines for incorporating sea level rise into habitat restoration projects. Ms. Freedman has been with CRMC since 1999.

Anne Herbst

Anne Herbst is Conservation Administrator and Community Rating System Coordinator for the Town of Hull, MA. She manages the town's hazard mitigation grants from FEMA and climate adaptation technical assistance grant from MA Coastal Zone Management. She recently received the Walter B. Jones Memorial award for Excellence in Local Government from NOAA for leading Hull's efforts in climate change adaptation. Ms. Herbst holds a Master in City Planning from MIT.

Daniella Hirschfeld

Daniella Hirschfeld works as a Program Officer in ICLEI's Climate Programs Division. In this role she builds climate adaptation tools, resources, and trainings for local governments throughout the country. With a focus on vulnerability assessments and hazard mitigation planning, Daniella helps increase local government's resilience to climate change. Daniella Hirschfeld joined ICLEI's climate adaptation team after a two-year NOAA Coastal Zone Management Fellowship, during which time she worked with Massachusetts communities to prepare for and adapt to sea level rise. Daniella has a master's degree in environmental management from Duke University's Nicholas School of the Environment and a B.A. in, psychology and philosophy from Dartmouth College.

Michael J. Murphy

Michael J. Murphy is a member of the American Institute of Certified Planners and is Director of Planning and Development in the Town of Groton, CT. His Office of Planning and Development Services (OPDS) administers the Town's land use and environmental planning functions, its economic and community development programs, community sustainability efforts, and zoning, property maintenance, rental housing and building codes. Mr. Murphy holds a B.A. in Political Science with a minor degree in French from Fairleigh Dickinson University, College at Florham (NJ), a Master of Public Administration (MPA) degree from Long Island University/C.W. Post Center (NY), and a Certificate of Local Government Management from the University of Connecticut. He lives in Oakdale, CT with his wife Debra.

Jared Rhodes

Jared Rhodes is currently the Chief of the Statewide Planning Program. Prior to this he had worked in the City of Cranston Planning Department since 1999 attaining the position of Director in 2005. Mr. Rhodes has also served on the State Planning Council, the Executive Committee of the Rhode Island Geographic Information System and as the Vice President of the Rhode Island Chapter of the American Planning Association. He is

a graduate of the University of Rhode Island with a BA in Marine Affairs and Master's Degree in Community Planning. He lives in East Providence, Rhode Island.

Pam Rubinoff

Pam Rubinoff is a Coastal Management Extension Specialist with the URI Coastal Resources Center (CRC). She works in both the U.S.-based Rhode Island Sea Grant initiatives and International Programs focusing on sustainable coastal community development through capacity building, policy creation, and direct technical assistance to government and non-government partners in the field. Currently, her efforts help advance regional ecosystem management by incorporating smart growth principles, coastal hazard prevention, and leadership training into local Rhode Island Sea Grant initiatives. In the Indian Ocean, she is collaborating in a project to create guidelines and tools for coastal community resilience, as a step forward in recovery from the 2004 tsunami. For five years, Rubinoff led a multi-year, multi-million dollar program to build capacity to manage critical coastal resources in Mexico for CRC 's cooperative agreement program with the U.S. Agency for International Development (USAID). This program oversaw the creation of one of Mexico's first community-based marine national parks as well as the first para-municipal framework for bay conservation and development. She has recently co-authored a Spanish language guide on marina good management practices, complementing an earlier publication on low-impact coastal tourism now employed by government and developers. Prior to joining CRC, Rubinoff was coordinator of the Massachusetts Coastal Zone Management Program's Cape Cod/Islands Region. Rubinoff has a M.A.F. in Marine Affairs from the University of Rhode Island and a B.C.E. in Civil Engineering from the University of Delaware.

David Vallee

David Vallee is the Hydrologist-in-Charge of the National Weather Service's Northeast River Forecast Center. The center provides detailed water resource forecasting information to National Weather Service Forecast Offices and the hundreds of federal, state and local water resource entities throughout the Northeast and New York. Prior to becoming the Hydrologist-in-Charge, David served as Science and Operations Officer, and Hurricane Program Leader at the NWS Weather Forecast Office, in Taunton, MA from 2001 through 2006, and as Senior Service Hydrologist from 1993 through 2000. David has extensive experience leading hydrometeorological forecast and warning operations and directing weather research and training programs. David has conducted research on a variety of topics including flooding, severe weather forecasting and radar detection, orographically enhanced heavy rainfall in southern New England, coastal flood climatology and the behavior and characteristics of New England Tropical Cyclones. David has served as the NWS lead investigator with the State University of New York, at Albany, on a multi-year project addressing Land Falling Tropical Cyclones in the Northeastern United States. This multi-faceted project was aimed at improving the forecasting of heavy precipitation associated with these land falling tropical cyclones, as well as developing a better understanding the mechanisms which lead to the recurvature and rapid acceleration of tropical cyclones as they approach the Northeast. David is a graduate of Lyndon State College. He is a life long resident of the Rhode Island, living

in the northeast part of Cumberland, with his wife and two sets of twins! He considers it a tremendous privilege to be serving the people of the very region he calls home.

Climate Change Adaptation Resources

National Oceanic and Atmospheric Administration (NOAA)

NOAA Climate Services Portal
http://www.climate.gov/
Serves as the central website for NOAA's climate data, products, and services from NOAA's National Climatic Data Center, Coastal Services Center, Climate Prediction Center, and others.

Coastal Climate Adaptation
http://community.csc.noaa.gov/climateadaptation
Focuses on adaptation-related resources, such as local and state plans, new policies, case studies, risk and vulnerability assessments, and decision-support tools. Provides a forum where users can suggest new resources, engage in dialogue on the issues, and submit comments and questions.

National StormSmart Coasts Network
http://stormsmartcoasts.org/
A resource for coastal decision-makers looking for the latest and best information on how to protect their communities from weather and climate hazards. Massachusetts included, Rhode Island coming soon.

"**Local Strategies for Addressing Climate Change**"
http://www.csc.noaa.gov/magazine/climatechangestrategies.pdf
Illustrates examples of the tools, programs, and projects that coastal resource managers are already using that address both direct and indirect effects of climate change.

"Adapting to Climate Change: A Planning Guide for State Coastal Managers"
http://coastalmanagement.noaa.gov/climate/adaptation.html
Provides science-based information on climate change to set the context for adaptation planning and includes steps for setting up a planning process, assessing vulnerability, devising a strategy, and implementing the plan. Compiles information from a number of sources and includes techniques currently being used successfully by coastal managers to address other coastal management issues such as coastal hazards, habitat loss, and secondary and cumulative impacts.

"Summary of Coastal Program Initiatives that Address Sea Level Rise as a Result of Global Climate Change"
http://www.seagrant.noaa.gov/focus/documents/hrcc/slr_policies_summary_mar6_final.pdf
Summarizes policies and initiatives aimed specifically at addressing the effects of climate change and sea level rise being carried out by Coastal Management Programs, including Sea Grant programs and others.

"Good Morning, America! The Explosive U.S. Awakening to the Need for Adaptation"
http://aquacomm.fcla.edu/3010/

Provides an overview of the public, political, and scientific concern with adaptation to climate change in the United States. Identifies barriers to adaptation planning and policy development, and provides suggestions to enable effective adaptation while avoiding the dangers of insufficient preparation.

Risk and Vulnerability Assessment Tool (RVAT)
www.csc.noaa.gov/rvat
Provides a process for conducting hazard identification, social and environmental vulnerability, and mitigation opportunity analyses as well as a storm surge visualization tool.

Digital Coast Coastal Inundation Toolkit
www.csc.noaa.gov/digitalcoast/inundation
Walks communities through an approach for understanding and addressing coastal inundation issues. Covers understanding coastal inundation, identifying exposure and potential impacts, mapping potential inundation and impacts, assessing community risks and vulnerability, and communicating risk strategies to initiate change. Provides case studies of how other communities are addressing this issue.

SLOSH (Sea, Lake and Overland Surges from Hurricanes)
www.nhc.noaa.gov/HAW2/english/surge/slosh.shtml
Computerized model run by the National Hurricane Center to estimate storm surge heights and winds resulting from actual and possible hurricanes.

Sea Level Online
http://tidesandcurrents.noaa.gov/sltrends/sltrends.shtml

Environmental Protection Agency

EPA's Climate Change Website
http://epa.gov/climatechange/index.html
Information on climate change indicators, climate economics, regulatory initiatives for greenhouse gas emissions, science, U.S. climate policy, greenhouse gas emissions, and health and environmental effects.

EPA's Climate Ready Estuaries Program
http://www.epa.gov/cre/
Information on climate change impacts to different estuary regions, access to tools and resources to monitor changes, and information to help managers develop adaptation plans for estuaries and coastal communities.

“Synthesis of Adaptation Options for Coastal Areas”
http://www.epa.gov/climatereadyestuaries/adaptationoptions.html
Provides a brief introduction to key physical impacts of climate change on estuaries and a review of on-the-ground adaptation options available to coastal managers to reduce their systems' vulnerability to climate change impacts.

Water Resource Adaptation Program (WRAP)
http://www.epa.gov/nrmrl/wswrd/wqm/wrap/index.html

Provides water resource managers and decision-makers with the tools they need to adapt water resources (e.g., watersheds and infrastructure) to future climate change and demographic and economic development.

Climate Ready Water Utilities Toolbox
http://www.epa.gov/safewater/watersecurity/climate/toolbox.htm
A searchable database for water utilities to identify relevant climate change resources, including current federal, state, and association activities related to climate change impacts on water resources and utilities; grant programs that could support climate-related actions by utilities and municipalities; publications and reports; tools and models; and workshops and seminars.

Federal Emergency Management Agency (FEMA)

Planning and Preparing for Hazards
http://www.fema.gov/plan/index.shtm
Helps identify people, property, and resources that are at risk of injury, damage, or loss from hazardous incidents or natural hazards. Helps determine and prioritize the precautionary measures that can make a community more disaster-resistant.

HAZUS-MH
http://haz.main.org/taxonomy/term/19/all
Estimates physical damage, economic losses, and social impacts from floods, hurricane winds, and earthquakes.

Digital Flood Mapping Products
http://www.fema.gov/plan/prevent/fhm/dfm_dfhm.shtm
Information about the FEMA requirements for Digital Flood Insurance Rate Maps (DFIRM) and DFIRM Database components.

ICLEI- Local Governments for Sustainability

"**Climate Change Outreach and Communications Guide**"
http://www.icleiusa.org/action-center/engaging-your-community/outreach-and-communications-guide
Helps local governments effectively communicate climate information to their constituencies. Contains an array of steps and methodologies for communication and outreach efforts as well as a compilation of best practices from around the United States.

"Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments"
http://www.cses.washington.edu/db/pdf/snoveretalgb574.pdf

Clean Air Partnership

"Cities Preparing for Climate Change: A Study of Six Urban Regions"
http://adaptation.nrcan.gc.ca/projdb/pdf/171e_e.pdf
Section 3.1 of this report on urban and regional adaptation planning efforts has review of community engagement and awareness-building approaches taken by the six cities, as well as the effectiveness of these approaches.

U.S. Agency for International Development (USAID)

"Adapting to Coastal Climate Change: A Guidebook for Development Planners"
http://www.usaid.gov/our_work/cross-cutting_programs/water/docs/coastal_adaptation/adapting_to_coastal_climate_change.pdf
An approach to assess vulnerability to climate change and climate variability, develop and implement adaptation options, and integrate options into programs, development plans, and projects at the national and local levels.

US Geological Survey

USGS Online Flood Information
http://waterdata.usgs.gov/nwis/
Map that tracks flood conditions in the United States. Real-time water monitoring that is part of a continuing effort by the USGS to assist the National Weather Service (NWS) in making accurate and timely flood forecasts. Information for surface and ground water from 1.5 million sites across the United States.

Intergovernmental Panel on Climate Change (IPCC)

http://www.ipcc.ch/index.htm
The leading intergovernmental, scientific body for the assessment of climate change, providing the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences.

PEW Center on Global Climate Change

Climate Change 101: Understanding and Responding to Global Climate Change
http://www.pewclimate.org/global-warming-basics/climate_change_101
A series of reports covering climate science and impacts, technological solutions, business solutions, international action, recent action in the U.S. states, and action taken by local governments.

Climate Adaptation Knowledge Exchange (CAKE)

http://www.cakex.org/
Aimed at building a shared knowledge base for managing natural systems in the face of rapid climate change. Consists principally of four interlinked components: Virtual Library, Case Studies, Directory, and Tools, as well as community forums for the discussion of current issues in conservation in a changing climate.

Regional/State

New England Integrated Sciences and Assessment

Indicators of Climate Change in the Northeast
http://www.neisa.unh.edu/Climate/index.html

View and download climate data for over 150 stations in the Northeast. View options such as: About NEISA, Climate, Air Quality and Health, Research and Products, Presentations, Publications, Calendar, New England Links and Data and Team Resources.

Union of Concerned Scientists

Northeast Climate Impacts Assessment (NECIA)

A collaboration between the Union of Concerned Scientists (UCS) and a team of more than fifty independent experts to develop and communicate a new assessment of climate change, impacts on climate sensitive sectors, and solutions in the northeastern United States.

> **"Climate Change in the U.S. Northeast"**
> http://www.climatechoices.org/assets/documents/climatechoices/NECIA_climate_report_final.pdf
> **"Rhode Island: Confronting Climate Change in the U.S. Northeast"**.
> http://www.climatechoices.org/assets/documents/climatechoices/rhode-island_necia.pdf
> Fact sheet based on: *Confronting Climate Change in the U.S. Northeast. Impacts and Solutions.* Synthesis report of the Northeast Climate Impacts Assessment (NECIA).

Brown University Center for Environmental Studies

"Preliminary Assessment of Rhode Island's Vulnerability to Climate Change and its Options for Adaptation Action"

http://envstudies.brown.edu/Summary-RIClimateChangeAdaptation.pdf

"Trees and the Urban Heat Island Effect: a Case from Providence, RI"

Release pending.

RI Coastal Resources Management Council

CRMC Sea Level Rise Regulations

http://www.crmc.ri.gov/regulations_adopted/2008-03-04_RICRMP_Section_145.pdf

Section 145 of the RICRMP: Climate Change and Sea Level Rise.

University of Rhode Island

"Literature Review of the U.S. Northeast Coastal Community: Management of Coastal Ecosystems and Natural Hazards."

http://www.crc.uri.edu/download/Northeast_Literature_Review.pdf

Discusses priority issues of the primary audience in the northeast region, management of coastal ecosystems, coastal hazards resilience, and cross-cutting issues of data and information access and usability.

"Global Climate Change Induced Inundation Modeling of South Kingstown, RI"

http://www.ci.uri.edu/ciip/projects/gccinri/Thompson_MESM_SK&GCC.pdf

RI Department of Environmental Management

Climate Change and Rhode Island

www.dem.ri.gov/climate

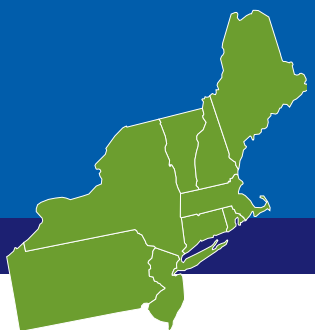
Fact sheet series covering potential impacts on RI's coastal areas, drinking water, energy supply, economy, and health as a result of climate change.

Environmental Council of Rhode Island

"Global Warming in Rhode Island: Warning Signs, Winning Solutions"
http://www.environmentcouncilri.org/pdf/global06.pdf

Rhode Island

Confronting Climate Change in the U.S. Northeast



From the bluffs of Block Island to the streets of Providence, the climate of Rhode Island is changing. Records show that spring is arriving earlier, summers are growing hotter, and winters are becoming warmer and less snowy. These changes are consistent with global warming, an increasingly urgent phenomenon driven by heat-trapping emissions from human activities.

New state-of-the-art research shows that if global warming emissions continue to grow unabated, Rhode Island can expect dramatic changes in climate over the course of this century, with substantial impacts on vital aspects of the state's economy and character. If the rate of emissions is lowered, however, projections show that many of the changes will be far less dramatic. Emissions choices we make today—in Rhode Island, the Northeast, and worldwide—will help determine the climate our children and grandchildren inherit, and shape the consequences for their economy, environment, and quality of life.

The research summarized here describes how climate change may affect Rhode Island and other Northeast states under two different emissions scenarios. The higher-emissions scenario assumes continued heavy reliance on fossil fuels, causing heat-trapping emissions to rise rapidly over the course of the century. The lower-emissions scenario assumes a shift away from fossil fuels in favor of clean energy technologies, causing emissions to decline by mid-century.

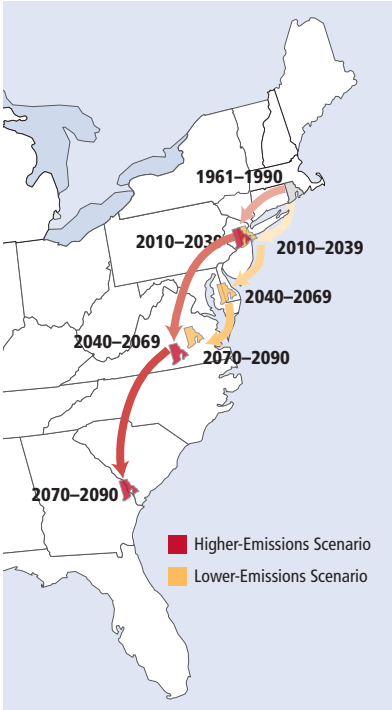
The research also explores actions that individual households, businesses, and governments in the Northeast can take today to reduce emissions to levels consistent with staying *below* the lower-emissions scenario and adapt to the unavoidable changes that past emissions have already set in motion.

RHODE ISLAND'S CHANGING CLIMATE

Temperature. Average temperatures across the Northeast have risen more than 1.5 degrees Fahrenheit (°F) since 1970, with winters warming most rapidly—4°F between 1970 and 2000. If higher emissions prevail, seasonal average temperatures across Rhode Island are projected to rise 7°F to 13°F above historic levels in winter and 6°F to 14°F in summer by late-century, while lower emissions would cause roughly half this warming. As in other Northeast states, Rhode Island can expect a large increase in the frequency of days with temperatures above 90°F over the course of this century, with steep increases under the higher-emissions scenario.

Precipitation and winter snow. The Northeast region is projected to see an increase in winter precipitation on the order of 20 to 30 percent. Slightly greater increases are projected under the higher-emissions scenario, which would also feature less winter precipitation falling as snow and more as rain.

Snow is an iconic aspect of Northeast winters and an integral part of many favorite winter



Migrating State Climate

Changes in average summer heat index—a measure of how hot it actually feels, given temperature and humidity—could strongly affect quality of life in the future for residents of Rhode Island. Red arrows track what summers could feel like over the course of the century under the higher-emissions scenario. Yellow arrows track what summers in the state could feel like under the lower-emissions scenario.

Photos: (from top) iStockphoto.com/Kenneth C. Zirkel; iStockphoto.com/Myles Dumas; No Credit; iStockphoto.com/Kenneth C. Zirkel; iStockphoto.com/Paul Burney

activities, but rising temperatures over the past few decades have caused snow to become wetter, or more "slushy," and decreased the average number of snow-covered days. Rhode Island could see its snow season reduced to just a handful of days per winter month by mid-century, and virtually eliminated by late-century. Under the lower-emissions scenario the state would retain roughly one week per winter month of snow cover through this century.

Heavy, damaging rainfall events have already increased measurably across the Northeast in recent decades. Intense spring rains struck the region in both 2006 and 2007, for example, causing widespread flooding. The frequency of these events is expected to rise further under either emissions scenario.

Drought. Rising summer temperatures coupled with little change in summer rainfall are projected to increase the frequency of short-term (one- to three-month) droughts, particularly if higher emissions prevail. By late-century, for example, short-term droughts are projected to occur annually under the higher-emissions scenario (compared with once every two years, on average, historically), increasing stress on both natural and managed ecosystems. In contrast, little change in drought is expected under the lower-emissions scenario.

Sea-level rise. Global warming affects sea levels by causing ocean water to expand as it warms, and by melting land-based ice. Under the higher-emissions scenario, global sea level is projected to rise between 10 inches and two feet by the end of the century (7 to 14 inches under the lower-emissions scenario). These projections do not account for the recent observed melting of the world's major ice sheets—nor the potential for accelerated melting—and may therefore be conservative. However, even under these projections, the Ocean State faces a substantial increase in the extent and frequency of coastal flooding, erosion, and property damage.

IMPACTS ON HUMAN HEALTH

Heat was the United States' leading weather-related killer in 6 of 10 recent years (between 1993 and 2003). More intense summer heat waves and deteriorating air quality caused by global warming will increase the risks of many health problems.

Extreme heat. While Rhode Islanders are accustomed to the occasional summer heat wave, the number of very hot days in large cities (where the urban heat-island effect can amplify temperatures) is expected to increase significantly, particularly under the higher-emissions scenario. By late-century, for example, neighboring cities like Boston and Hartford could experience roughly 25 days over 100°F every summer under the higher-emissions scenario, compared with roughly seven such days under the lower-emissions scenario.

Very hot days are not only unpleasant but also dangerous. As the number of these days increases, so does the risk of heat stress, heart attack, and even death. The state's larger cities such as Providence, Cranston, Warwick, and Pawtucket will need to prepare for an increase in dangerously hot conditions by taking steps (e.g., installing better insulation, establishing heat warning systems and cooling centers) that will lessen the impact of extreme heat on vulnerable populations.

Air quality. Air pollution from ground-level ozone and other components of smog is a serious concern across much of Rhode Island. From 2001 to 2005, the average summer in Rhode Island included nearly 11 days that did not meet U.S. Environmental Protection Agency (EPA) air-quality standards for ground-level ozone, putting additional stress on people with cardiovascular and respiratory diseases. In the absence of more stringent controls on ozone-forming pollutants, the number of days with poor air quality in cities like Providence could quadruple under the higher-emissions scenario. Under the lower-emissions scenario such days could increase by half.

Higher temperatures and increasing levels of plant-stimulating carbon dioxide (CO_2) in the air are also expected to accelerate seasonal pollen production in plants over the next several decades under the higher-emissions scenario. This could extend the allergy season, increase asthma risks, and exacerbate symptoms for both urban and rural residents of Rhode Island.

Vector-borne disease. Mosquitoes and ticks carry West Nile virus and Lyme disease-causing bacteria, respectively, and spread them to animals and humans. Factors affecting vector-borne diseases are complex; however, projections for the Northeast of warmer winters, hotter summers, and more frequent summer dry periods punctuated by heavy rainstorms are the same conditions that can set the stage for more frequent West Nile virus outbreaks.

IMPACTS ON COASTAL COMMUNITIES

Rhode Island's coastline spans estuaries, salt marshes, and wildlife preserves, and its many coastal parks are prized for family beach outings and recreational boating. From ecologically vital wetlands to critical infrastructure to waterfront homes, much of this coastline is exceptionally vulnerable to sea-level rise. Indeed, some major insurers have withdrawn coverage from thousands of homeowners in coastal areas across the Northeast in recent years.

Coastal flooding. Rising sea levels caused by global warming are projected to increase the frequency and severity of damaging storm surges and coastal flooding along the Northeast coast. Just across Buzzards Bay, what is now considered a once-in-a-century

iStockphoto.com/Ed Halley

Beaches, such as these on Block Island, will become increasingly vulnerable to erosion as sea level rises, and neighboring homes will become more vulnerable to coastal flooding.

coastal flood in Woods Hole, MA (one of five sites analyzed in this study) is expected to occur as frequently as once every 21 years, on average, by late-century if the lower-emissions scenario prevails and once every nine years, on average, under the higher-emissions scenario. Rhode Island has a lengthy history of protecting itself against the sea, but the extra stresses created by sea-level rise and more frequent and extensive flooding can be expected to severely tax both new and aging infrastructure and threaten vulnerable coastal communities across the state.

Shoreline change. Sea-level rise is expected to permanently inundate certain low-lying coastal areas and dramatically accelerate erosion, particularly on important barrier beaches such as East Beach and Misquamicut State Beach. Continued sea-level rise will also threaten the state's ecologically important salt marshes and estuaries, which serve as critical feeding grounds for migrating waterfowl and other birds, and nursery habitat for important commercial fish.

Rhode Island policy makers will need to take steps to protect the state's vulnerable populations and infrastructure, as well as wildlife and critical coastal wetlands. This includes public education, updating and enforcing building codes and land-use regulations, and working with the insurance industry to effectively protect property and people.

IMPACTS ON FISHERIES

Clambakes and lobster feasts are synonymous with summer in Rhode Island. The state's lobster catch totaled more than 1,900 metric tons in 2005, bringing in $23 million to the state economy. Global warming is expected to take a serious toll on this already declining shellfish population: lobster stocks in Rhode Island's nearshore waters are expected to collapse entirely as the maximum heat-stress threshold for lobster is consistently exceeded by mid-century under either emissions scenario.

IMPACTS ON AGRICULTURE

From the Blackstone Valley to the fertile soils of the coastal lowlands, Rhode Island growers harvest some of the region's finest potatoes, fruits, and vegetables. More than 800 Ocean State farms produced $51 million in agricultural sales in 2005. Global warming will present both opportunities and challenges to Rhode Island's growers and producers; for example, increases in the frequency of short-term drought (see p.2) could necessitate increased irrigation and operational costs, while a longer growing season could benefit those farmers invested in warmer-weather crops.

Rhode Island fruit growers produce an abundance of high-value fruit crops, many of which require a certain number of hours each winter of adequately cold temperatures for optimal flowering and fruit development. By mid-century under the higher-emissions scenario, the winter chilling requirements of blueberries, raspberries, cranberries, and certain varieties of apples (e.g., McIntosh, Empire) would not be met across most of the state. Under the lower-emissions scenario the southern half of the state would, by late-century, become too warm to support these crops.

WHAT WE CAN DO

From the historic status of the Blackstone River Valley as the birthplace of America's Industrial Revolution to Newport's modern-day role as an international sailing mecca, Rhode Island has a legacy of outsized contributions to our nation's fortune. Today, the Ocean State is poised to continue this legacy by leading the effort to reduce heat-trapping emissions and combat the dangerous effects of global warming. By reducing emissions today, we have an opportunity to help protect our children and grandchildren from the most severe consequences of global warming. At the same time, effective adaptation strategies are needed to help reduce the vulnerability of Rhode Island's residents, ecosystems, and economies to those changes that are now unavoidable.

Here in Rhode Island, the Northeast, and around the world, there is growing momentum to meet the climate challenge. Of course our actions alone will not be sufficient to avoid dangerous climate change, but Rhode Island (and the rest of the Northeast) is well positioned to help drive national and international progress. Concerted, sustained

efforts to reduce emissions in the region—on the order of 80 percent below 2000 levels by mid-century and just over 3 percent per year on average over the next several decades—can help pull global emissions below the lower-emissions scenario described here.

State and local governments have a rich array of strategies and policies at their disposal to meet the climate challenge in partnership with other states, businesses, civic institutions, and the public. These strategies and policies can reduce emissions in the following sectors:

Save the Bay

The Save the Bay headquarters in Providence won an EPA prize for brownfield development and includes solar panels and a "green" roof.

Electric power. Legislation enacted with broad support in 2007 positions Rhode Island to make great strides in implementing its state Climate Change Action Plan and achieving substantial emissions reductions. Key provisions include requirements that utilities prioritize cost-effective energy-efficiency gains over new electricity supply and that the state auction 100 percent of the emissions permits created under the Regional Greenhouse Gas Initiative (RGGI), a multi-state effort to reduce heat-trapping emissions from power plants. These proceeds should provide substantial resources to invest in energy efficiency and renewable energy development. Governor Carcieri's call to raise the state's renewable electricity standard to a target of 20 percent by 2011 could help create jobs and enhance the diversity and security of Rhode Island's energy supply.

Buildings. Rhode Island's relatively old stock of residential, commercial, and industrial buildings offers substantial opportunities to reduce emissions associated with water and space heating. The state can support stronger enforcement of building energy codes, while local governments can amend zoning laws to encourage and/or require new construction and substantial renovation projects to achieve the U.S. Green Building Council's LEED certification and/or energy-efficiency levels that qualify for the EPA's Energy Star Building designation.

Transportation. Cars and trucks are the largest and fastest-growing source of Rhode Island's heat-trapping emissions, accounting for nearly 40 percent of the state total. The state has adopted California's tailpipe emissions standards, which require reductions of approximately 30 percent below 2002 levels by 2016, beginning with the 2009 model year (implementation is contingent upon a ruling expected from the EPA). State and local governments can further reduce vehicle emissions through sustained investment in public transit (with a focus on achieving new ridership targets), incentives to purchase low-emissions vehicles, and incentives and regulations that promote "smart growth" strategies such as concentrating development near existing downtowns and public transportation routes. In addition, Rhode Island can adopt standards to reduce the carbon content of fuels.

CONCLUSION

Global warming represents an enormous challenge, but we can meet this challenge if we act swiftly. The emissions choices we make today in Rhode Island, the Northeast, and globally will shape the climate our children and grand-children inherit. The time to act is now.

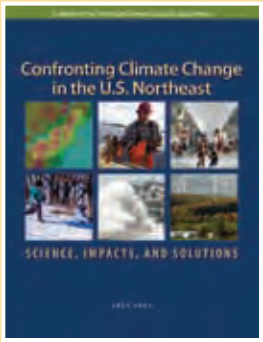
Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

Two Brattle Square
Cambridge, MA 02238
(617) 547-5552

1707 H St. NW, Suite 600
Washington, DC 20006
(202) 223-6133

This summary was prepared by the Union of Concerned Scientists based on *Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions*, a report of the Northeast Climate Impacts Assessment (NECIA, 2007). NECIA is a collaborative effort between the Union of Concerned Scientists and a team of independent scientific experts to assess how global warming may further affect the climate of the U.S. Northeast and to explore options for meeting the climate challenge.

For more information on our changing Northeast climate and what you can do, or to download a copy of the full report and additional state summaries, visit *www.climatechoices.org*.



METHODOLOGY FOR PRIORITIZATION OF QUALIFIED CAPITAL PROJECTS

High Priority

These qualified projects are considered essential and/or impending, and should meet at least five, if not more, of the below listed criteria.

- Comply with a governmental mandate or referendum requirement
- Project has been previously funded as part of the coordinated development of a project
- Removes or reduces threats to public safety
- Promotes energy efficiency and conservation (see Sustainability Goals)
- Improves operational efficiencies and services to customers
- Advances recognized public policy objectives
- Provides relative economic benefits
- Funding availability has been explored and is likely
- Recognizes need to adapt to climate change (see Sustainability Goals)

Medium Priority

These qualified projects would normally meet an essential or important need but may not have to be funded immediately. They normally meet the minimum criteria, listed below.

- Advances recognized public policy objectives
- Maintain or improve standard of service
- Provide relative economic benefits
- Source of funding availability has been explored

Low Priority

These qualified projects may benefit the community but not enough to merit inclusion in the CIP in the upcoming budget year, given other needs, funding limitations, and existence of higher ranking medium and high priority projects.

SUSTAINABILITY GOALS TO BE CONSIDERED FOR PROJECT DEVELOPMENT:

Does the project result in, or can it be designed to:

1) Reduce overall energy use (make facilities more efficient, meet any established goals, energy retrofits)

2) Facilitate transitions to renewable energy (invest in alternatives such as solar, wind, etc.)

3) Help reduce GHG emissions and/or reduction of vehicle trips (bikeways, sidewalks, trails, paths)

4) Adapt to climate change (alternative location decisions to avoid floodplains, elevate roads, move facilities, protect assets, etc.)

5) Retention of landscaping, reduction of impervious surfaces, innovative stormwater management methods, etc.

A Quick Assessment of Your Community

Where do you think your community might experience the highest impacts(s) from climate change?

Natural Resources (rivers, wetlands, aquatic species…)

Built infrastructure (bridges, roads, stormwater system, wastewater treatment plant, buildings…)

Public Services (water supply, parks and recreation, health services…)

Cultural Resources (tribal lands, places of historical interest...)

Local Economy (fisheries, shellfish, tourism…)

Taking Action….

List one thing that could be done to make your community less at risk:

How would you describe the time frame for implementation:

___ 1 year ___ 2 years ___ 3 years ___ 5 years ___10 years

Name three groups or individuals who would need to be involved in the climate planning discussion:

1.

2.

3.

How would you best engage them?

Describe one next step that you could take:

How would you measure the effectiveness of this action?

Attendance List

Planning For Community Climate Change Adaptation

October 28, 2010, 8:30 a.m. to 4:00 p.m.

RI DEM, Providence, RI

Last Name	First Name	Affiliation	Email
Anders	Rosalie	City of Cambridge, MA	randers@cambridgema.gov
Austin	Jane	Save The Bay	jaustin@savebay.org
Bergantino	Benny	RI Statewide Planning Program	bbergantino@doa.ri.gov
Boardman	Dori	Town of South Kingstown	doriboardman@cox.net
Boyd	Jim	RI CRMC	jboyd@crmc.ri.gov
Bradbury	Erika	Brown University	Erika_Bradbury@brown.edu
Bryer	Lisa	Town of Jamestown	lbryer@jamestownri.net
Calabro	Rachel	Save The Bay	rcalabro@savebay.org
Cameron	Linsey	Town of North Kingstown	lcameron@northkingstown.org
Guimond	Carol	Town of Tiverton	carolaguimond@yahoo.com
Clapp	Alan	Clapp Design Group	aclapp1@comcast.net
Dake	Betsy	RI DEM	elizabeth.dake@DEM.RI.GOV
DePasquale Jr.	William	City of Warwick	william.depasquale@warwickri.com
Dottai	Deanna	Brown University	Deanna_Dottai@brown.edu
England	Kate	Brown University	Kate_England@brown.edu

Ericson	Bob	Town of North Smithfield	rericson@nsmithfieldri.org
Everett	Dave	City of Providence	Deverett@providenceri.com
Ferguson	Wenley	Save The Bay	wferguson@savebay.org
Flood	Vin	RI Statewide Planning Program	vflood@doa.ri.gov
Freedman	Janet	RI CRMC	jfreedman@crmc.ri.gov
Fultz	Bob	Town of Hull, Ma	rfultz@town.hull.ma.us
Gennaro	Gale	Providence College	ggennaro@providence.edu
Gonsalves	Paul	RI Statewide Planning Program	pgonsalves@doa.ri.gov
Good	Alicia	RI DEM	alicia.good@dem.ri.gov
Gray	Pete	Bay Spring Community Center	pgray@whydata.com
Greenberg	Jed	The Apeiron Institute for Sustainable Living	Jed@apeiron.org
Herbst	Anne	Town of Hull, MA	aherbst@town.hull.ma.us
Hirschfeld	Daniella	ICLEI- Local Governments for Sustainability	daniella.hirschfeld@iclei.org
House	June	City of Newport	jhouse@cityofnewport.com
Hyde	Bruce	University of Connecticut	bruce.hyde@uconn.edu
Kammerer	Thomas	City of Newport	tkammerer@hotmail.com
Koehler	Christa	Clean Air-Cool Planet ®	ckoehler@cleanair-coolplanet.org
Kotin	Adam	Brown University	Adam_Kotin@brown.edu
LaChance	Jim	Brown University	james_lachance@brown.edu
Marinosci	Sal	Town of Little Compton	salmarinosci@gmail.com

Martinez	Taryn	Brown University	Taryn_Martinez@brown.edu
McCue	Colleen	Narragansett Bay Research Reserve	colleen@nbnerr.org
Moniz	Peter	Town of Tiverton	pmmoniz@cox.net
Murphy	Mike	Town of Groton, CT	MMurphy@town.groton.ct.us
Nelson	Kevin	RI Statewide Planning Program	knelson@doa.ri.gov
Newton	David	Blackstone River Watershed Council	davidj1957@cox.net
Paquet	Jen	Town of West Greenwich	jrpaquet@wgtownri.org
Patenaude	Bill	RI DEM	bill.patenaude@dem.ri.gov
Poepping	Nicole	Providence Environmental Sustainability Task Force	npoepping@cleanwater.org
Poyer	Denise	Wood-Pawcatuck Watershed Association	denisep@wpwa.org
Prescott	David	Save The Bay	dprescott@savebay.org
Presley	Fred		frederickpresley@gmail.com
Reiner	Jon	Town of North Kingstown	JReiner@northkingstown.org
Rhodes	Jared	RI Statewide Planning Program	jrhodes@doa.ri.gov
Ribb	Richard	Narragansett Bay Estuary Program	rribb@gso.uri.edu
Riccitelli	Joanne	South Kingstown Land Trust	Joanne.Riccitelli@sklt.org
Roberts	Timmons	Brown University	j_timmons_roberts@brown.edu
Rubinoff	Pam	RI Sea Grant	rubi@crc.uri.edu
Shellman	Marilyn	Town of Westerly	mshellman@westerly.org
Sherrill	Pam	Town of Johnston	planner@johnston-ri.us;

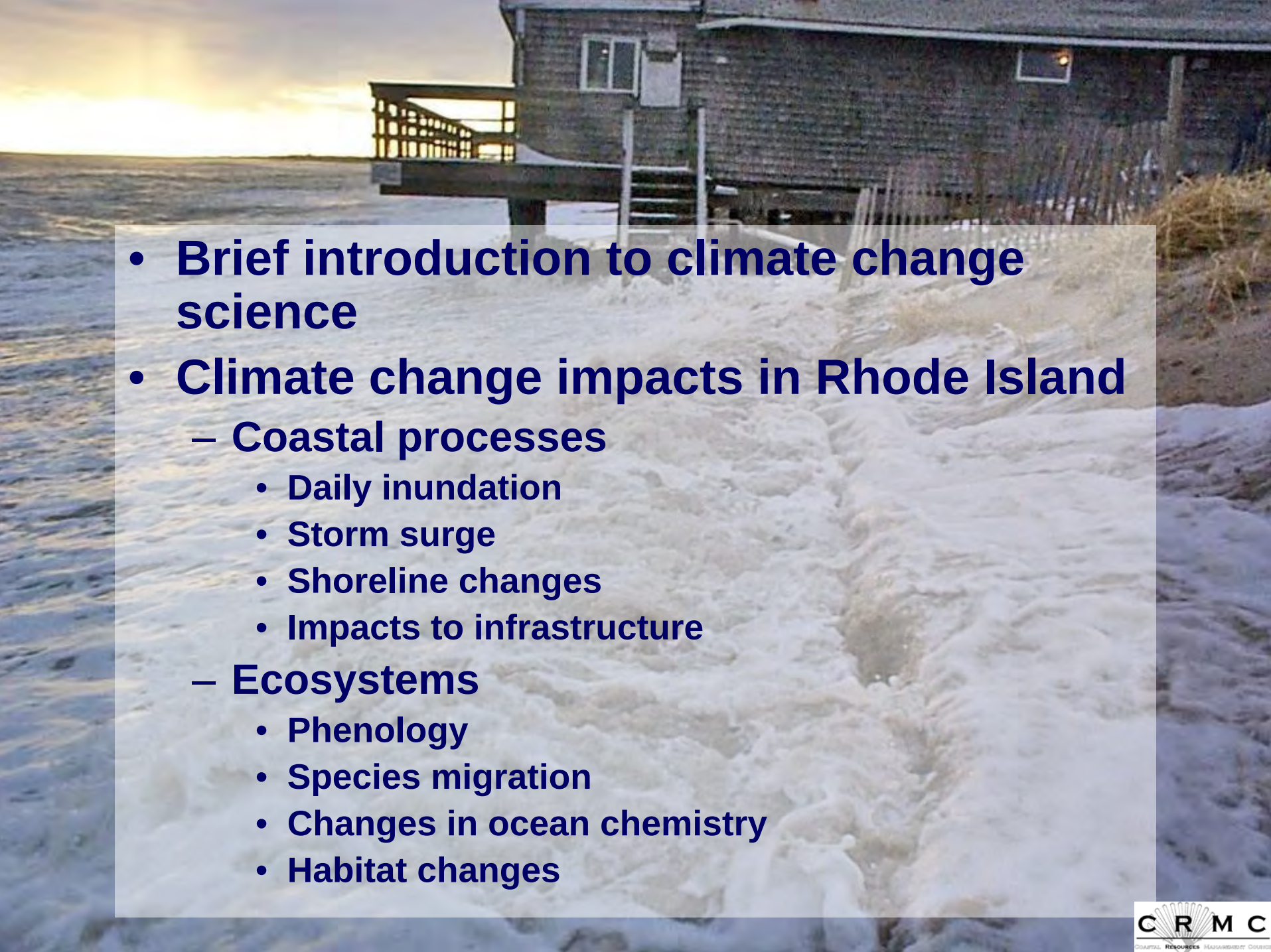
Smith	Rian	Town of Johnston	rian.smith@verizon.net
Steers	Mike	Town of Little Compton	amsteers@gmail.com
Stetson	Denise	Town of Richmond	townplanner@richmondri.com;
Stone	Jonathan	Save The Bay	jstone@savebay.org
Vallee	Dave	National Weather Service	David.Vallee@noaa.gov
Watka	Lauren	Brown University	Lauren_Watka@brown.edu
Weidman	Jane	Town of New Shoreham	janeweid@aol.com
West	Jennifer	Narragansett Bay Research Reserve	jennifer@nbnerr.org
Wolanski	Ron	Town of Middletown	rwolanski@middletownri.com
Wyatt	Sandra	Barrington Land Trust	swyatt9@cox.net

Changing Climate Changing Future

Climate Change Impacts to Rhode Island and Supporting Science

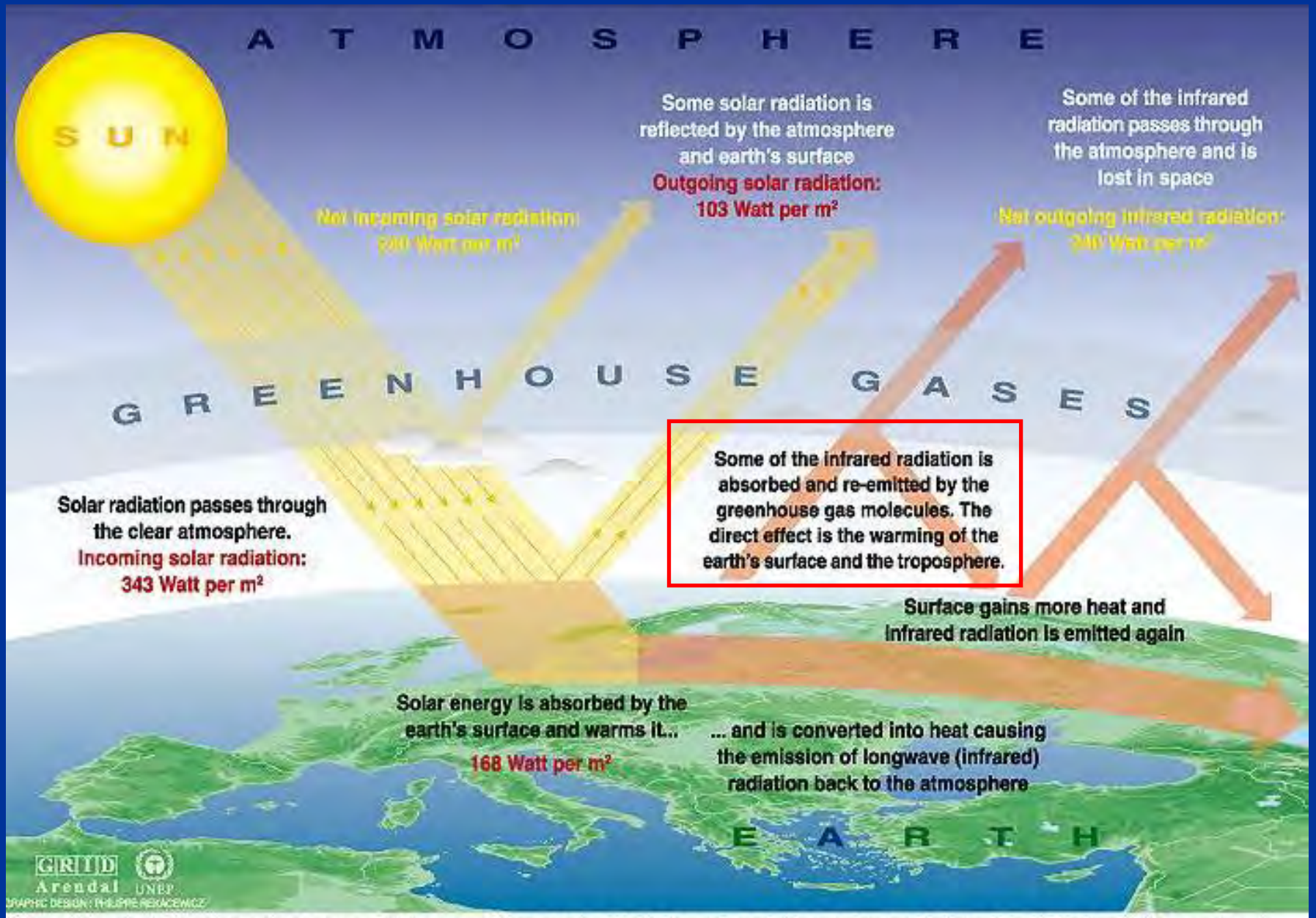
Planning for Community Climate Change Adaptation
Narragansett Bay Estuarine Research Reserve
October 28, 2010
Providence, RI

CRMC
Coastal Resources Management Council



- Brief introduction to climate change science
- Climate change impacts in Rhode Island
  - Coastal processes
    - Daily inundation
    - Storm surge
    - Shoreline changes
    - Impacts to infrastructure
  - Ecosystems
    - Phenology
    - Species migration
    - Changes in ocean chemistry
    - Habitat changes

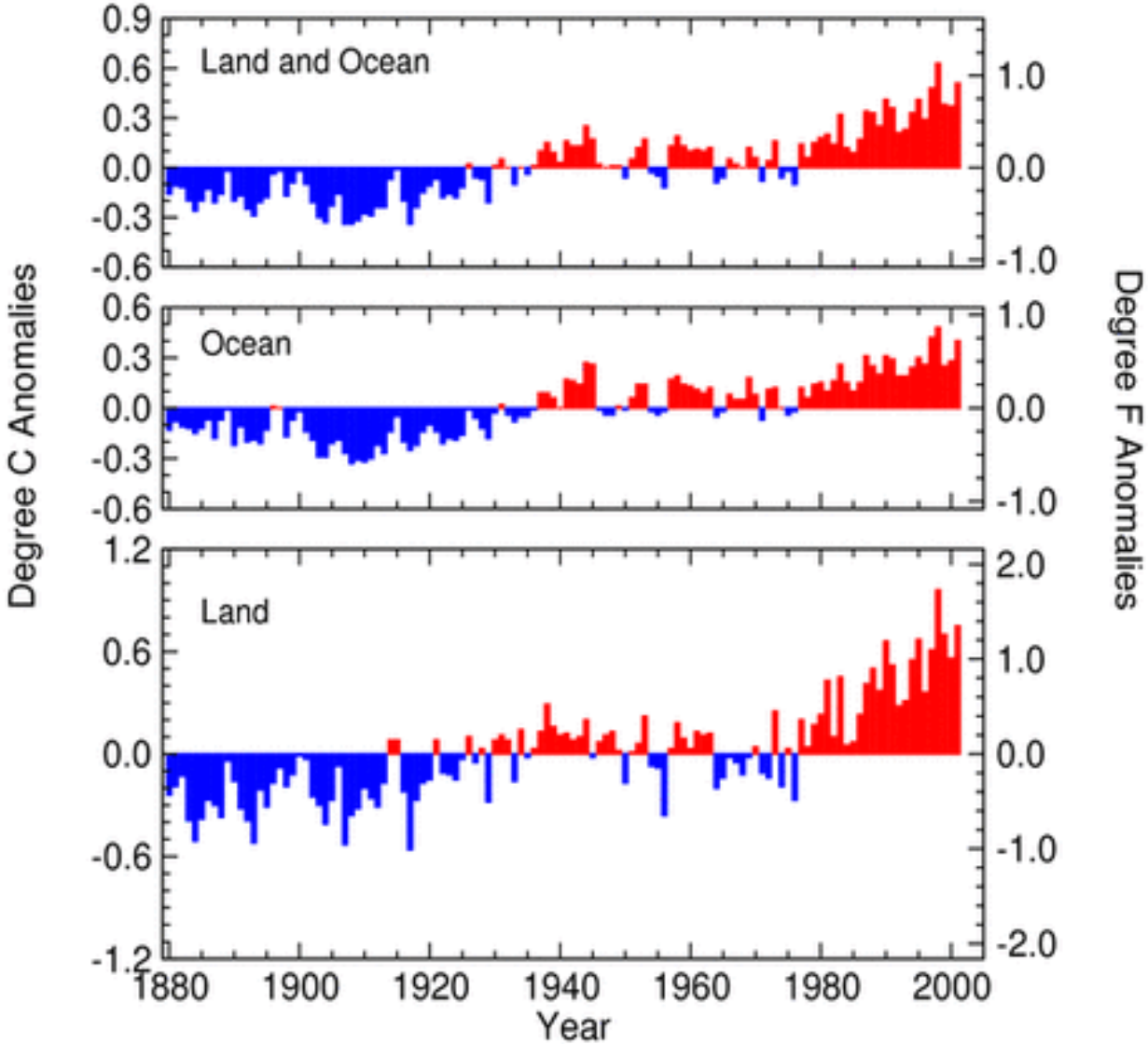
GREENHOUSE EFFECT

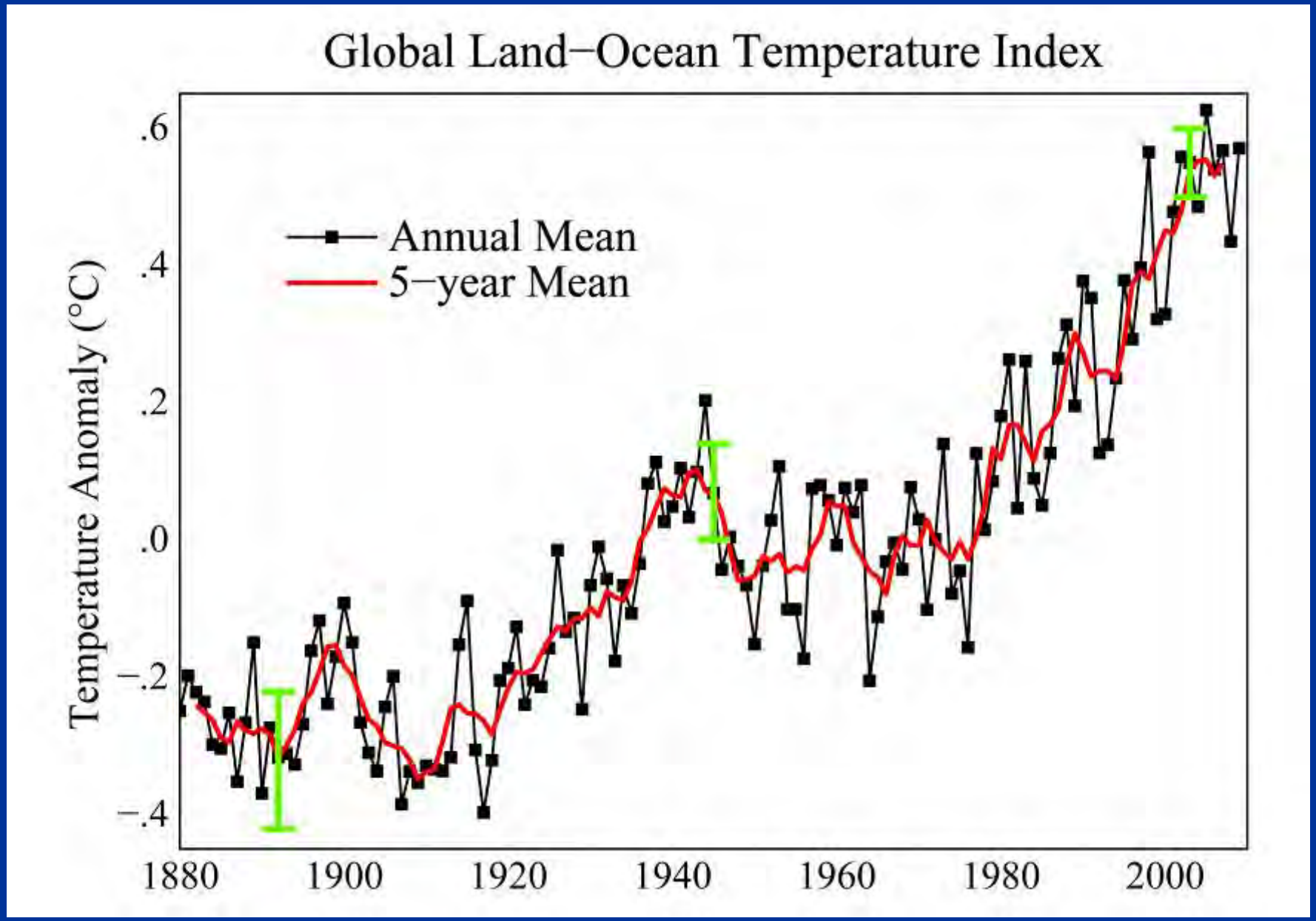


Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

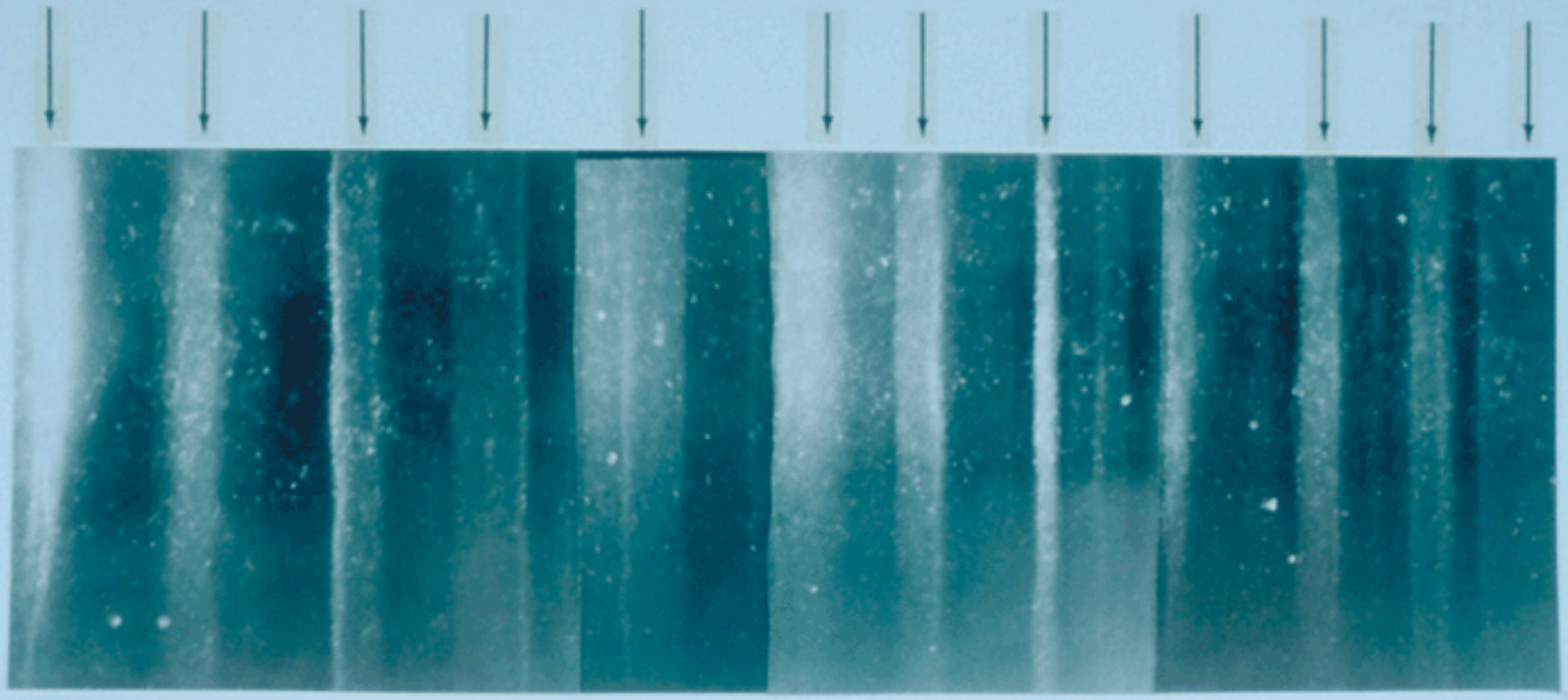
Jan - Dec Global Surface Mean Temp Anomalies

National Climatic Data Center/NESDIS/NOAA

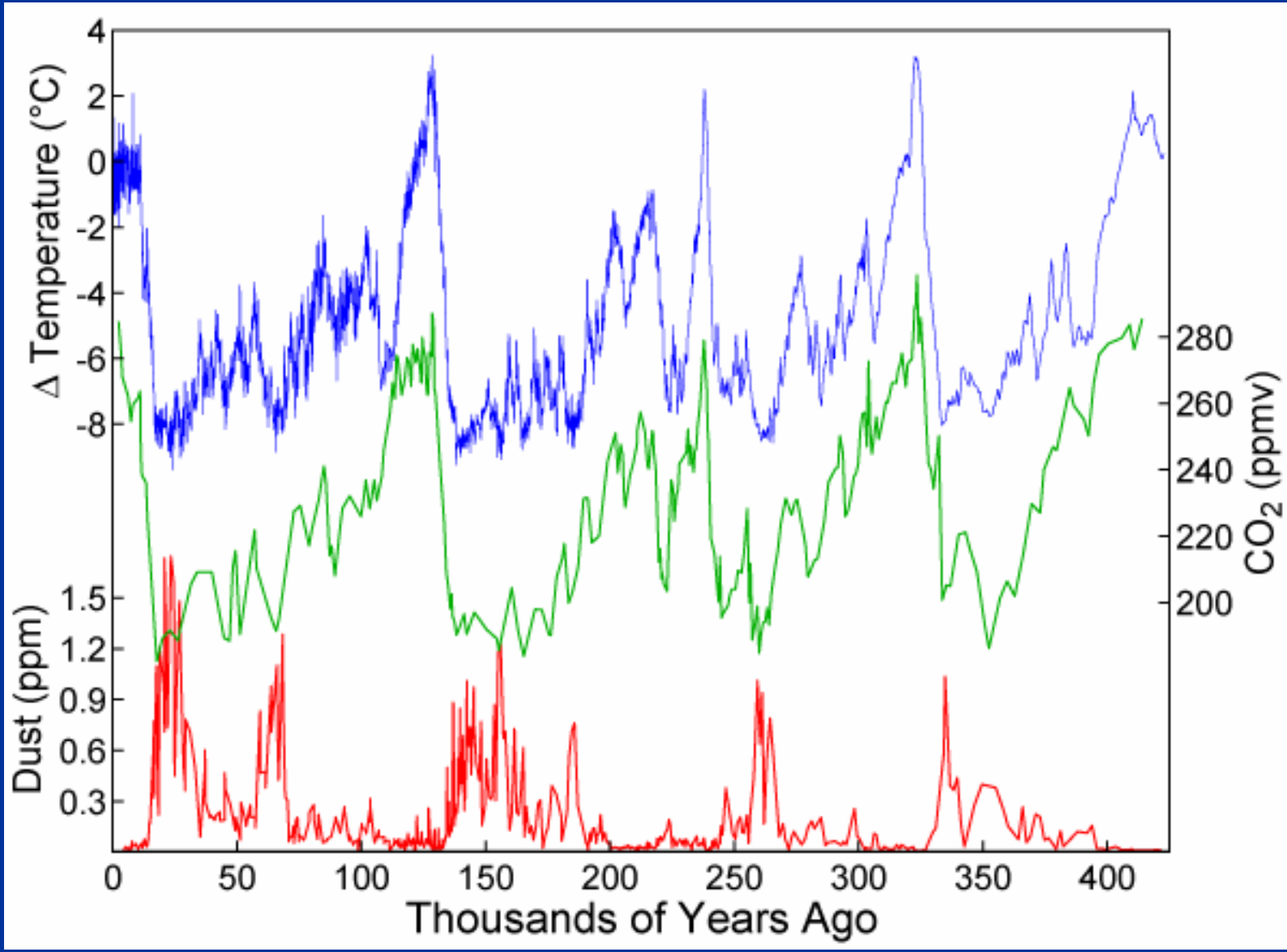




http://www.giss.nasa.gov/research/news/20100121/418335main_land-ocean-full.jpg



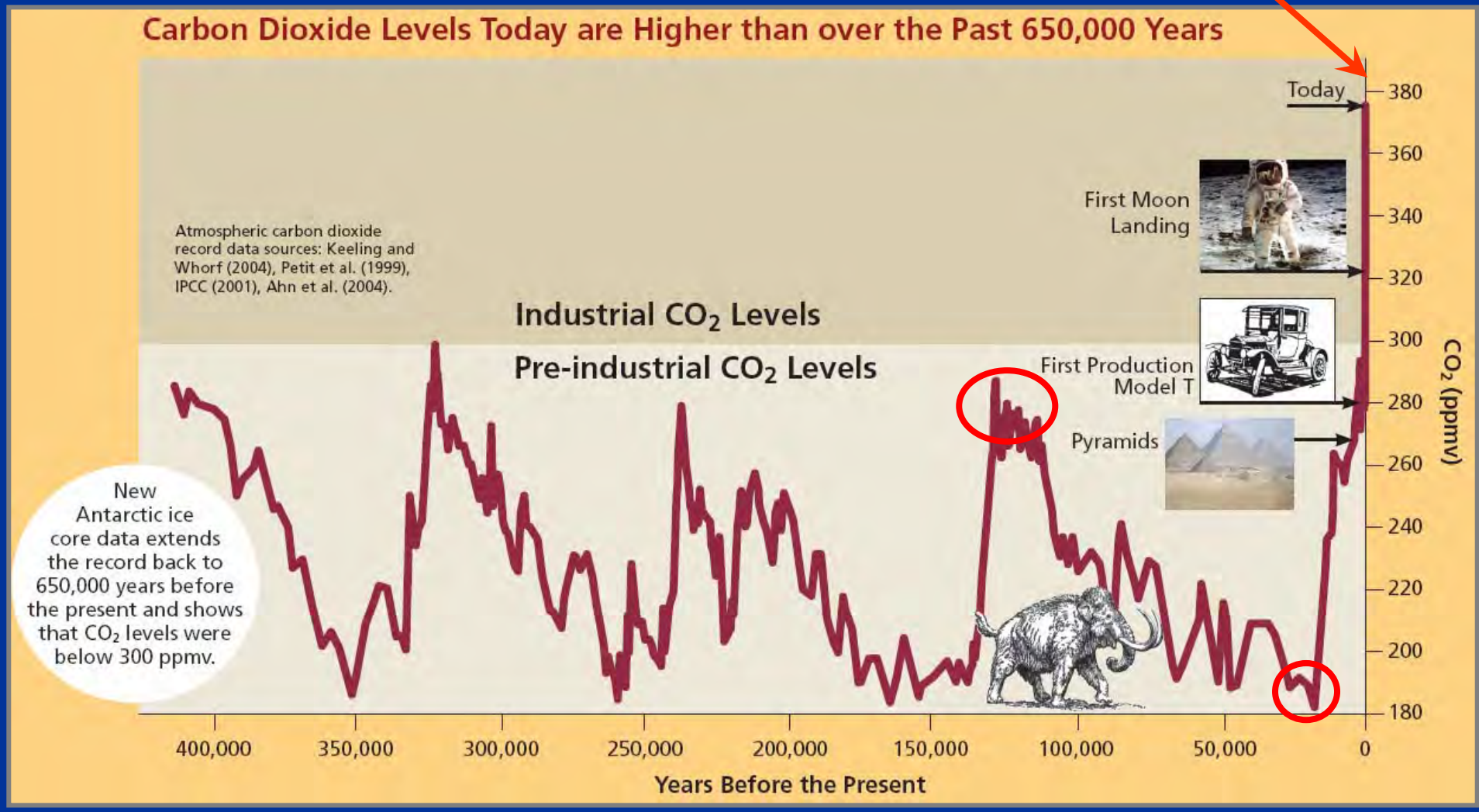
19 cm long section of GISP 2 ice core from 1855 m showing annual layer structure illuminated from below by a fiber optic source. Section contains 11 annual layers with summer layers (arrowed) sandwiched between darker winter layers.



Graph of CO2 (green), reconstructed temperature (blue) and dust (red) from the Vostok ice core for the past 420,000 years

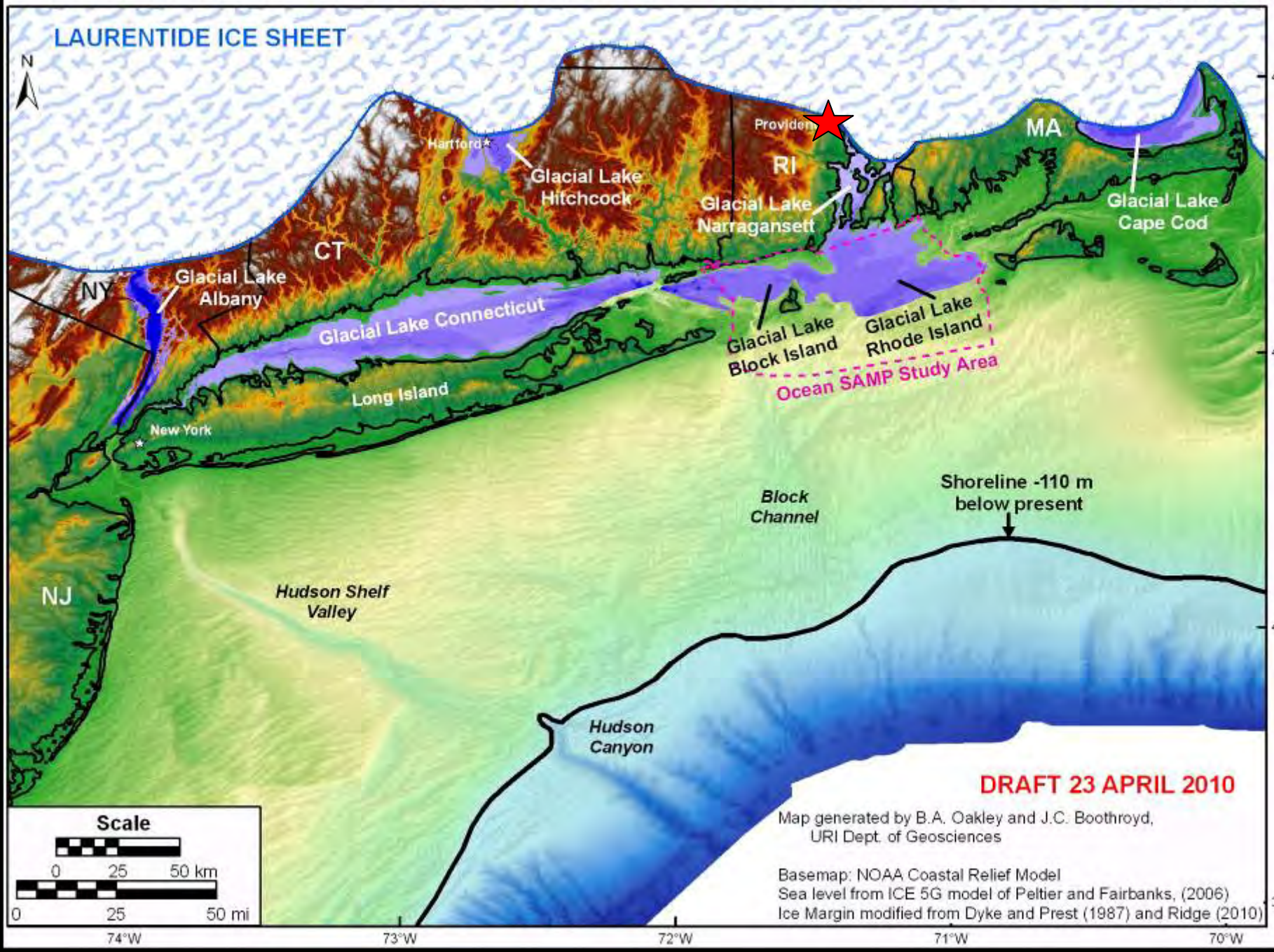
Carbon Dioxide - CO_2 – Levels
A Cause for Concern

Now 388+ ppm

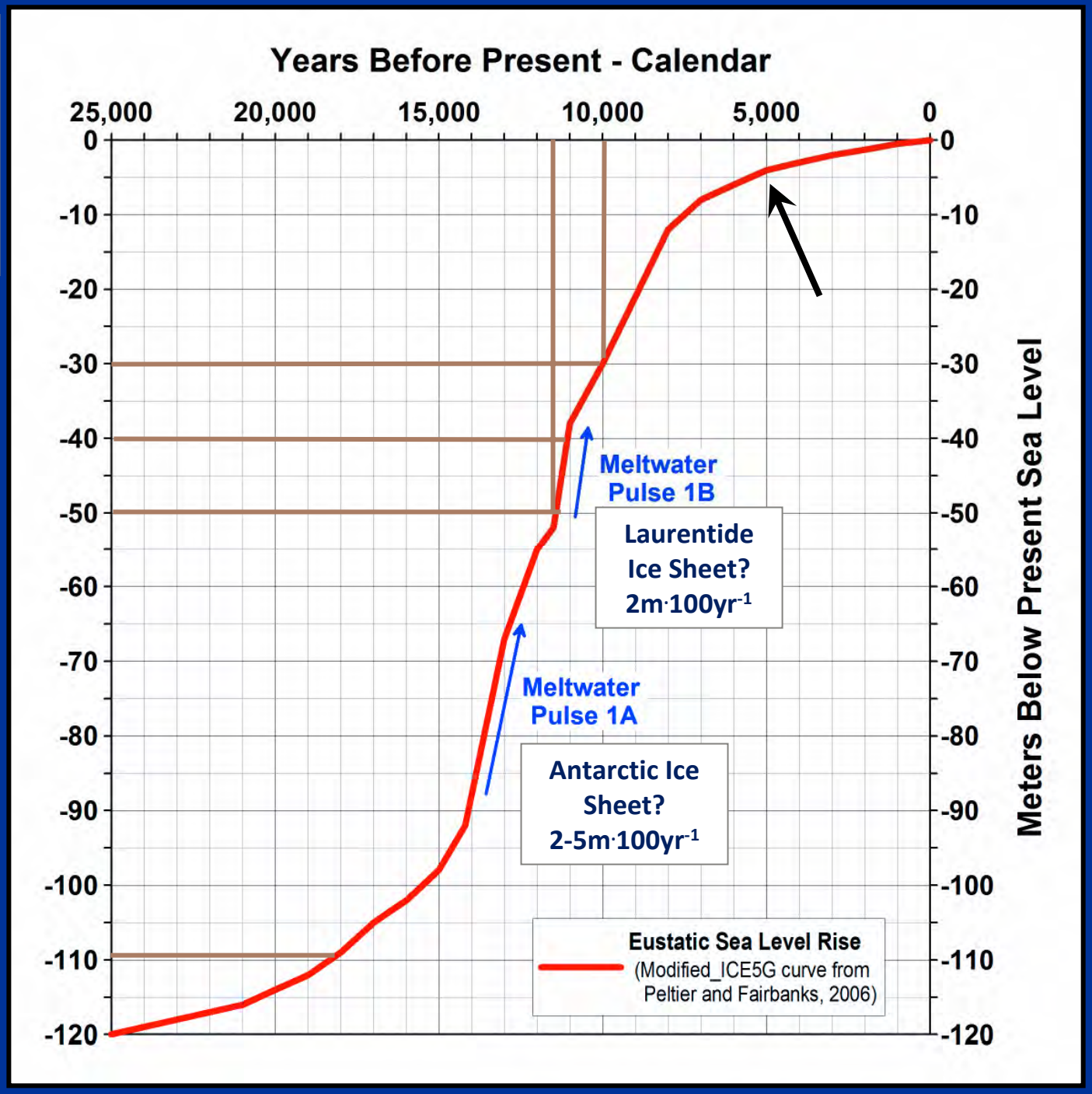


http://www.ucsusa.org/global_warming/science_and_impacts/science/past-present-and-future.html#3

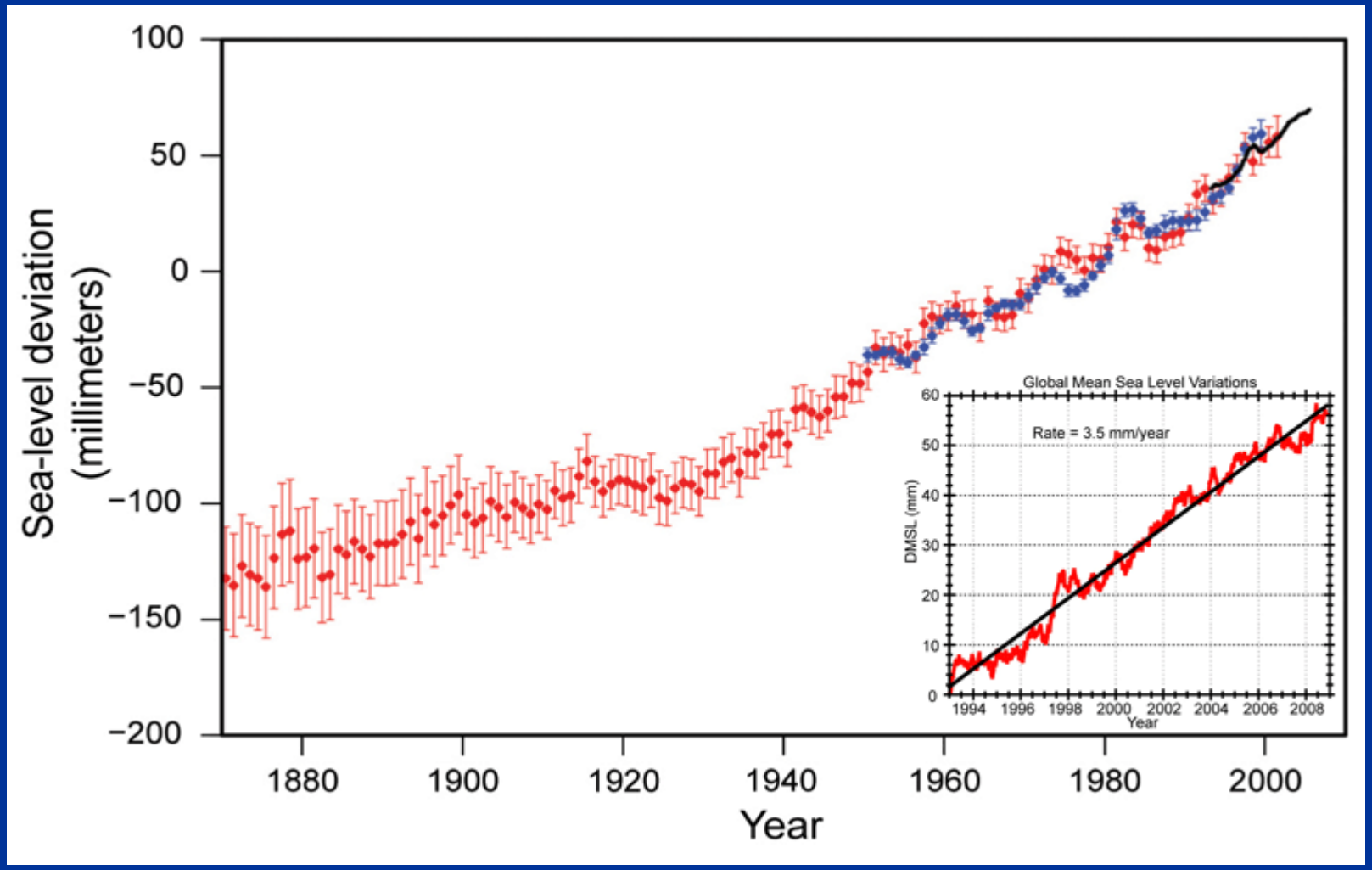
PALEOGEOGRAPHIC MAP OF THE SOUTHERN NEW ENGLAND CONTINENTAL SHELF 18,000 yBP



Eustatic Sea-Level Rise

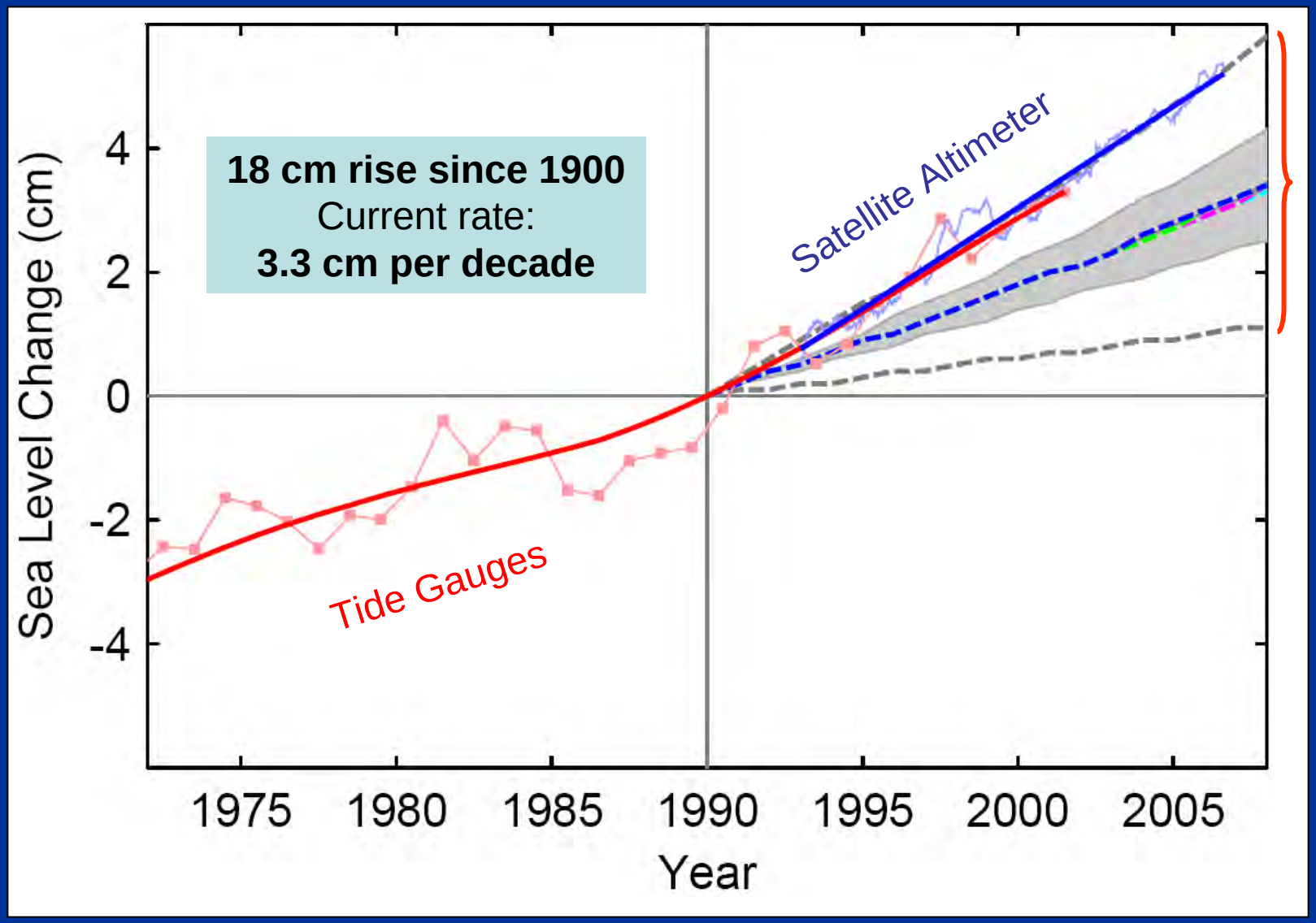


Courtesy of Jon Boothroyd



Annual averages of global sea level. Red: sea-level since 1870; Blue: tide gauge data; Black: based on satellite observations. The inset shows global mean sea level rise since 1993 - a period over which sea level rise has accelerated

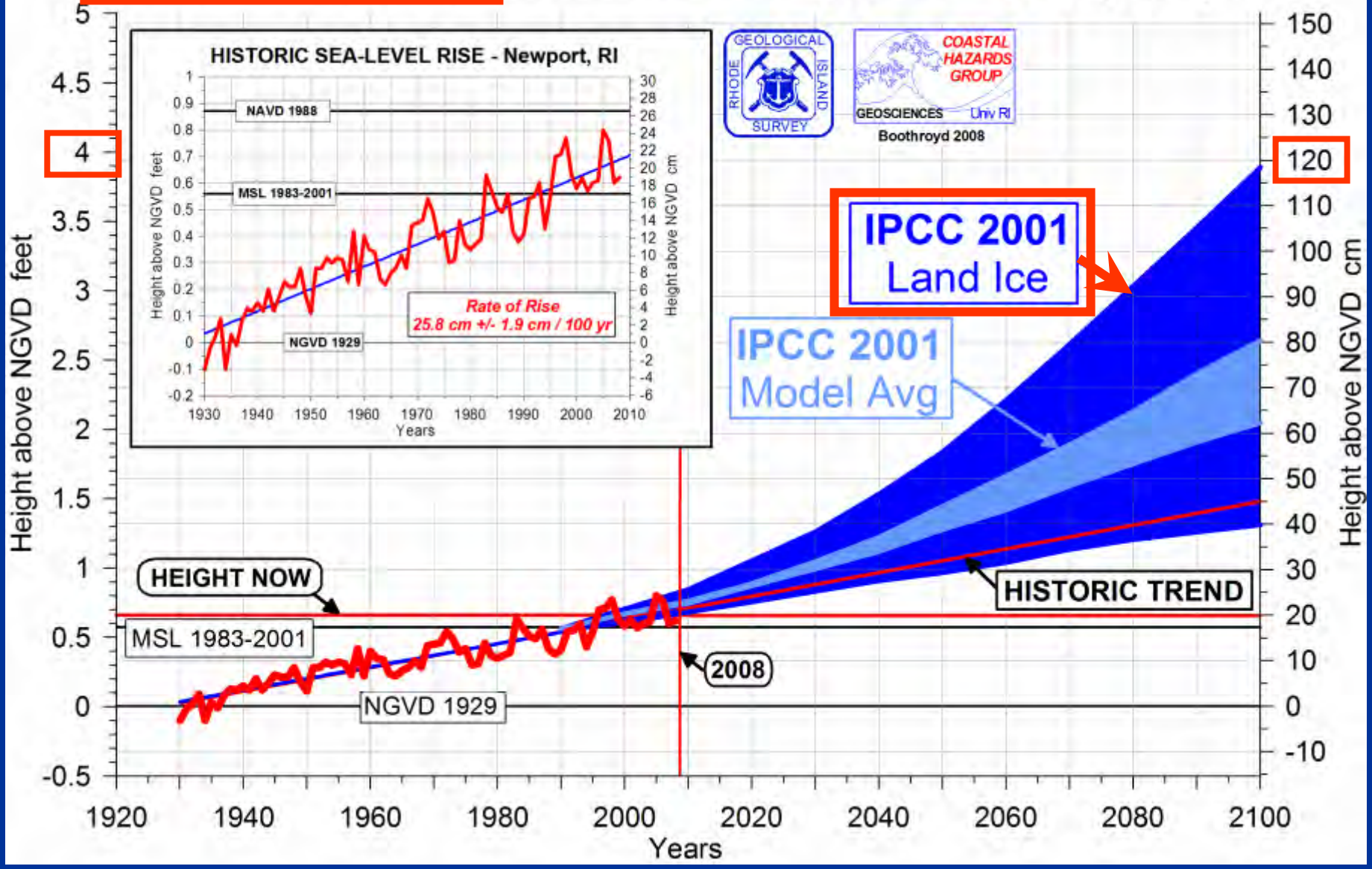
OBSERVED GLOBAL SEA LEVEL RISE



IPCC 2001 estimate

Rahmstorf, Cazenave, Church, Hansen, Keeling, Parker and Somerville (Science 2007)

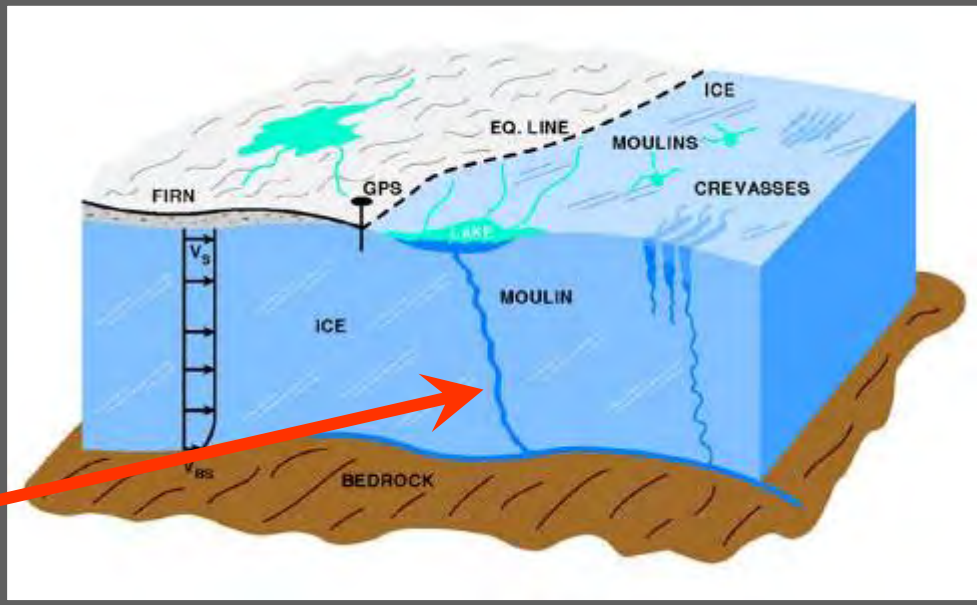
ACCELERATED SEA-LEVEL RISE - Newport, RI



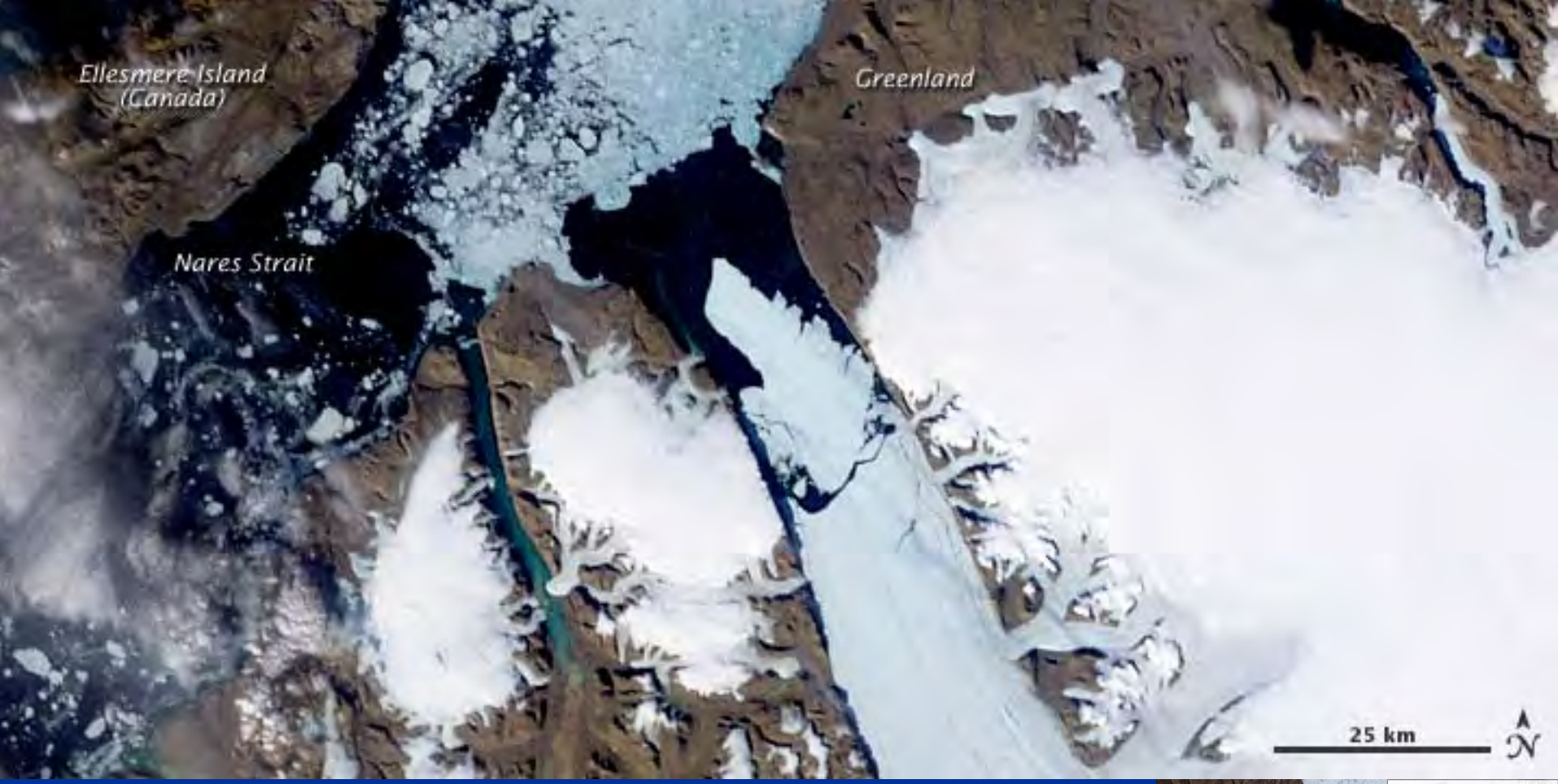
Courtesy of Jon Boothroyd

Greenland Outlet Glaciers Changing from Polythermal to Warm Based

A Key to Future Sea-Level Rise

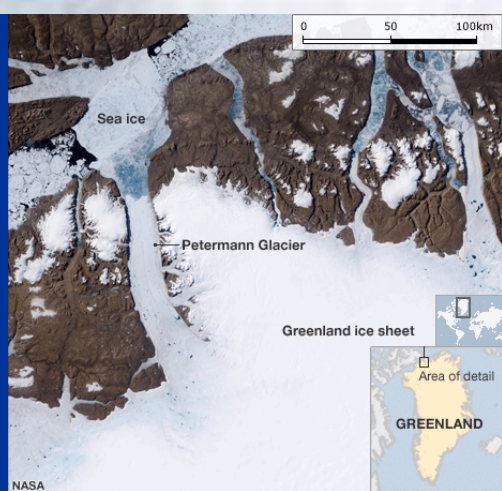


Brathwaite, 2002



Peterman Glacier August 5, 2010 - NASA

A chunk of ice, roughly 97 square miles (251 square kilometers) broke off the Petermann Glacier along the northwestern coast of Greenland



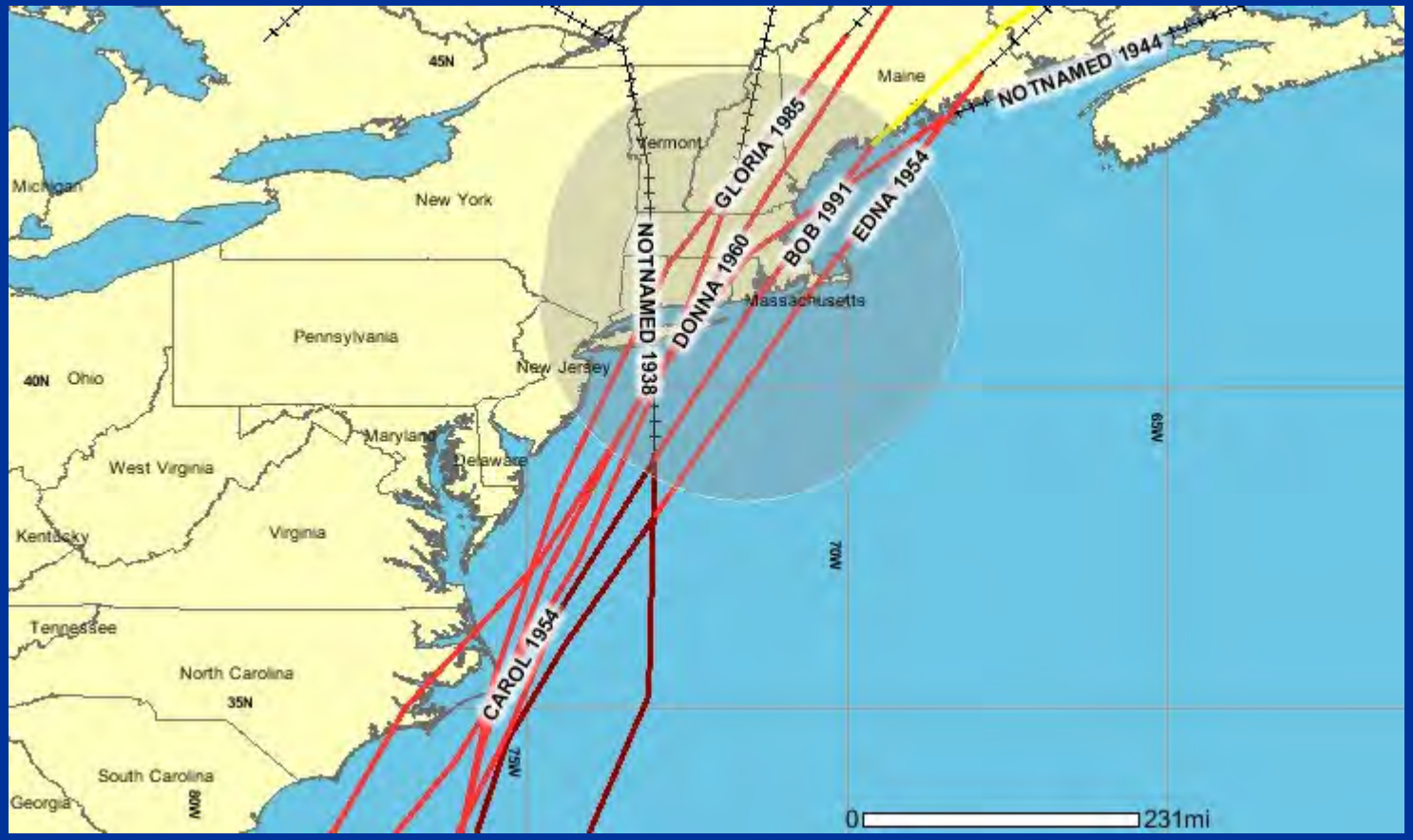
Inundation

Lands susceptible to 3 feet of sea level rise - Quonochontaug Pond, Charlestown, RI.
Vinhateiro, 2008

Inundation

Lands susceptible to 5 feet of sea level rise - Quonochontaug Pond, Charlestown, RI.
Vinhateiro, 2008

Category 2-5 Historic Hurricane Tracks 1850-2007



From: http://maps.csc.noaa.gov/hurricanes/viewer.html

Courtesy of Jon Boothroyd

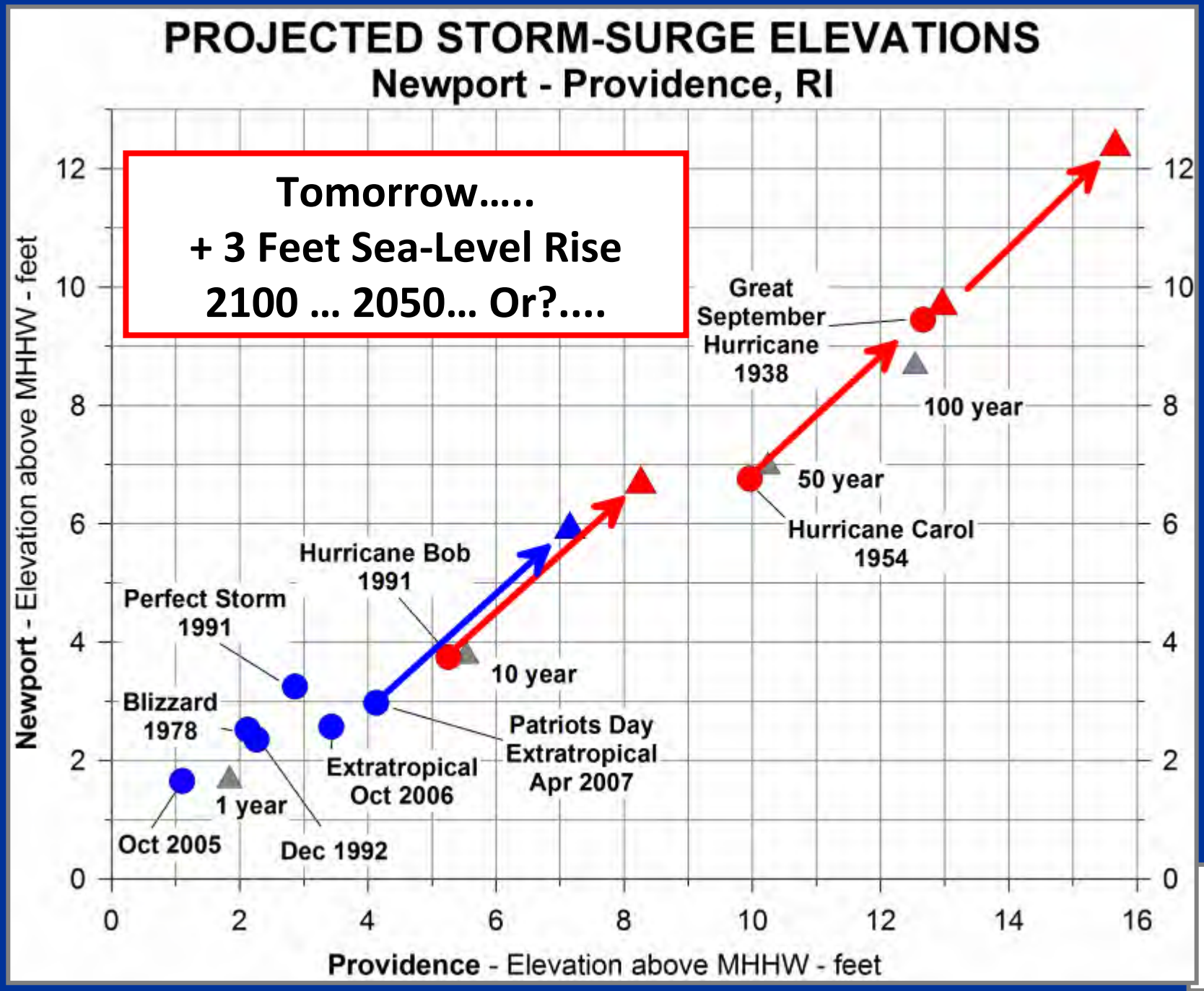
Nor'easters (Extra Tropical Cyclones)

Strong low pressure system that affects the Mid-Atlantic and New England states.

Heavy snow, rain, storm surge and waves

Wind gusts associated with these storms can exceed hurricane force in intensity.

Coastal Erosion



Adapted from NOAA; USACE 1988; Hehre 2007

Climate Change Impacts to Coastal Resources

- Wetlands:
  - Saltmarsh drowning/squeazing
  - Introduction of new pathogens, invasive species
  - Increased stress on eelgrass beds with higher water temperatures
- Fisheries:
  - Shifting habitat
  - Increased stress on species with higher water temperatures
  - Ocean acidification

Questions?

Janet Freedman
jfreedman@crmc.ri.gov
www.crmc.ri.gov

Planning For Climate Change

Climate Change Impacts Session

David R. Vallee
Hydrologist-in-Charge
NWS/Northeast River Forecast Center
http://weather.gov/nerfc

Providence Street – West Warwick, RI at 1030 am Wednesday 3/31/10

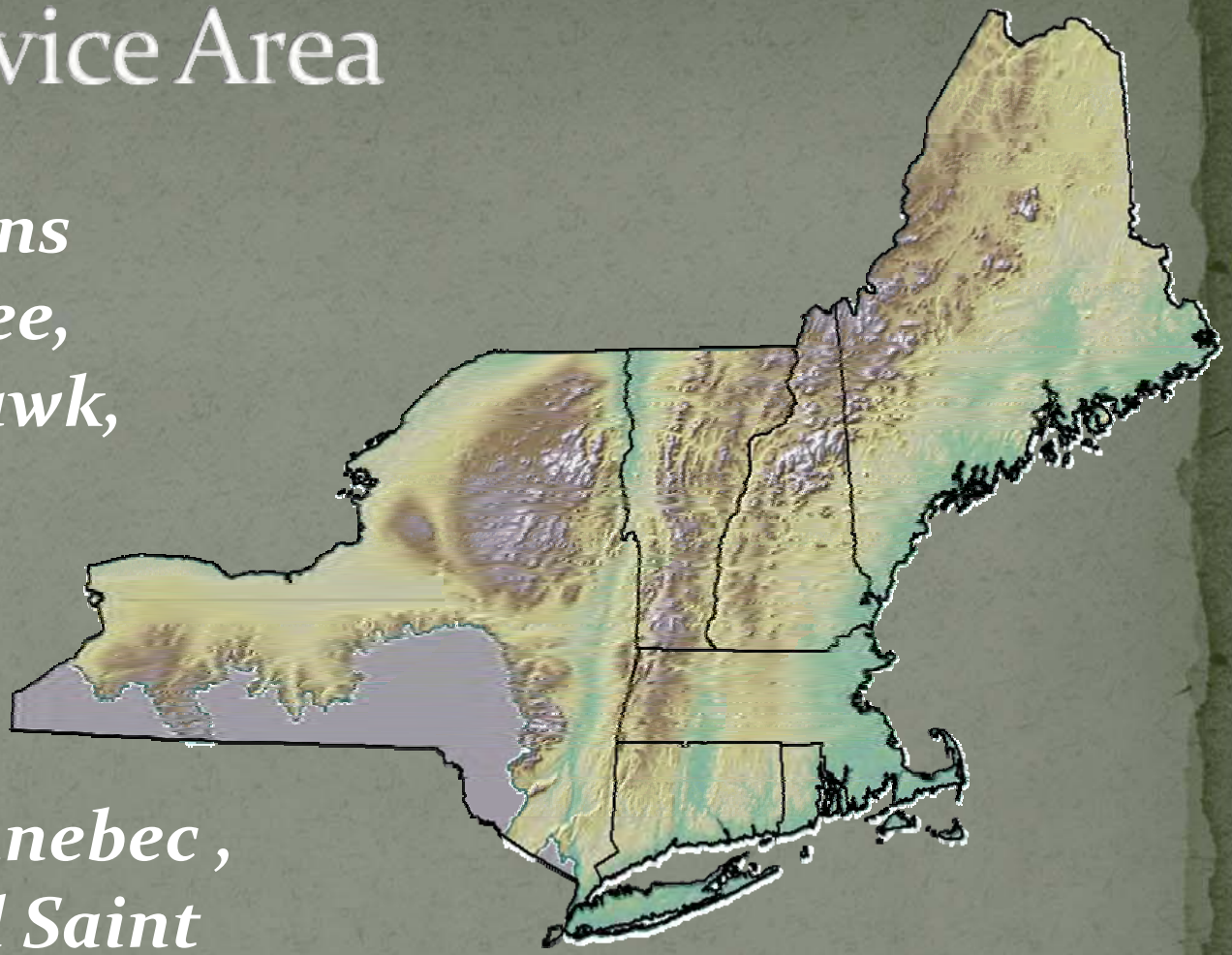
Outline

- A bit about the Northeast River Forecast Center
- What ingredients brought us to such a remarkable flood event in March 2010?
- A few historical foot-notes
- What does this all mean in light of climate change scenarios?

NERFC Service Area

Major river basins include Genesee, Hudson, Mohawk, Housatonic, Connecticut, Merrimack , Blackstone, Pawtuxet, Kennebec , Penobscot and Saint John

~180 forecast points



Staffing profile:

HIC, SCH and DOH

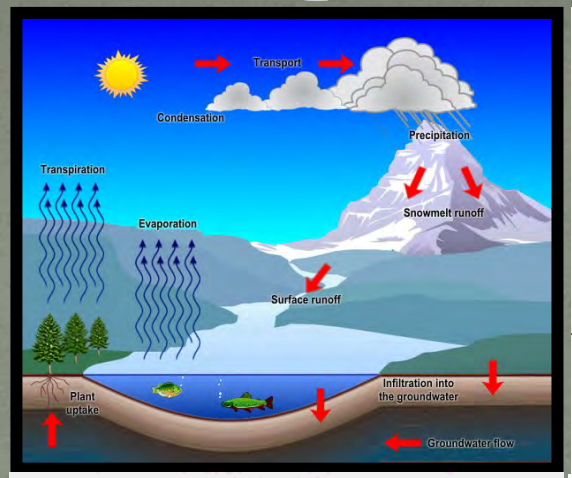
4 Senior Hydrologists & 1 Senior HAS

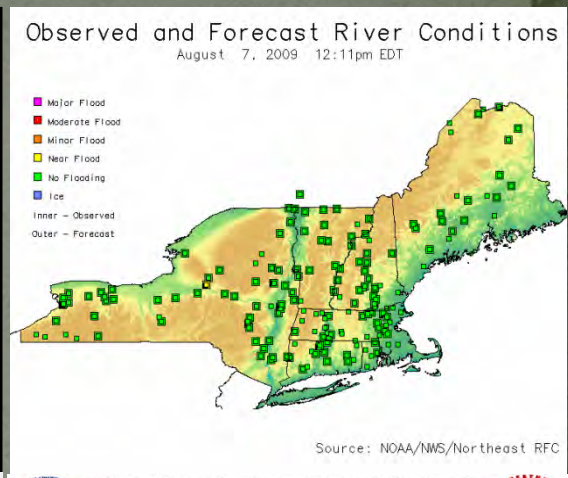
3 Hydrologists & 2 HAS

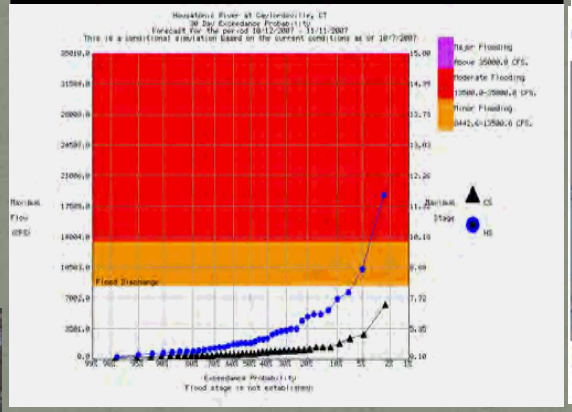
1 ASA/Hydro Tech

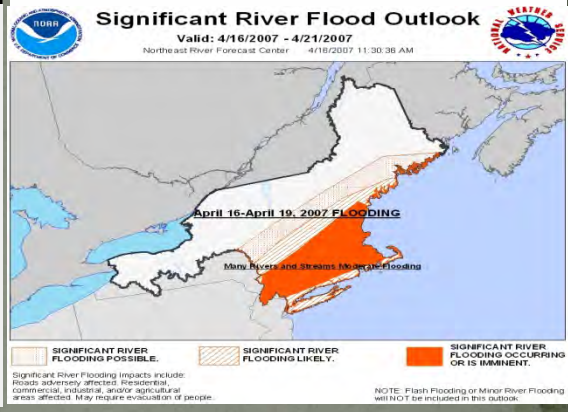
River Forecast Center Responsibilities

- Calibrate and implement a variety of hydrologic and hydraulic models to provide:
  - River flow and stage forecasts at 180 locations
  - Guidance on the rainfall needed to produce Flash Flooding
  - Ensemble streamflow predictions
  - Ice Jam and Dam Break support
  - Water Supply forecasts
  - Partner with NOAA Line Offices to address issues relating to Hazard Resiliency, Water Resource Services, Ecosystem Health and Management, and Climate Change

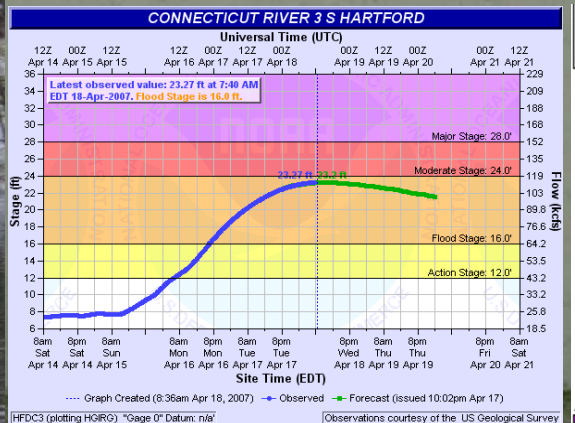


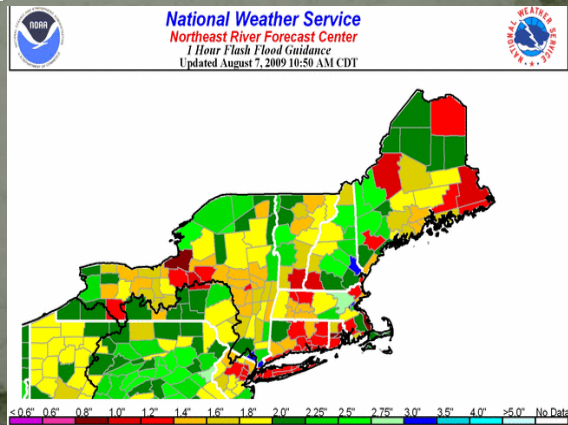






Moderate flooding - Connecticut River at Portland, CT.





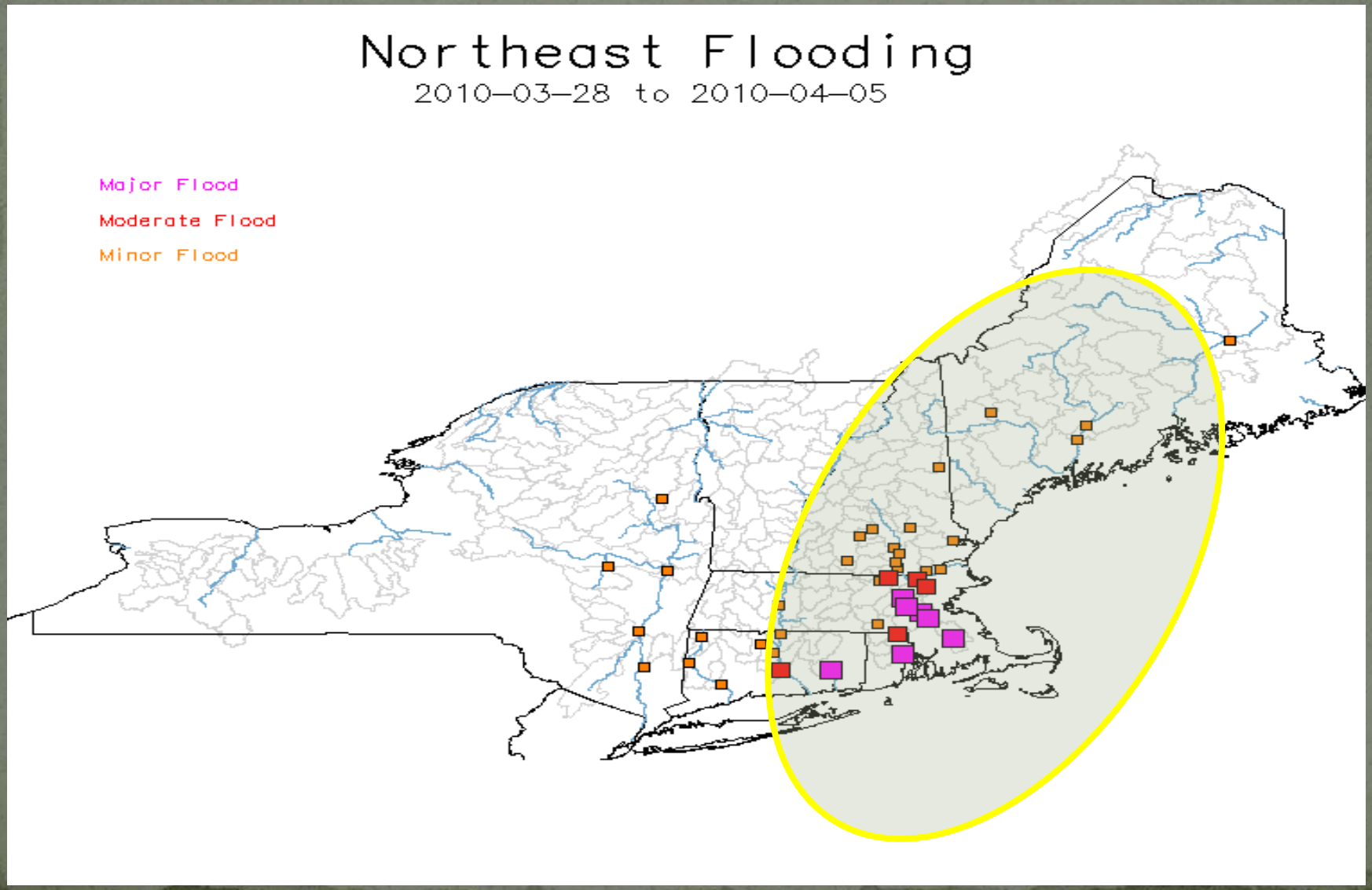
So what brought us to the tipping point during the last week of March?

- It was not caused by
  - One single Nor'easter or one Coastal Storm
  - Snowmelt
  - Improper water management

So what brought us to the tipping point?

- It was caused by:
  - The atmospheric river – "energized" by El Nino
  - Blocking high pressure over Greenland
  - ***A sequence of heavy rainfall events over 5 weeks***
  - Record monthly rainfall totaling 12-18 inches
    - Axis of each event over Pawcatuck & Pawtuxet Valleys
  - Saturated ground
  - A "chuck-full" Scituate Reservoir
    - Designed for Water Supply not Flood Control!
  - Swollen streams and ponds running well above normal
  - The lack of nature's grasses, flowers and trees
    - Pre-growing season – no Evapo-transpiration to help us out

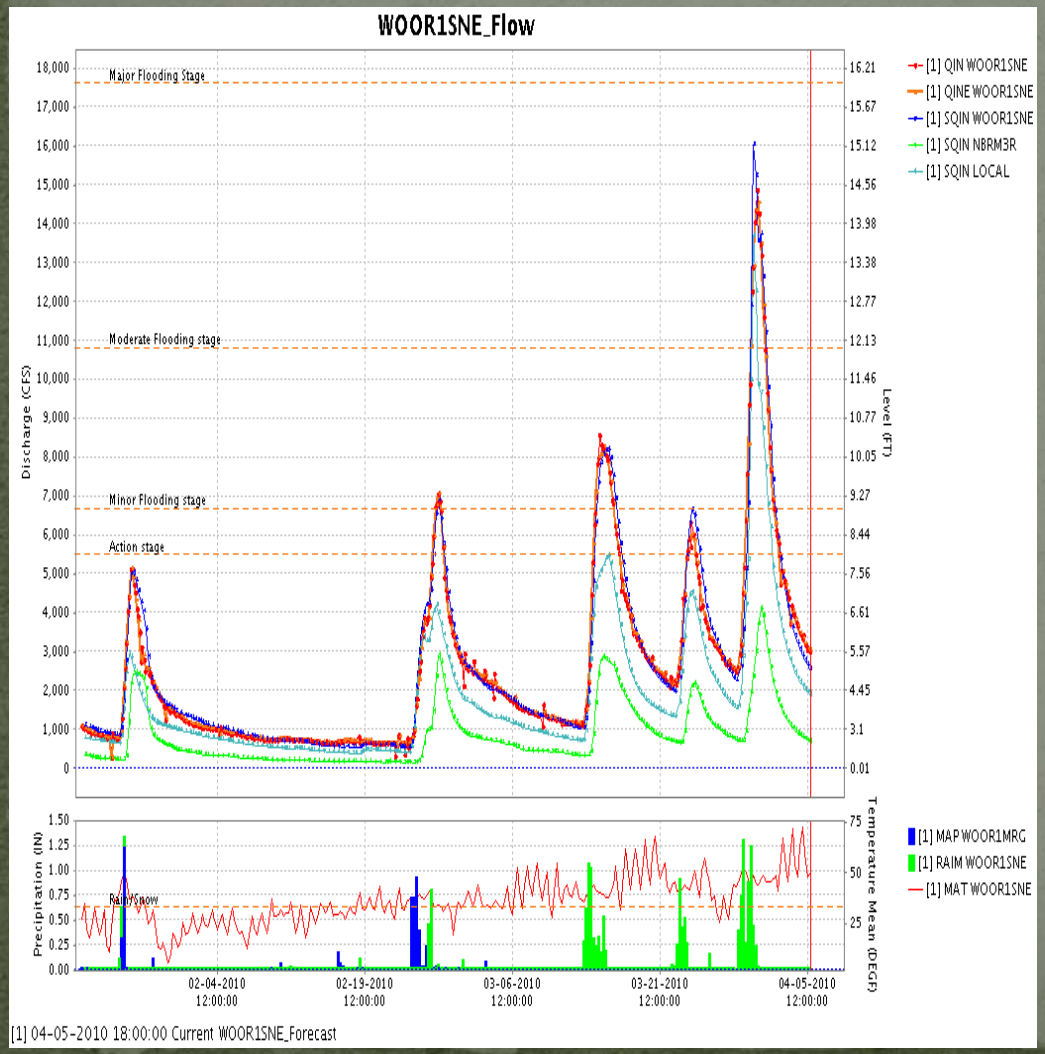
Major to Record flooding across southeast New England



The Blackstone Response

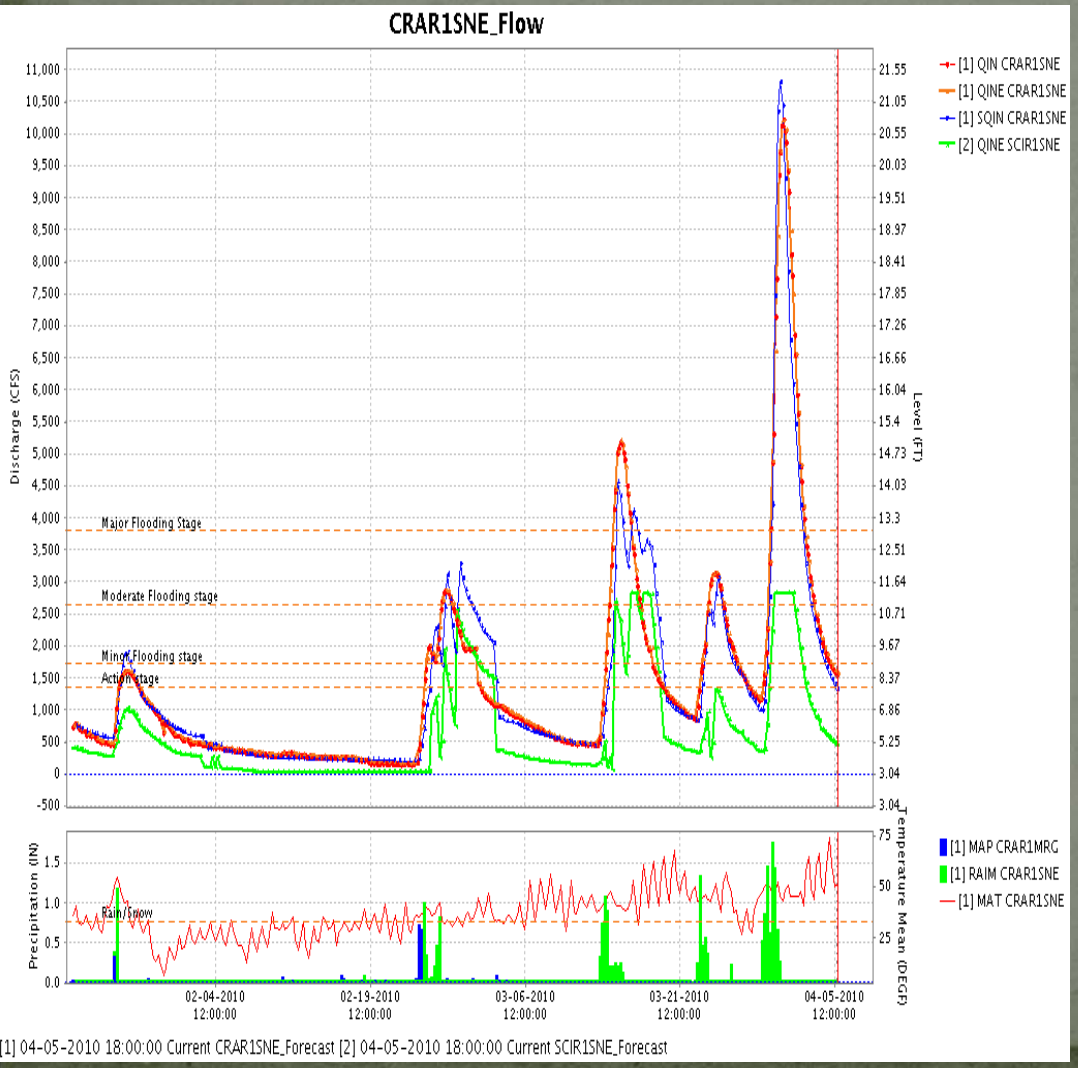
Dodged a huge bullet – as heaviest rains stayed south of the basin

Considerable flooding on mainstem and many small streams

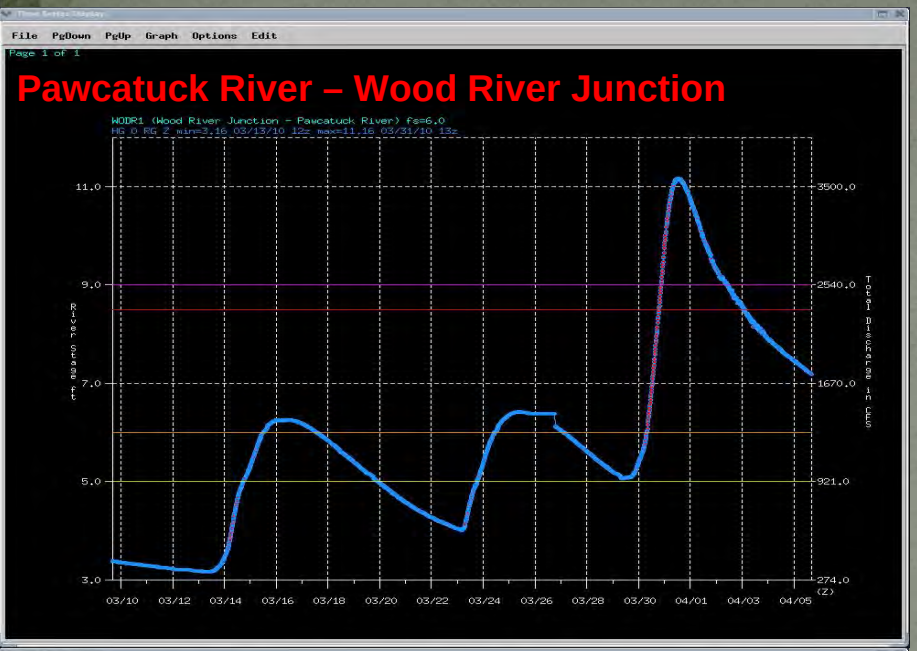


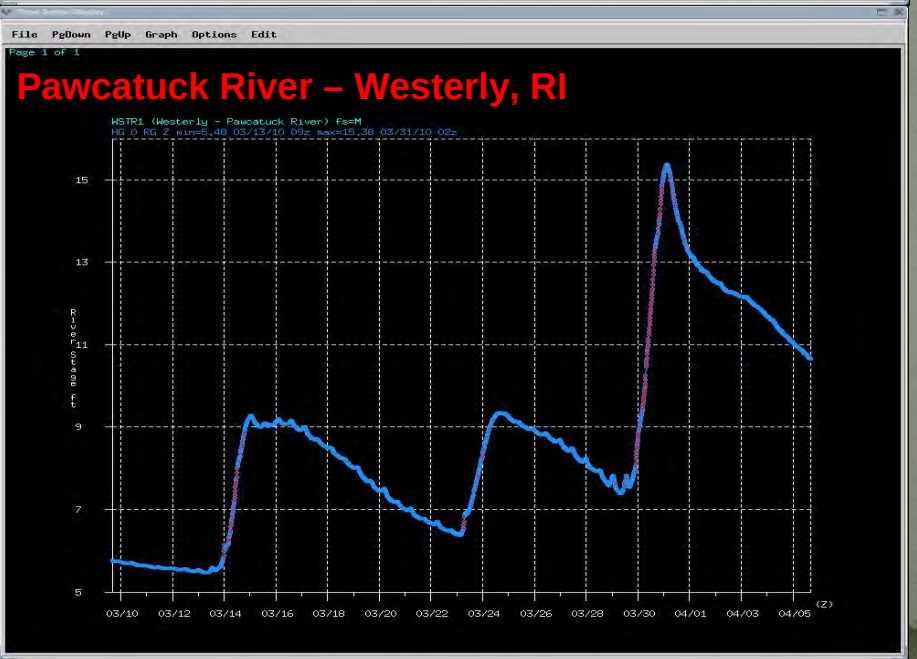
The Pawtuxet's Record Response

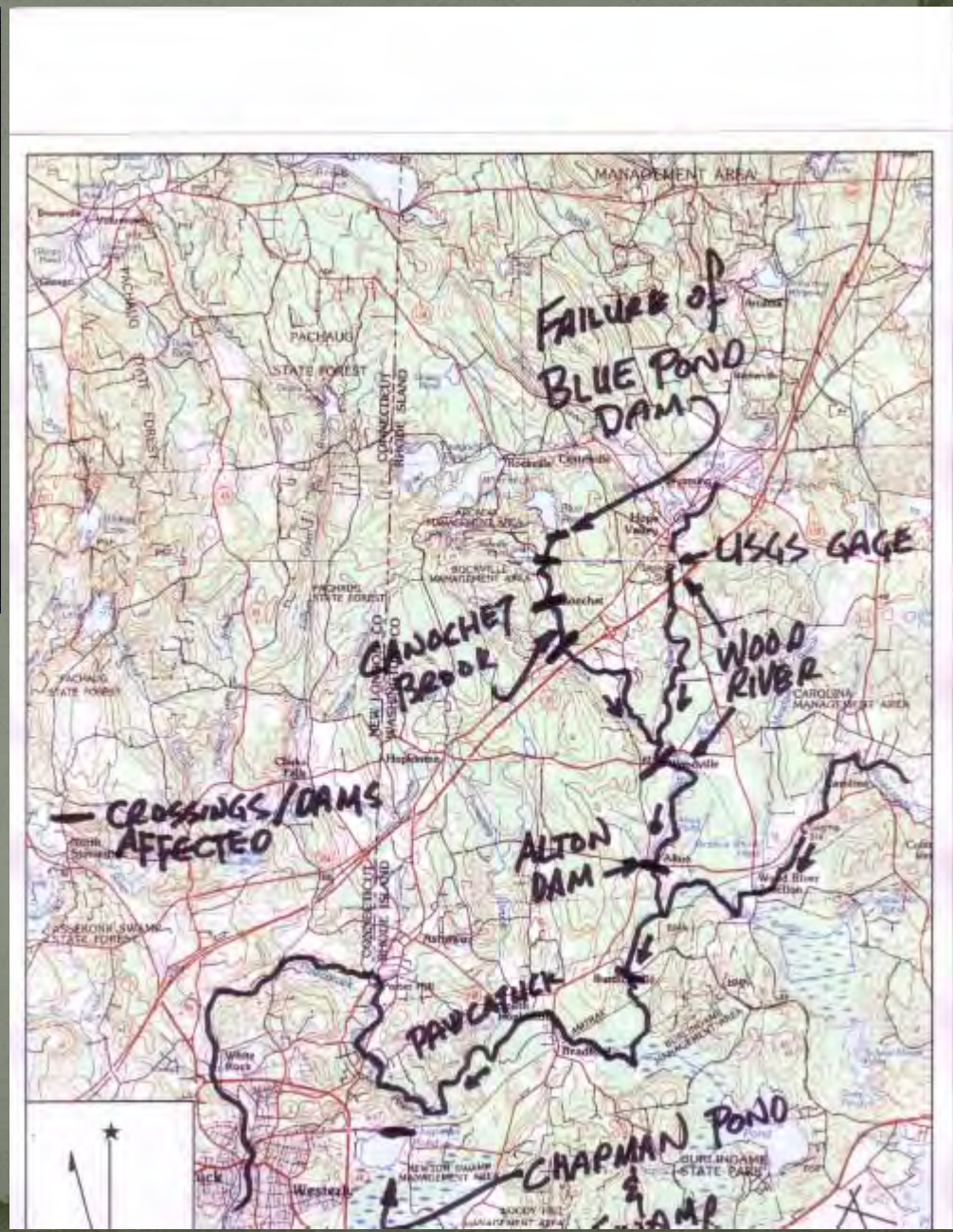
Dramatic "urban response" in the lower basin followed by record reservoir flows from Scituate Reservoir



Pawcatuck Basin – similar responses



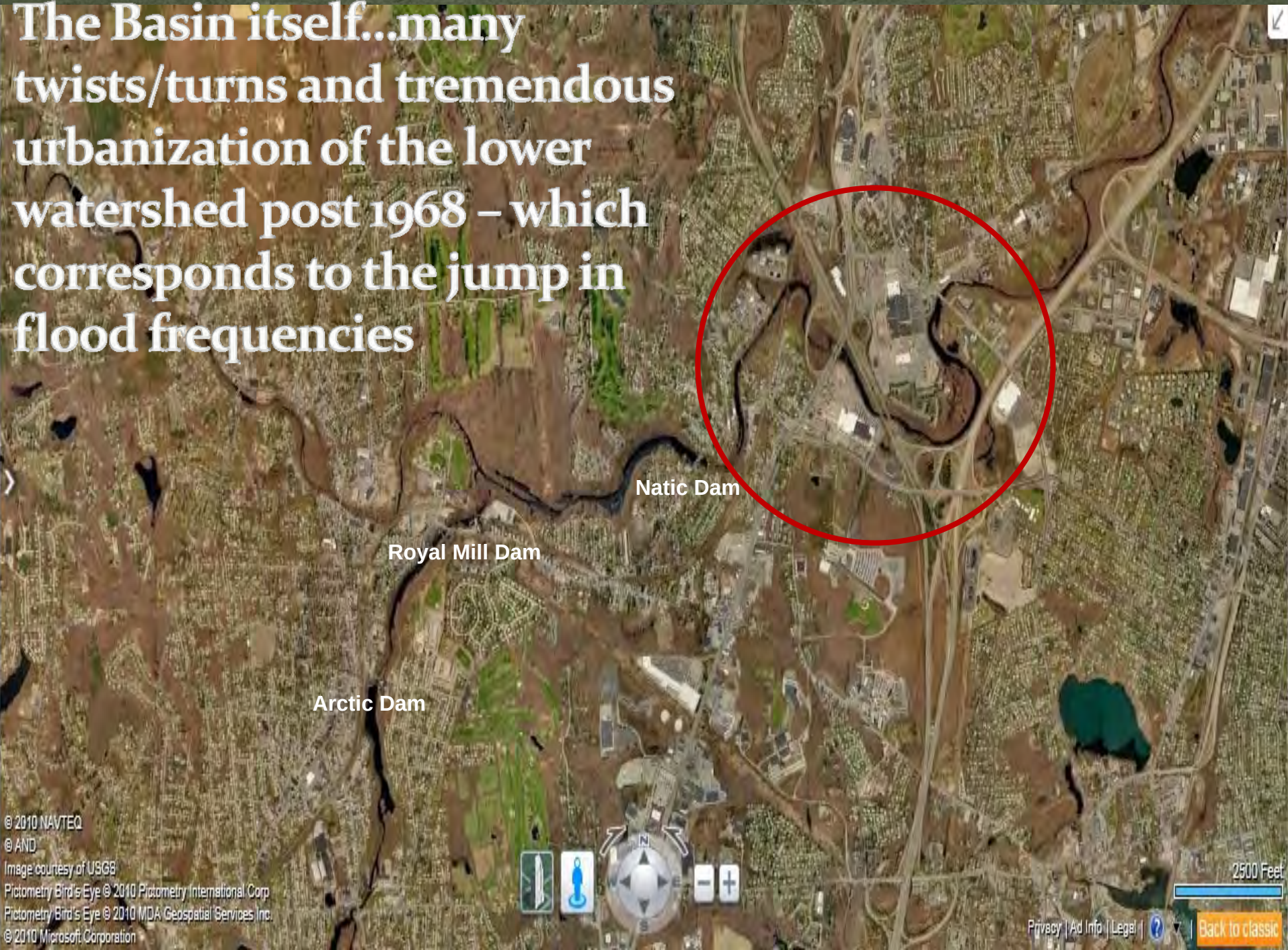




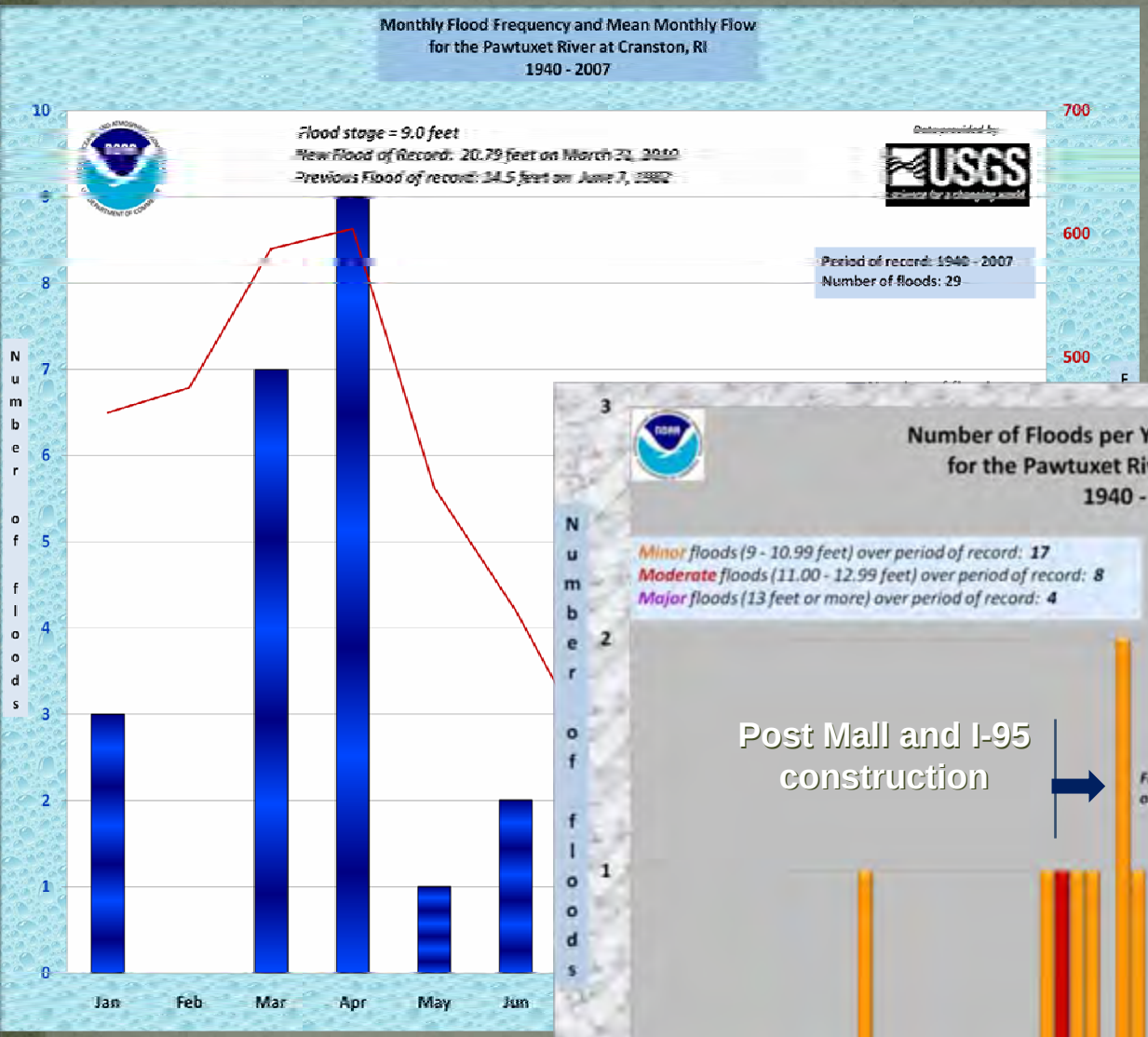
Historical Footnotes

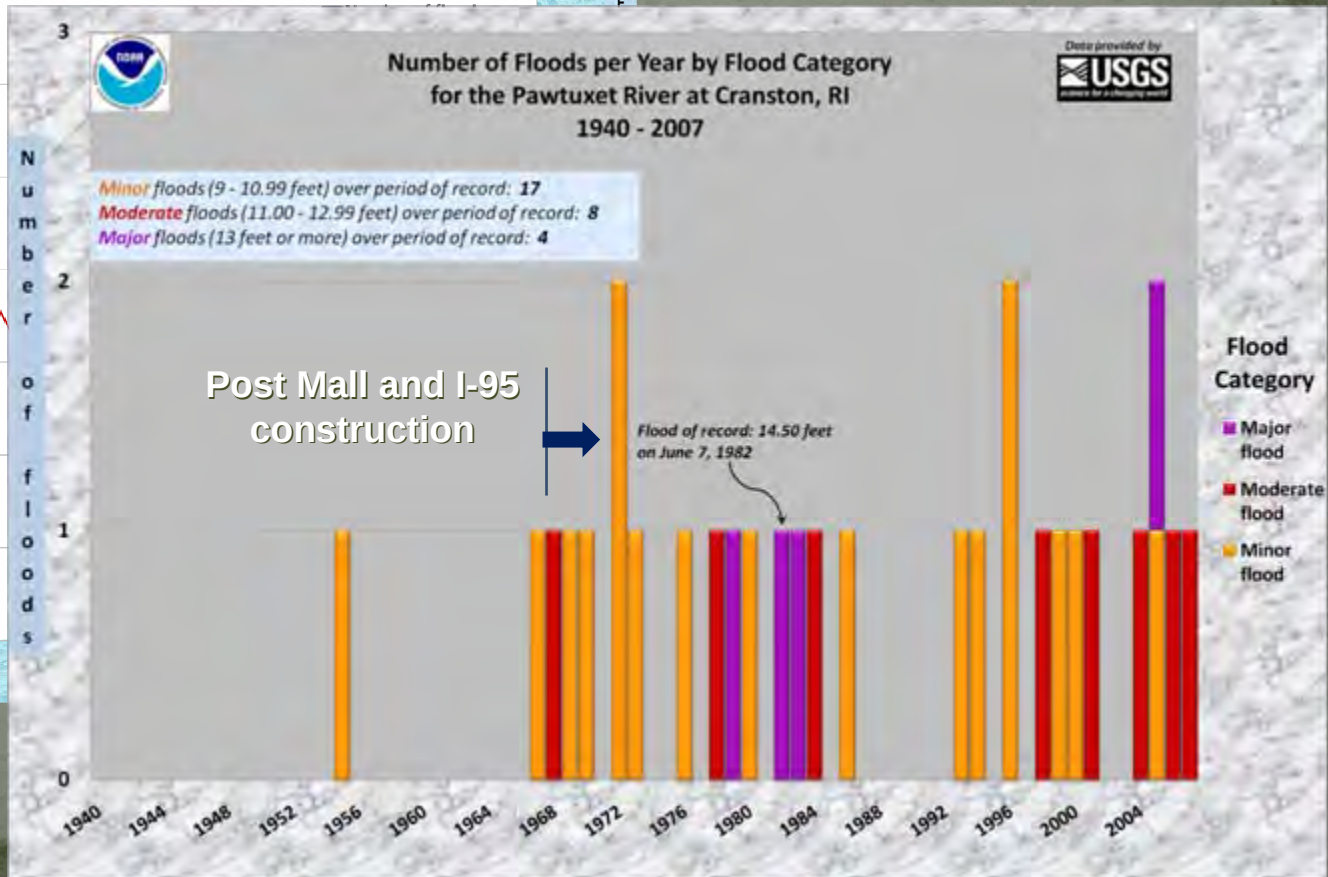
- Extremely rare to set two record flood elevations in two weeks – as was done on the Pawtuxet
- Consider this fact:
  - The ***storms*** in March 2010 dumped over 16 inches of rain
  - The record Flood for the Blackstone in 1955 was the result of over 10 inches in **ONE DAY** with over 14 to 16 inches of rain in 1 week in Woonsocket northward through the head waters in Worcester.
- Fits pattern of more intense heavy rainfall events which have been impacting the Northeast since the mid 1990s.
  - Merrimack Oct'96, Hurricane Floyd flooding Sept '99, Connecticut, Merrimack, Blackstone Oct'05, Mother's Day 2006 Merrimack valley, May 2007, and now 2010.

The Basin itself…many twists/turns and tremendous urbanization of the lower watershed post 1968 – which corresponds to the jump in flood frequencies

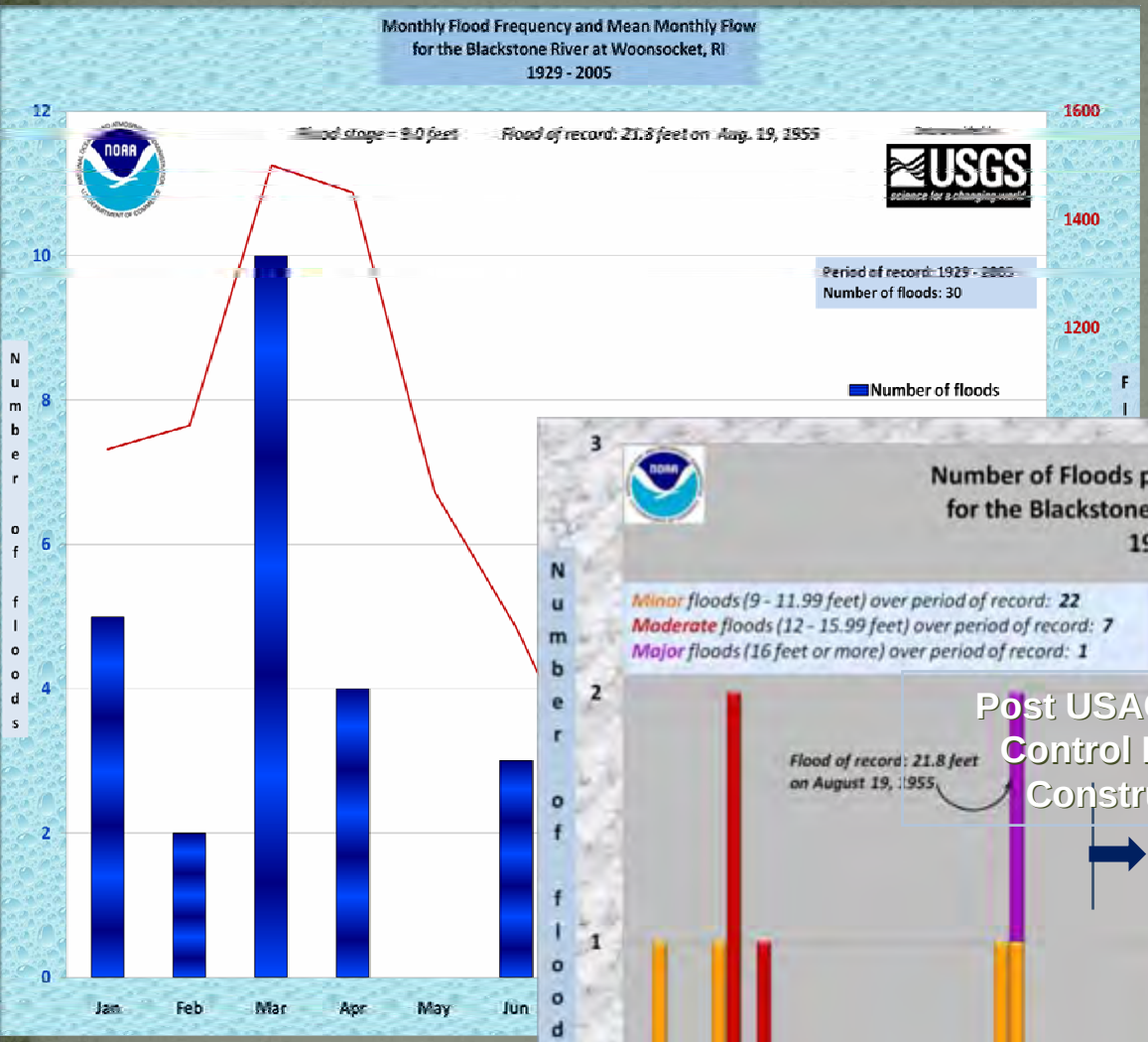


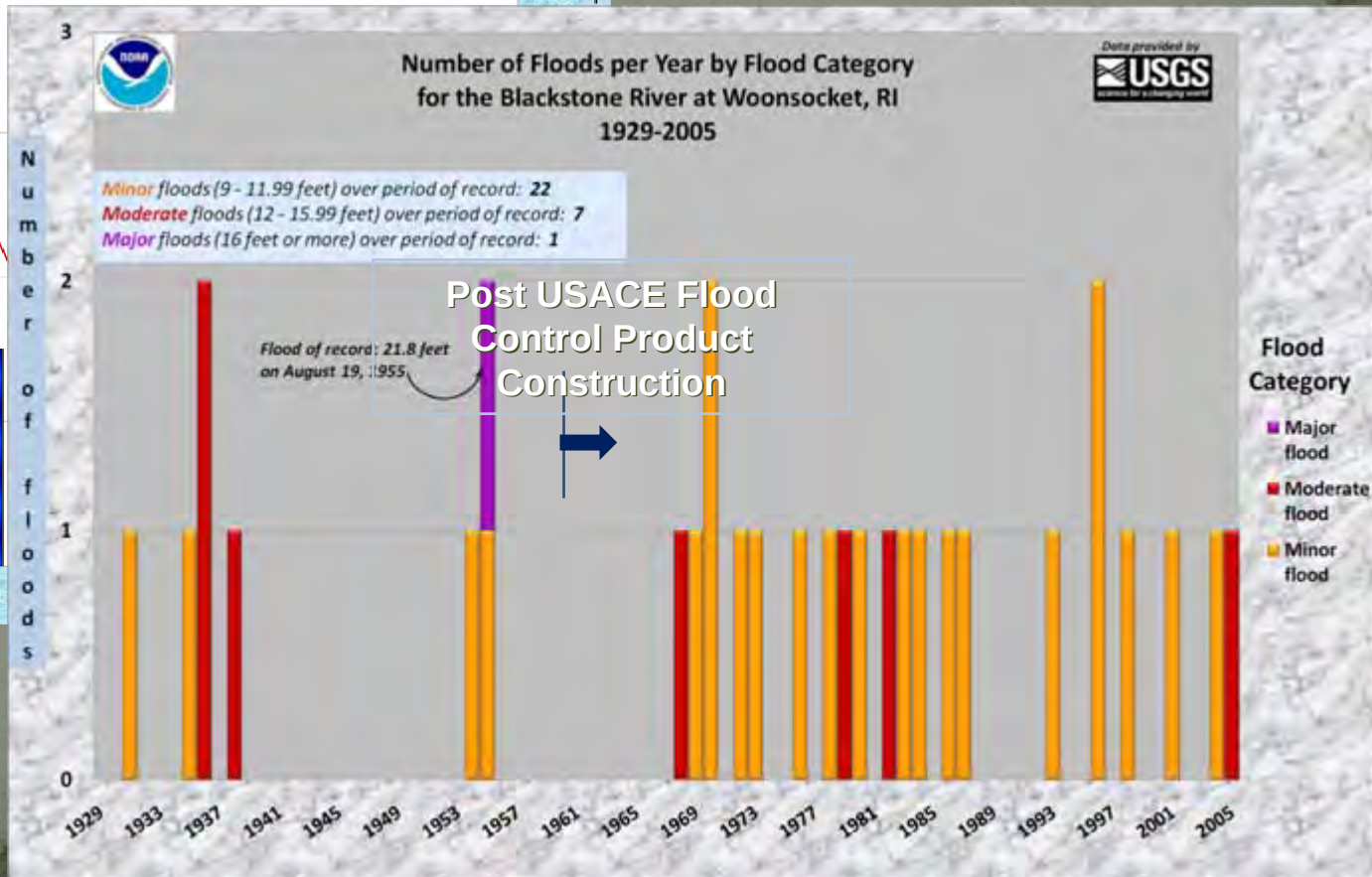
Pawtuxet River Flood Frequency





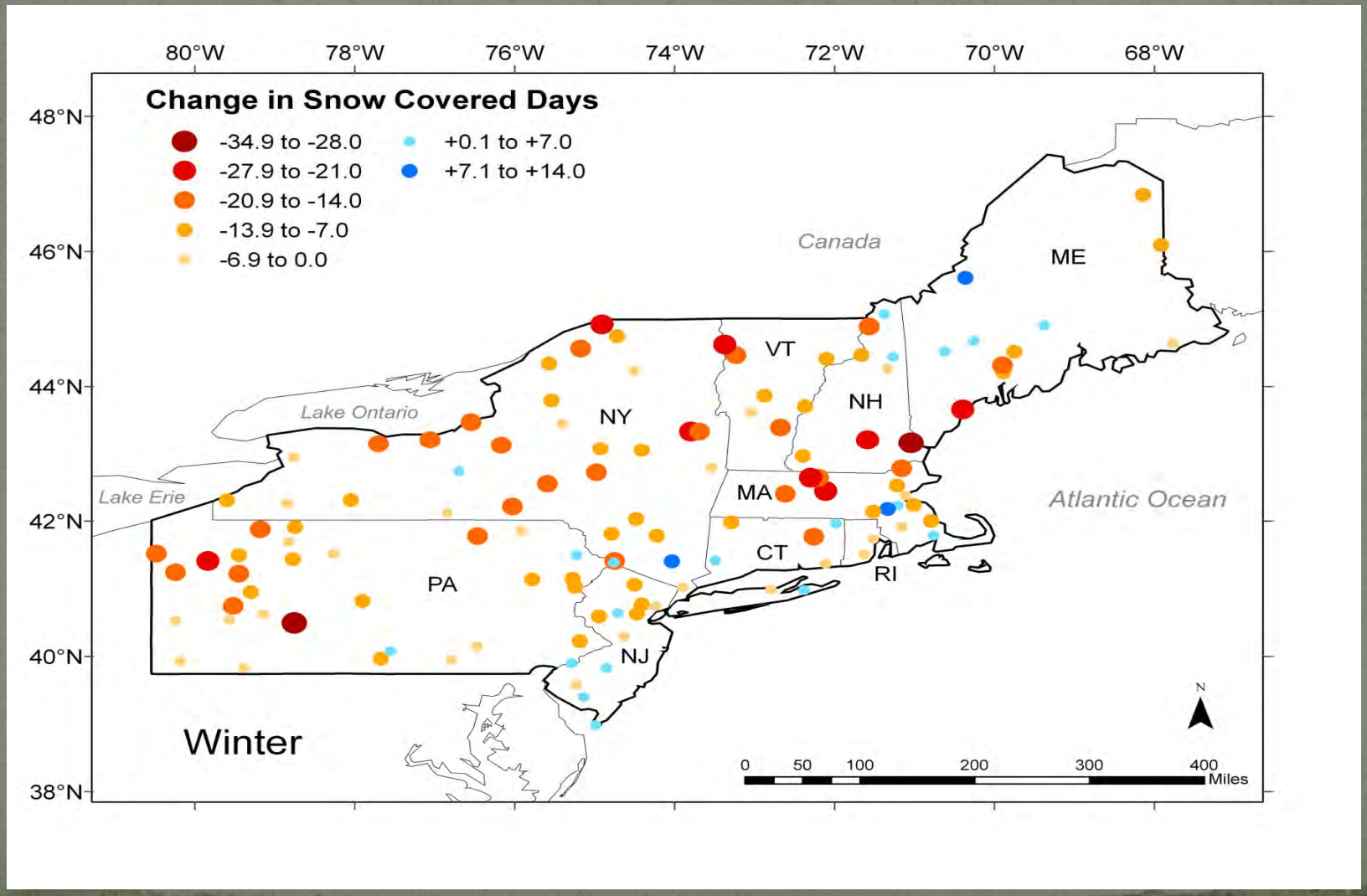
Blackstone River Flood History





Climate Change Scenarios:

Shorter snow season – less days with snow on the ground

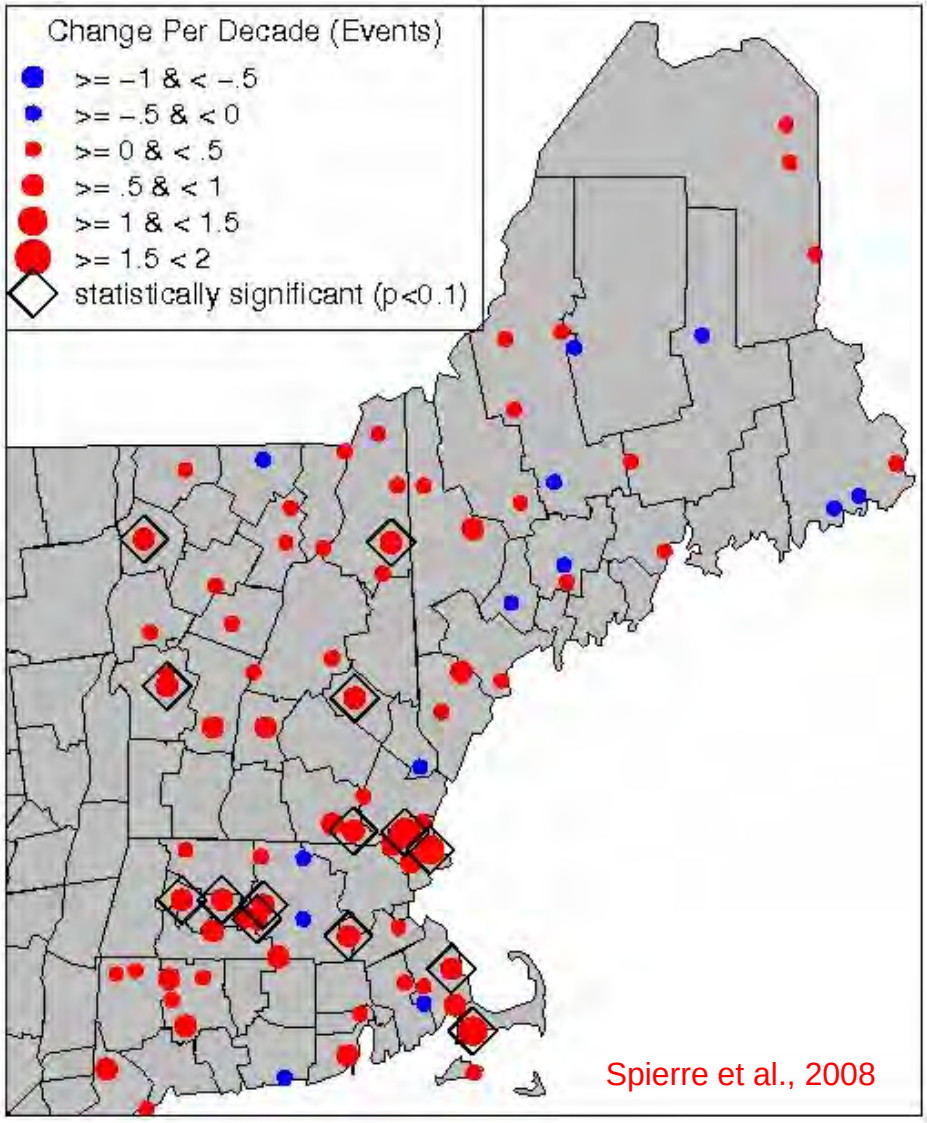


Burakowski et al., 2008, JGR

Climate Change Scenarios:

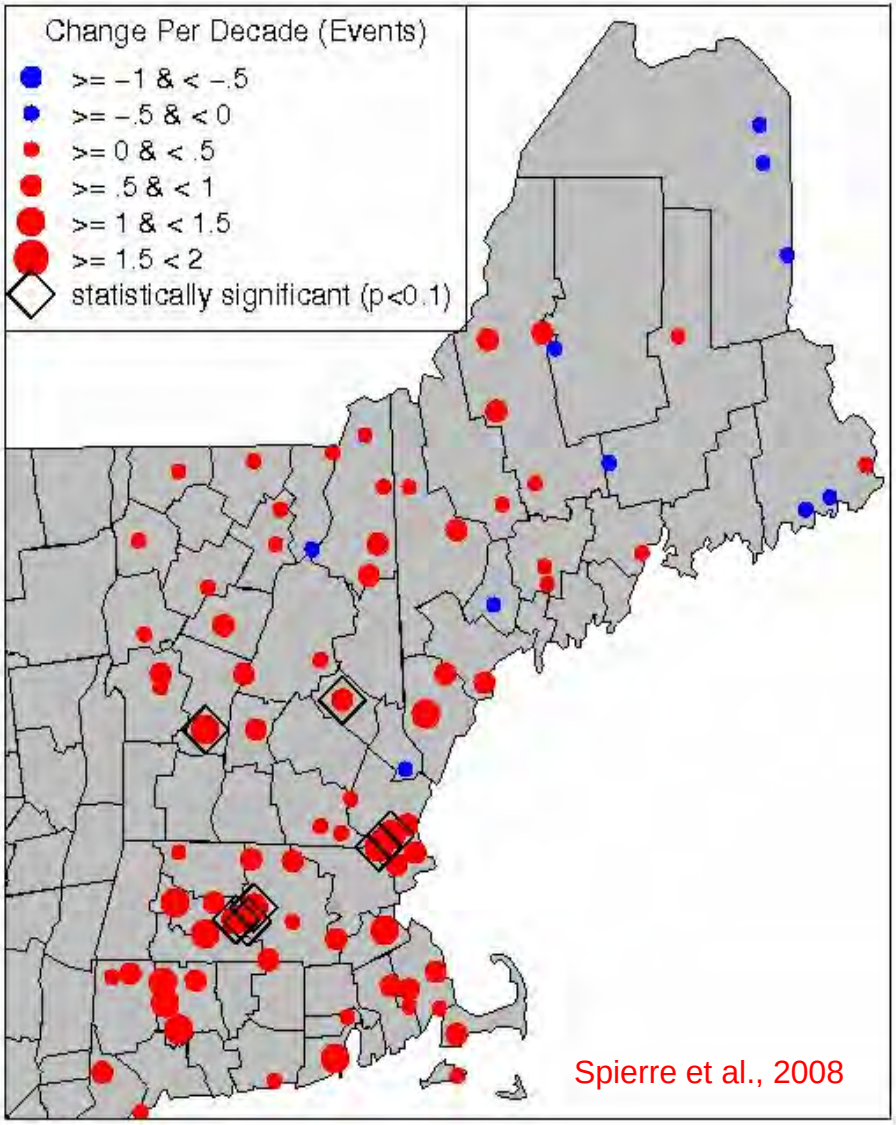
Increase in 1 inch and 2 inch rainfall events

1 inch events (1947-2007)



Spierre et al., 2008

2 inch events (1947-2007)

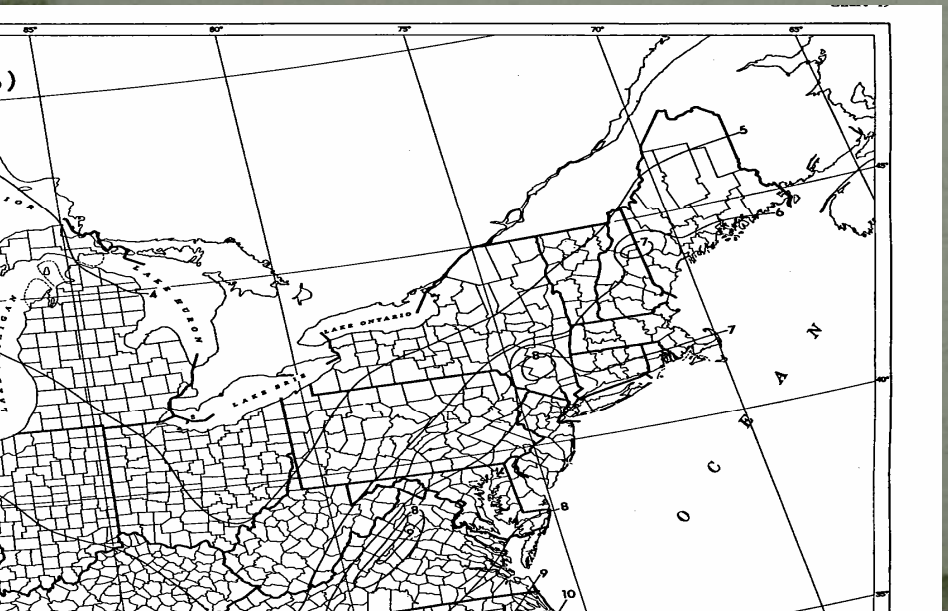


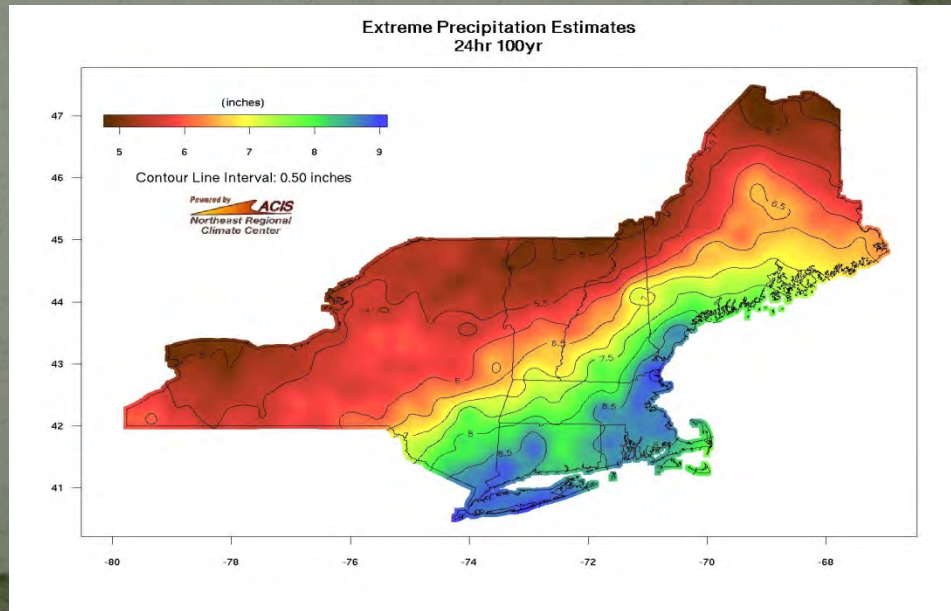
Spierre et al., 2008

Frequency

Most significant in the 25 to 100 yr recurrence interval.

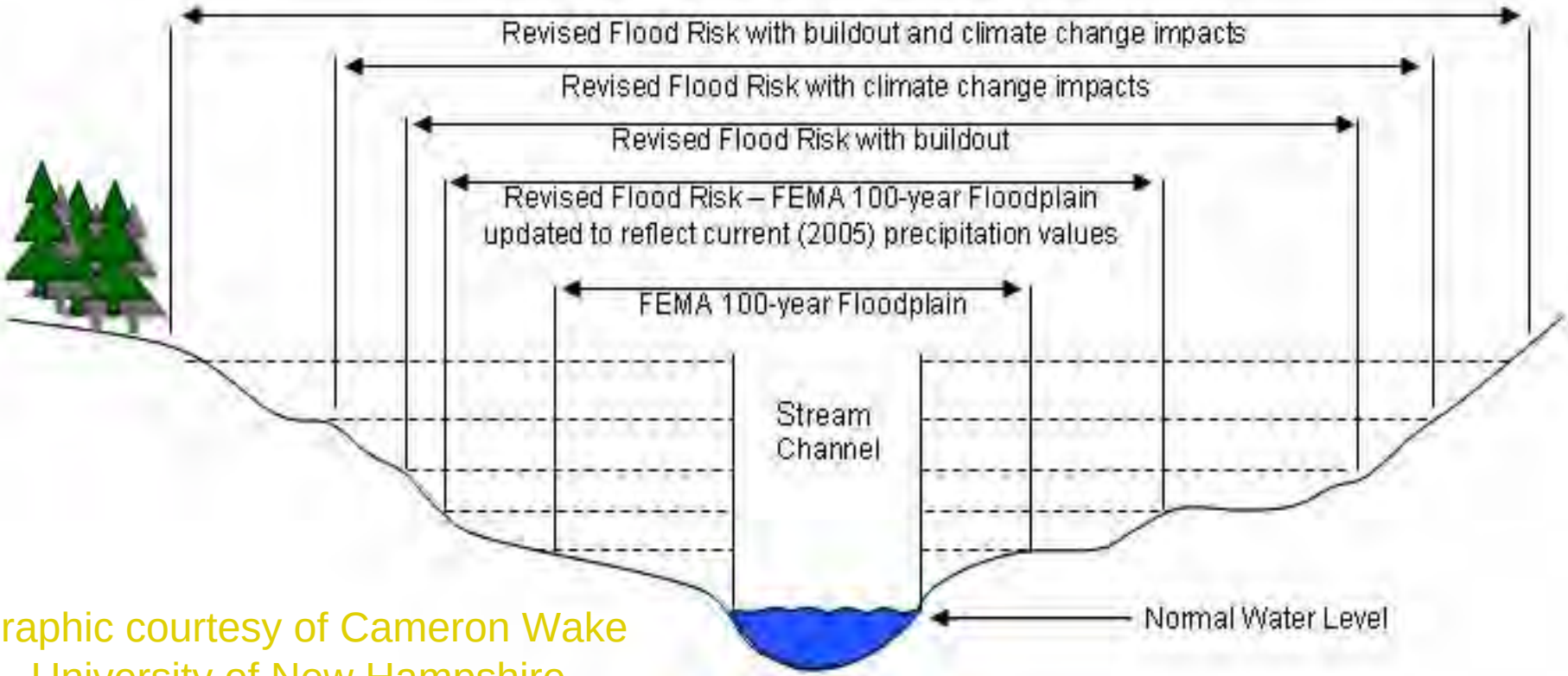
1 Day Return period	TP-40 from 1961	NRCC Draft 2010 http://www.precip.net
Event in years	Inches in 24 hours	Inches in 24 hours
2	3.25	3.26
10	4.75	4.86
25	5.50	6.15
50	6.15	7.30
100	7.00	8.70





Physical implications:

- Impacts on the flood plain, land use, infrastructure, dam spillway requirements, drainage requirements, bridge clearances, property values, etc…



Graphic courtesy of Cameron Wake
University of New Hampshire

Planning For Climate Change

Climate Change Impacts Session

David R. Vallee
Hydrologist-in-Charge
NWS/Northeast River Forecast Center
http://weather.gov/nerfc

Providence Street – West Warwick, RI at 1030 am Wednesday 3/31/10

Fundamental Concepts in Planning for Climate Change

Daniella Hirschfeld, Program Officer

October 28th, 2010

Principles of Planning

- Comprehensive
- Efficient
- Inclusive
- Informative
- Integrated
- Logical
- Transparent

Climate Change Adaptation

Climate Mitigation – Any measure or action taken to reduce greenhouse gas emissions.

Climate Adaptation – Any measure or action that reduces the negative impacts of climate change or increases new opportunities.

Adaptation and Mitigation are not mutually exclusive!

Why Plan For Climate Change

Goal of Adaptation Planning

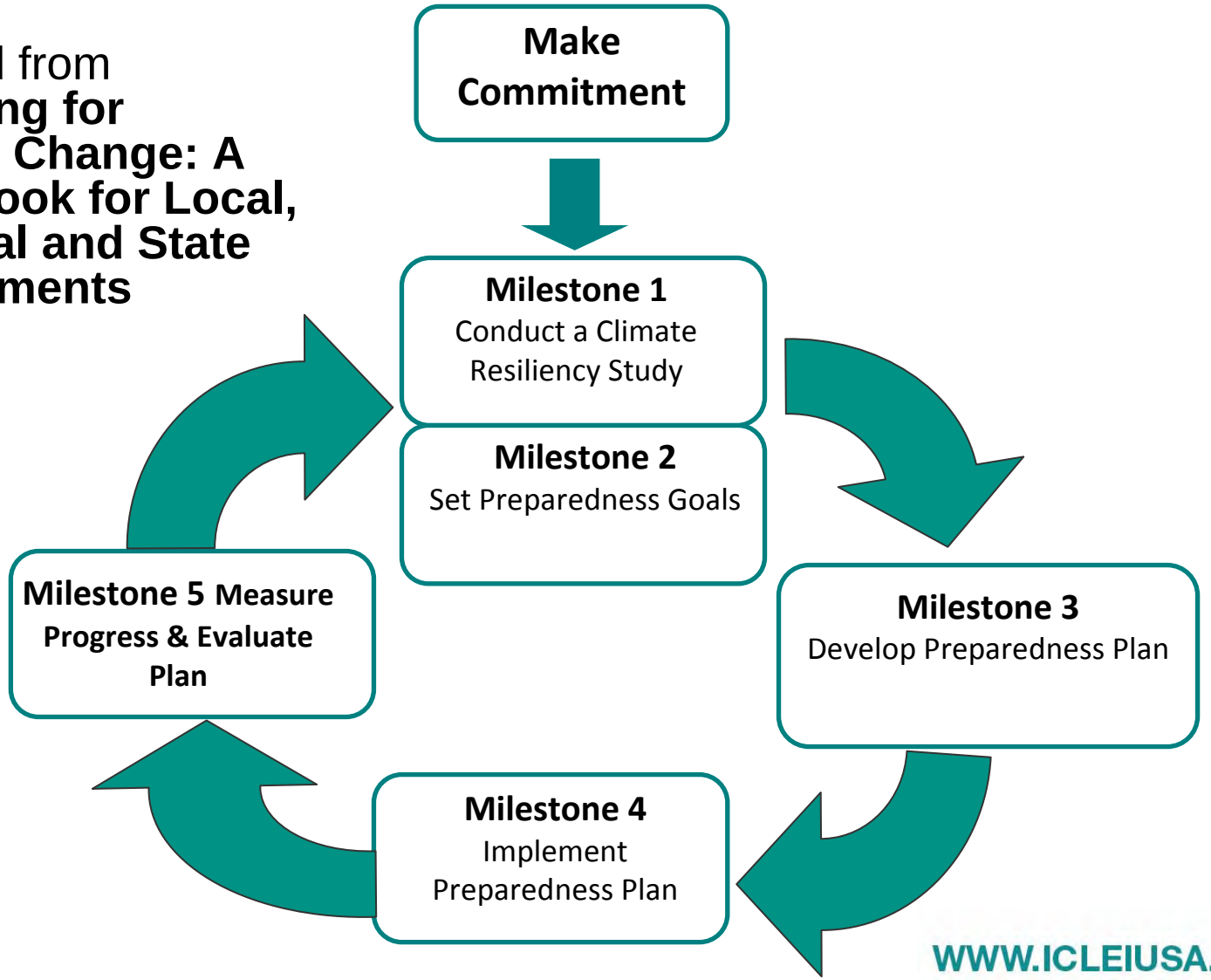
Developing more "climate resilient" organizations, departments, infrastructure communities, economies, and ecosystems

What does this mean?

Ensuring that systems (social, political, economic, natural, etc.) have the ability to absorb, recover, and adapt to climate changes or perturbations that can span multiple combinations, conditions, and timeframes.

Five Milestones for Climate Adaptation

Adapted from **Preparing for Climate Change: A Guidebook for Local, Regional and State Governments**



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Pre-Milestone One: Getting Started

Identify who should be involved

Begin identifying regional/local changes in climate

- Local climate scientists
- State scientists
- University professors
- Union of Concerned Scientists
- ICLEI's guidebooks

Build support and provide education

Formalize commitment (resolution)

Form and hold first Preparedness Team meeting

Milestone One: Conduct Resiliency Study

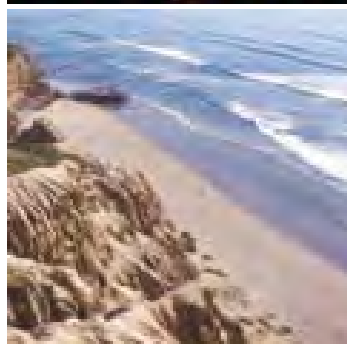
Assess how regional climate is expected to change

Assess regional/community ***impacts*** predicted from these changes in climate

Identify systems that could be impacted (+/-) from forecasted changes in climate

Conduct climate vulnerability assessment (**sensitivity x adaptive capacity**)

Conduct risk assessment (**likelihood x consequence**)



Milestone Two: Establish Preparedness Goals

- Analyze results of vulnerability and risk assessment
- Establish goals for the systems that have the highest vulnerability and risk
- Consider short, medium, and long-term goals
- Consider alignment with existing community goals

Milestone Three: Create Preparedness Plan

- Review goals established for vulnerable and at risk systems
- Identify actions that capitalize on opportunities and reduce vulnerability and risk to climate change
- Prioritize actions
- Draft Adaptation Plan or integrate into existing plans
  - Framework (roadmap) for approaching adaptation
  - Outlines preparedness goals
  - Actions to achieve goals
  - Timelines and associated costs with actions

START

Milestone Four: Implement Preparedness Plan

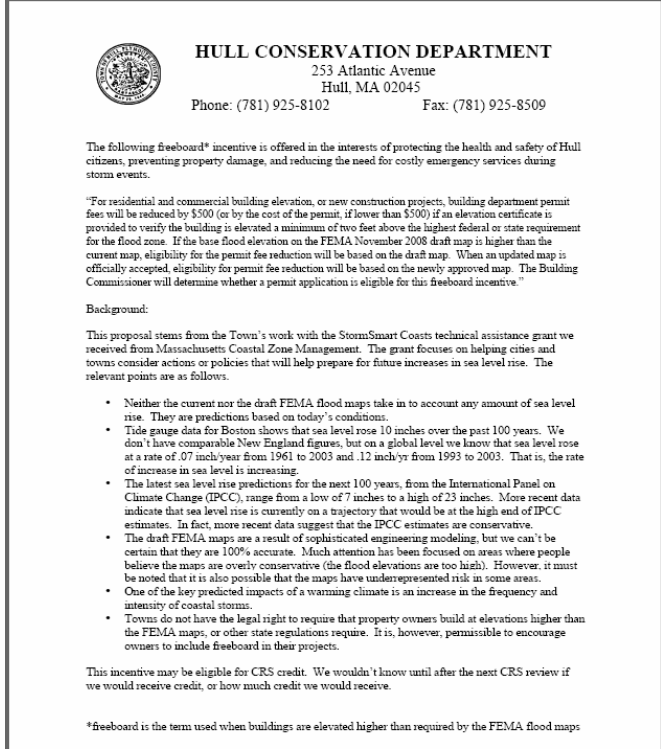
IMPLEMENT identified actions

- Create and adopt policy
- Identify funding, staffing, other resource needs, etc.
- Create a timeline and designate responsibility parties
- Share implementation results with community and ICLEI
- Celebrate successes!

Example: Hull, MA

Building a case for adaptation with 3D photorealistic images of flooding impacts

The Board of Selectman unanimously passed a freeboard incentive - gives citizens up to $500 in building permit fees if the builder elevates the home 2 feet above the current highest standard



HULL CONSERVATION DEPARTMENT
253 Atlantic Avenue
Hull, MA 02045
Phone: (781) 925-8102 Fax: (781) 925-8509

The following freeboard* incentive is offered in the interests of protecting the health and safety of Hull citizens, preventing property damage, and reducing the need for costly emergency services during storm events.

"For residential and commercial building elevation, or new construction projects, building department permit fees will be reduced by $500 (or by the cost of the permit, if lower than $500) if an elevation certificate is provided to verify the building is elevated a minimum of two feet above the highest federal or state requirement for the flood zone. If the base flood elevation on the FEMA November 2008 draft map is higher than the current map, eligibility for the permit fee reduction will be based on the draft map. When an updated map is officially accepted, eligibility for permit fee reduction will be based on the newly approved map. The Building Commissioner will determine whether a permit application is eligible for this freeboard incentive."

Background:

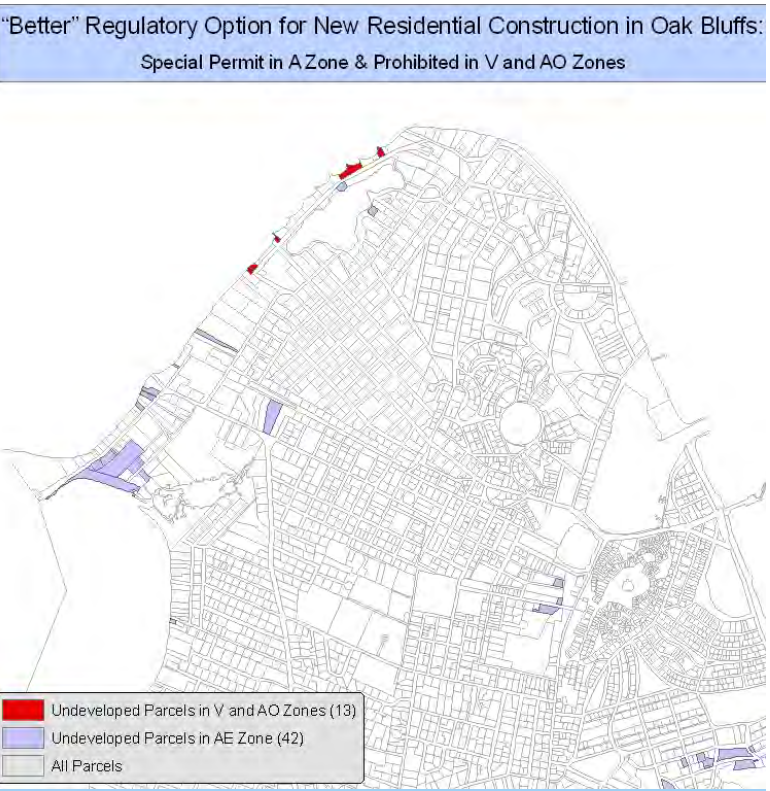
This proposal stems from the Town's work with the StormSmart Coasts technical assistance grant we received from Massachusetts Coastal Zone Management. The grant focuses on helping cities and towns consider actions or policies that will help prepare for future increases in sea level rise. The relevant points are as follows.

- Neither the current nor the draft FEMA flood maps take in to account any amount of sea level rise. They are predictions based on today's conditions.
- Tide gauge data for Boston shows that sea level rose 10 inches over the past 100 years. We don't have comparable New England figures, but on a global level we know that sea level rose at a rate of .07 inch/year from 1961 to 2003 and .12 inch/yr from 1993 to 2003. That is, the rate of increase in sea level is increasing.
- The latest sea level rise predictions for the next 100 years, from the International Panel on Climate Change (IPCC), range from a low of 7 inches to a high of 23 inches. More recent data indicate that sea level rise is currently on a trajectory that would be at the high end of IPCC estimates. In fact, more recent data suggest that the IPCC estimates are conservative.
- The draft FEMA maps are a result of sophisticated engineering modeling, but we can't be certain that they are 100% accurate. Much attention has been focused on areas where people believe the maps are overly conservative (the flood elevations are too high). However, it must be noted that it is also possible that the maps have underrepresented risk in some areas.
- One of the key predicted impacts of a warming climate is an increase in the frequency and intensity of coastal storms.
- Towns do not have the legal right to require that property owners build at elevations higher than the FEMA maps, or other state regulations require. It is, however, permissible to encourage owners to include freeboard in their projects.

This incentive may be eligible for CRS credit. We wouldn't know until after the next CRS review if we would receive credit, or how much credit we would receive.

*freeboard is the term used when buildings are elevated higher than required by the FEMA flood maps

Example: Oak Bluffs, Massachusetts



- Focused on a floodplain overlay zoning bylaw change
- Worked across town boards:
- Used a good / better / best framework in conjunction with parcel maps to assist in decision making
- Created support for the change through public meetings, letters to the editor and mailings to citizens
- The citizens voted to adopt the new bylaw that prohibits new development in the most hazardous flood zones and has a special review process for all flood zones

Milestone Five: Monitor, Evaluate, and Re-Assess

- Continue implementation and keep track of progress
- Report progress to the elected officials, community, funders, and ICLEI (annually)
- 2 to 5 years in – take stock and evaluate focus
- Revisit updated climate forecasts
- Change course, if needed
- Update Preparedness Plan
- Continue to celebrate successes!

Example: Adaptation in Keene, NH

Full Planning Process – looking holistically at climate impacts and vulnerabilities

Member of ICLEI's CRC Pilot

Established Committee of Department Heads to go through process (inc. Mayor, Chief of Police, etc.)

Completed Milestones 1-3; currently in implementation phase

Currently looking to include adaptation in:

- Capital Improvement Program
- Wetlands ordinances
- Land rights issues along watershed
- Culvert studies

Including adaptation and mitigation in Community Visioning and Comprehensive Planning

Questions

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Missy Stults
Adaptation Manager – ICLEI USA
Missy.stults@iclei.org

Climate Adaptive Planning and Program Actions Groton, Connecticut

Michael J. Murphy, AICP

Director of Planning and Development

October 28, 2010

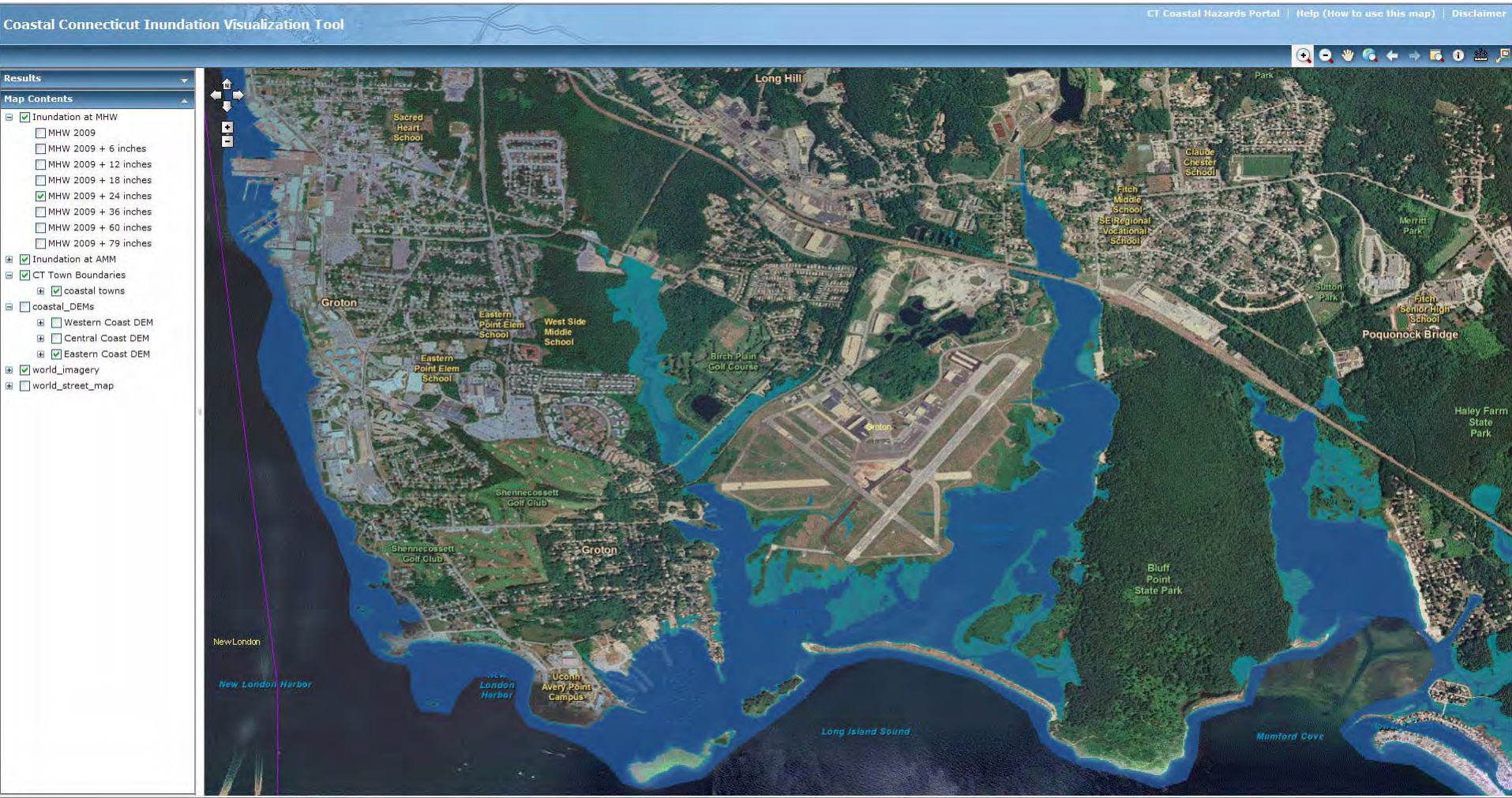
Building Blocks for Groton's Local Adaptation Program

- Coastal Hazards Analysis and Management Program (CHAMP) Project
- Task Force on Climate Change and Sustainable Community
- Enhanced Resources Through Partnerships With Government, NGO' s and Academia

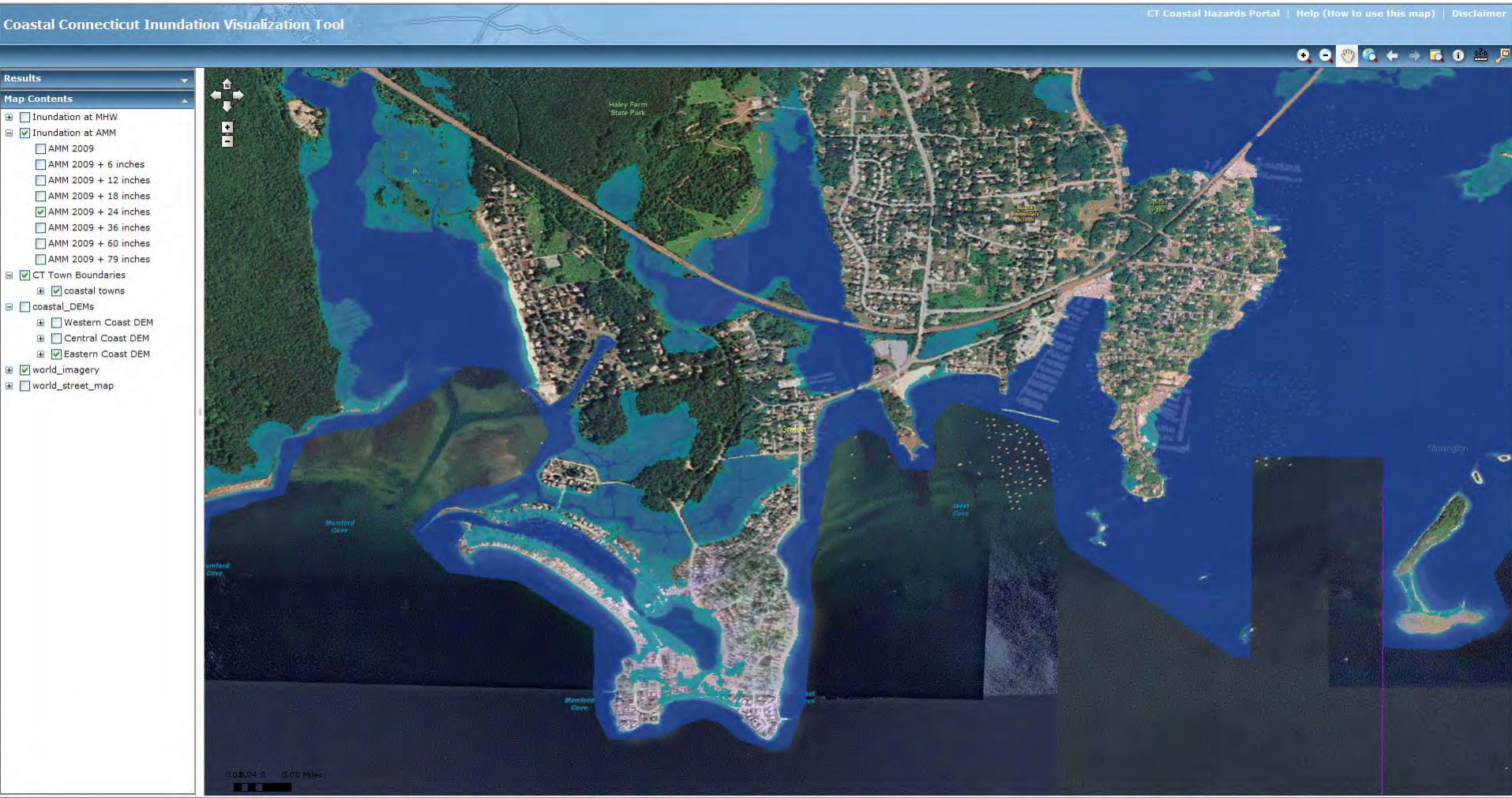
Building Blocks for Groton's Local Adaptation Program -Continued

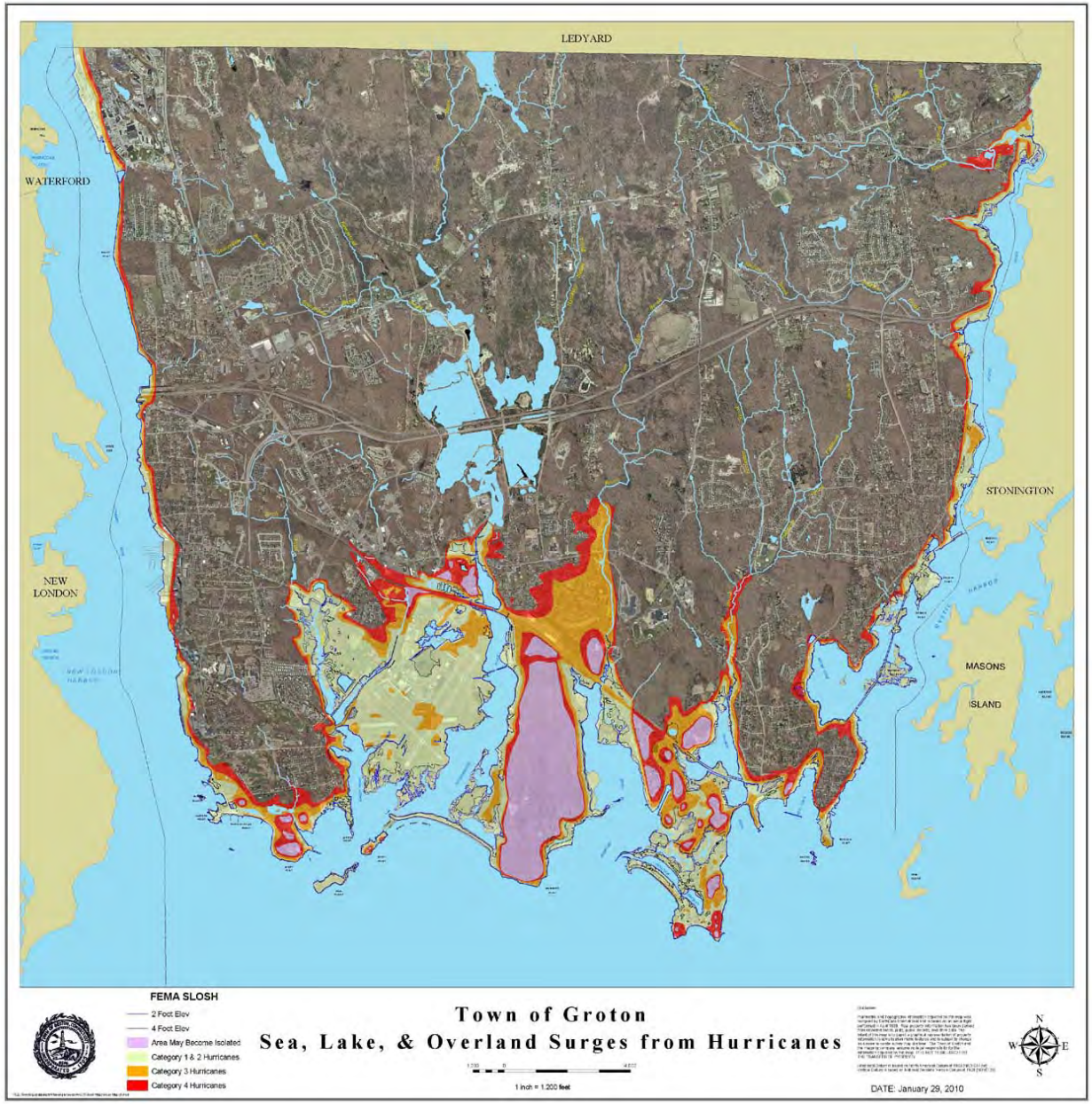
- Professional Staff and Technical Capacity to Achieve Sustainability Goals, and Identify and Implement Projects
- Participation in Model Approach to Climate Adaptation Planning for Region
- Establish Communication Strategy and Groundwork for Effective Public Engagement

Groton Airport: 2009 MHW + 24” (2.0’) SLR



Groton Long Point / Noank: 2009 AMM + 24” (2.0’) SLR





SLOSH MAP

- ACOE created Data for FEMA
- Displays storm surge impacts & scenarios
- Preliminary impact assessment
- Inserted 2’ and 4’ sea level rise contours
- Need to Integrate SLR with storm data

Areas of Concern

- Utilities Infrastructure Networks
- Transportation Facilities
- Ecological Resources
- Isolation of Coastal Living Areas


Sanitary Sewer Pump Station Network
Groton Long Point
Study Area


Groton Long Point
North Street Pump Station
Sea Level Rise based on IPCC High
Emissions Scenario : 3.13' NAVD
Beach Road Pump Station
Pacific Street Pump Station


Gravel Street Pump Station
Historic Downtown Mystic
Groton, CT
Stonington
Study Area
Stonington


Storm Sewer Outlets
Impacted by Sea Level Rise
and/or Storm Surge

Public Infrastructure Investment

- Capital Improvement Program
  - Institutionalized project review
  - Criteria includes recognition of climate change impacts
  - Enhanced priority for inclusion of adaptation measures
  - Sustainability goals/guidelines
  - OPDS staff to assist departments with project development

Next Steps

- Further Develop Tools for Risk Assessment
  - GIS display SLR/storm inundation scenarios as single layer
  - Evaluate and prioritize infrastructure asset and network vulnerabilities
  - Adjust to trends in SLR and/or storm severity
- Continue to Pursue Funding Opportunities and Increase Local Capacity for Adaptation Actions
- Formalize a Working Preparedness Committee
- Incorporate Resilience and Energy Themes into Upcoming Community Master Planning Process
- Consolidate Sustainability Policies - Energy Efficiency & Conservation (Mitigation) and Resilience (Adaptation) - in Climate Action Plan (CAP)

Community Engagement and Overcoming Barriers

ICLEI Local Governments for Sustainability USA

Daniella Hirschfeld, Program Officer

October 28th, 2010

WWW.ICLEIUSA.ORG

Reasons to Engage…

Citizens:

- They will have to vote on the changes
- Their buy in is essential to the success of the program
- Your job is on the line (especially true of elected officials)
- You see them at nursery school

Elected Officials:

- They can get things done in town
- They are your boss
- Your project would be better served as a collaborative effort

Possible Barriers

- Do not believe that climate change is actually happening
- Believe that someone will “solve the problem”
- The economic investment today isn’t worth it
- We don’t have the resources – police are being fired,
- Other things are more important – education for our children
- It is not under our jurisdiction
- We are already mitigating
- Property Rights

Communication Rules of Thumb

- Remember The Big Picture
- Be Technically Correct
- Be Cool
- Create A Sense of Belonging
- Only Stories Work
- Optimism
- Glory Button
- Change Is For All
- We Need More Heroes
- Personal Circle

Things to Consider

What is your message?

Who is your target audience?

What does your audience know and think?

What would you like your audience to think and or do?

How can you get your message across?

Exercise

Engaging Municipal Employees

- Already doing the work, just need to formalize or enhance it
- Part of their job requirements (providing health / safety)
- Create educational programs
- Develop incentive programs
- Integrate into existing staff trainings

Engaging Residential Sector

Homeowners

- Long-term investment
- There are financial benefits
- Creating a place kids and grandchildren can return to

Renters / Landlords

- Cost savings

Engaging Commercial Sector

Make it about creating partnerships

Cost savings is important

Positive marketing matters

Other Sectors to Think About

- Youth
  - Engaging through the schools
  - A way to reach adults (recycling)
  - Broad range – higher education
- Seniors
- Media

Engaging the Media

Finding the right local reporters for your message

Develop a personal connection with them

Identify a newsworthy story

- Events
- Policy change
- Accomplishments

Create a press release

Remember all the different types of media available

- Newspapers
- Radio
- TV
- Magazines

Questions

Daniella Hirschfeld
Program Officer – ICLEI USA
daniella.hirschfeld@iclei.org

Missy Stults
Adaptation Manager – ICLEI USA
Missy.stults@iclei.org

Planning for Climate Change:
Providence

Dave Everett, Principal Planner/Environmental Coordinator, City of Providence Department of Planning and Development

October 28, 2010

RI DEM

Planning and Policy Efforts with Climate Change Implications:

- Providence Tomorrow: the Interim Comprehensive Plan - New section ("element") called "Sustainability and the Environment" with focus on emissions reduction, tree planting, waste reduction, green space, green buildings, environmental justice, etc. – has become a model for other communities
- Greenprint – City policy/action plan ICLEI membership; energy efficiency; alternative energy; waste reduction and recycling; and other best green practices for City operations and facilities; green development; green jobs; establishing a culture of sustainability
- On-street parking pilots – less paving, more green space
- Trees 2020 - planting/canopy coverage goals
- Transit 2020 – goals of increased ridership; improved access, service and routes; alternative modes, etc.

More Planning, Policy and Regulatory Efforts

- Zoning sections 425 and 427: Tree planting/Landscaping and pervious surface in residential zones (minimum 30%)
- Extensive tree planting at hospitals to reduce heat island effect – condition of approval of Institutional Master Plan process (RI Hospital and Women & Infants)
- More amendments to Comp Plan incorporating additional Greenprint initiatives, composting objectives, community gardening, etc. and highlighting accomplishments
- Current planning for grants targeting flood mitigation and business/job creation and retention: new approach emphasizing green principles including native planting/bank stabilization; rain gardens/detention ponds/swales; wetland/riparian buffer restoration; permeable driveways; less structural intervention and hardscape

More Planning, Policy and Regulatory Efforts

- Parks – expansion, less paving, more green space, community gardens, more trees
- Depaving initiatives (conceptual stage)
- Support for Urban Agriculture
- New Flood Zone Regulations: including freeboard requirements in coastal flood zones (CRMC/State Building Code-mandated)
- Implementation of Urban Coastal Greenways (UCG)

Opportunity:

"Green the Knowledge District" (GKD)

- OSCAR = Ocean State Consortium of Advanced Resources
- "Energy and Environment Collaboratory" – Green the Knowledge District Project
- Opportunity presented by relocation of I-195 – new development parcels = a rare blank slate opportunity (20 acres)
- Existing institutions (hospitals, colleges)and related growth industries
- City Support for GKD
- Data-driven approach – establishing baseline energy data and ultimately developing policy and perhaps a Climate Action Plan for the district
- Focus on energy efficiency but also likely to address stormwater, LID practices, water use, etc.
- A (climate neutral) model of energy efficiency, ecological health and sustainability, and quality of life for the city, state and beyond
- Attracting business by doing the right thing (a new business model)

What a Climate Action Plan might look like

TARGETS, MITIGATION STRATEGIES, TRACKING/REPORTING

- Emissions Inventory/History
- Business as Usual Projections: Historical and Build-out
- Minimum Actions: LEED; public transit use; waste minimization: performance contracting for energy efficiency and conservation?; fixture replacement/retrofitting; lighting controls; energy management systems; weatherization; etc.
- Reduction Goals
- Mitigation Strategies (conservation, efficiency, renewables, transportation)
- Standards for new construction; on-site stormwater/LID; incentives for green roofs, etc.
- Other: recycling/waste reduction/composting

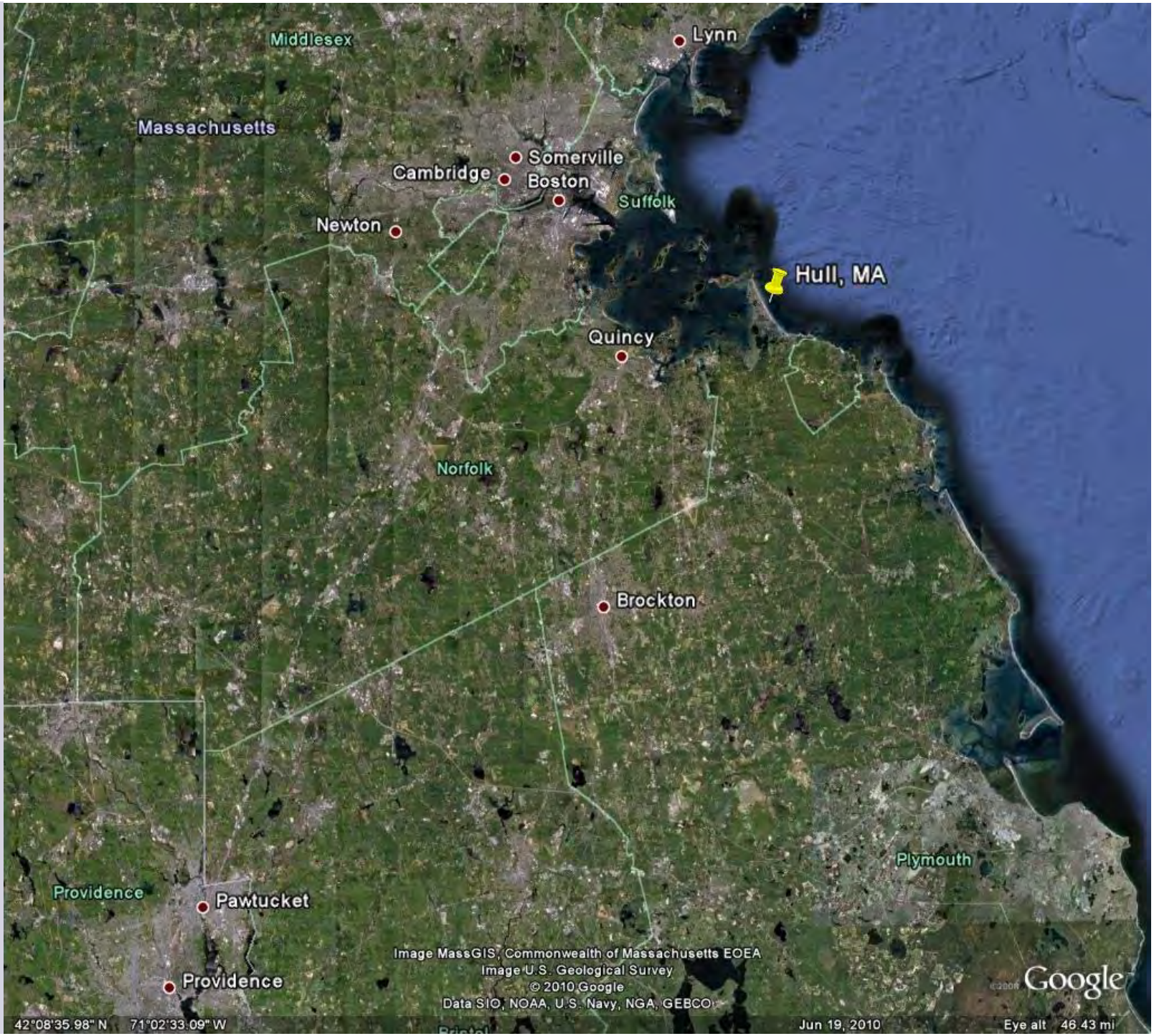
Meeting Challenges:

- Public and professional education essential
- Rally the troops and avoid turf battles – non-profits, institutions, businesses, government, etc.
- Data-driven decisions
- Sustain City support
- Sustain enthusiasm
- GKD: Translate the message into action and attraction – businesses attracted by the cause and by uniqueness, efficiency, design, etc.
- Political will: local and statewide, regardless of the economic climate
- Time/patience/political cycles

Planning for Community Climate Change Adaptation

October 28, 2010

Hull, MA



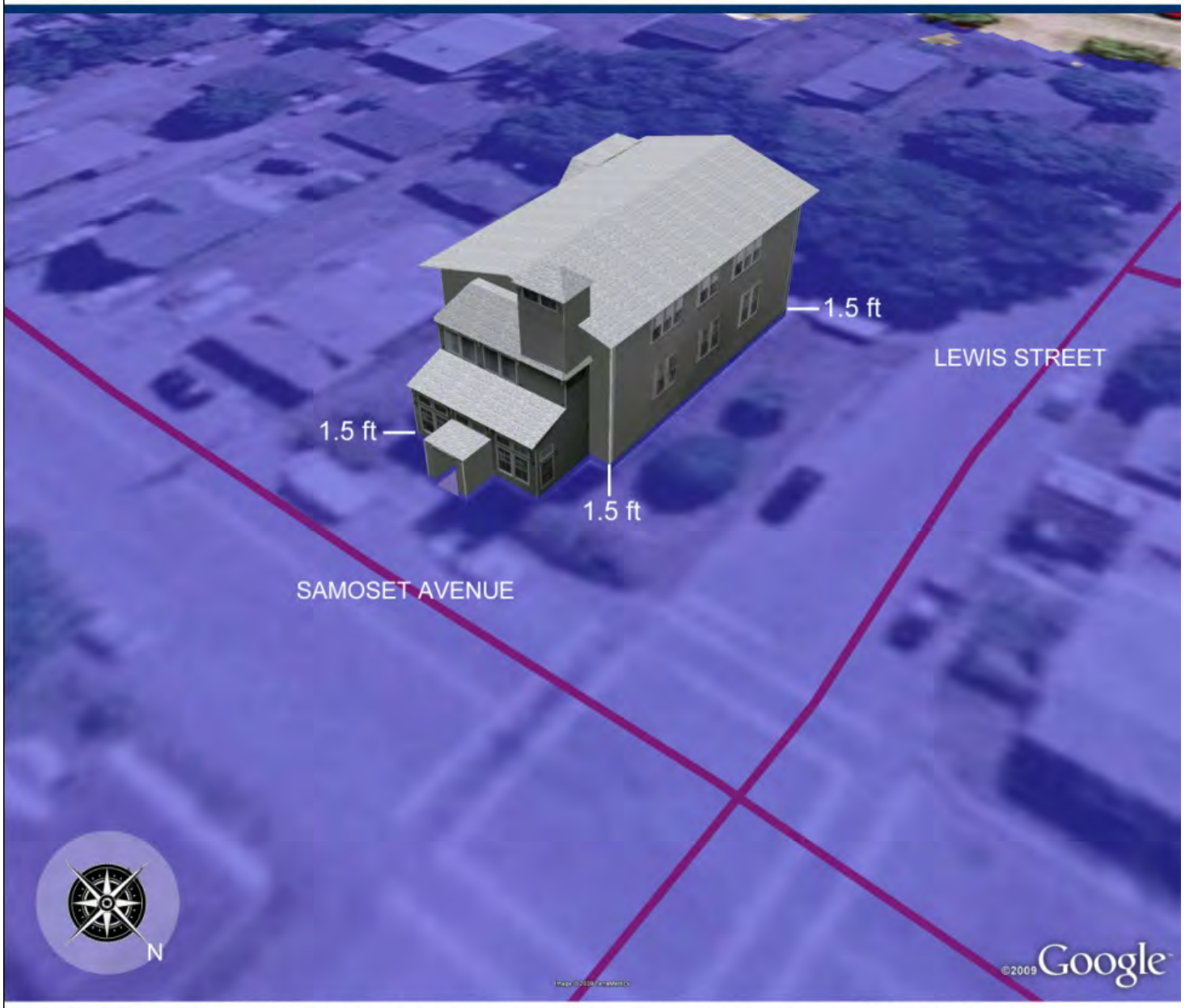
Preparing for Climate Change Impacts on Hull

Department Head Presentation
Anne Herbst
4/29/10

Gun Rock Patriots Day 2007

Scully Senior Center

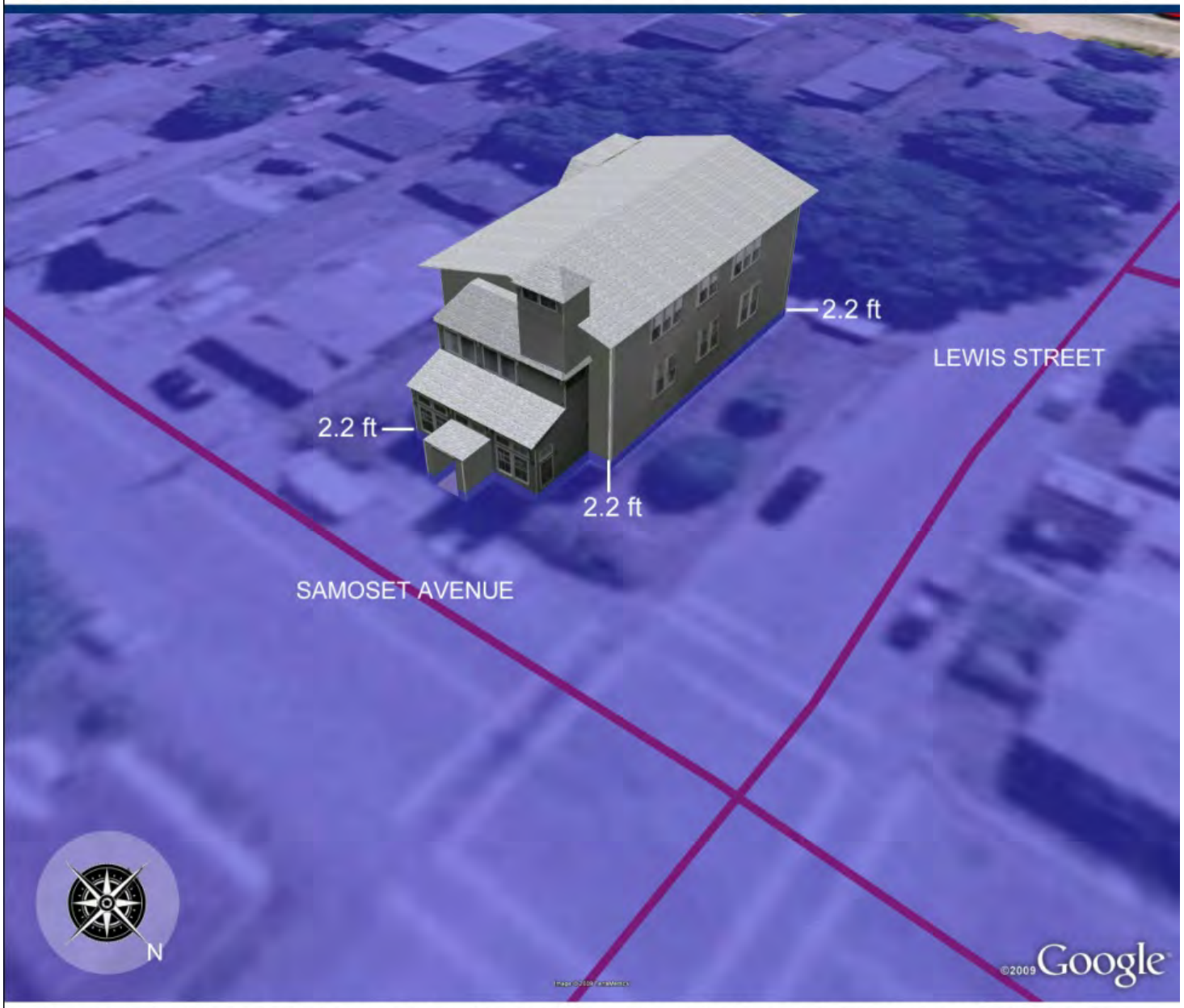
Flooding around critical facility from base flood plus 1 foot of sea level rise



Base flood is the flood having a one percent chance of being equaled or exceeded in any given year. Base Flood Elevations were taken from the Federal Emergency Management Agency Preliminary Digital Flood Insurance Rate Map for Plymouth County dated November 7, 2008. Labels represent flood water depths measured from the foundation at ground level. Vertical accuracy is +/- 1.0 ft. Completed October 2009.

Scully Senior Center

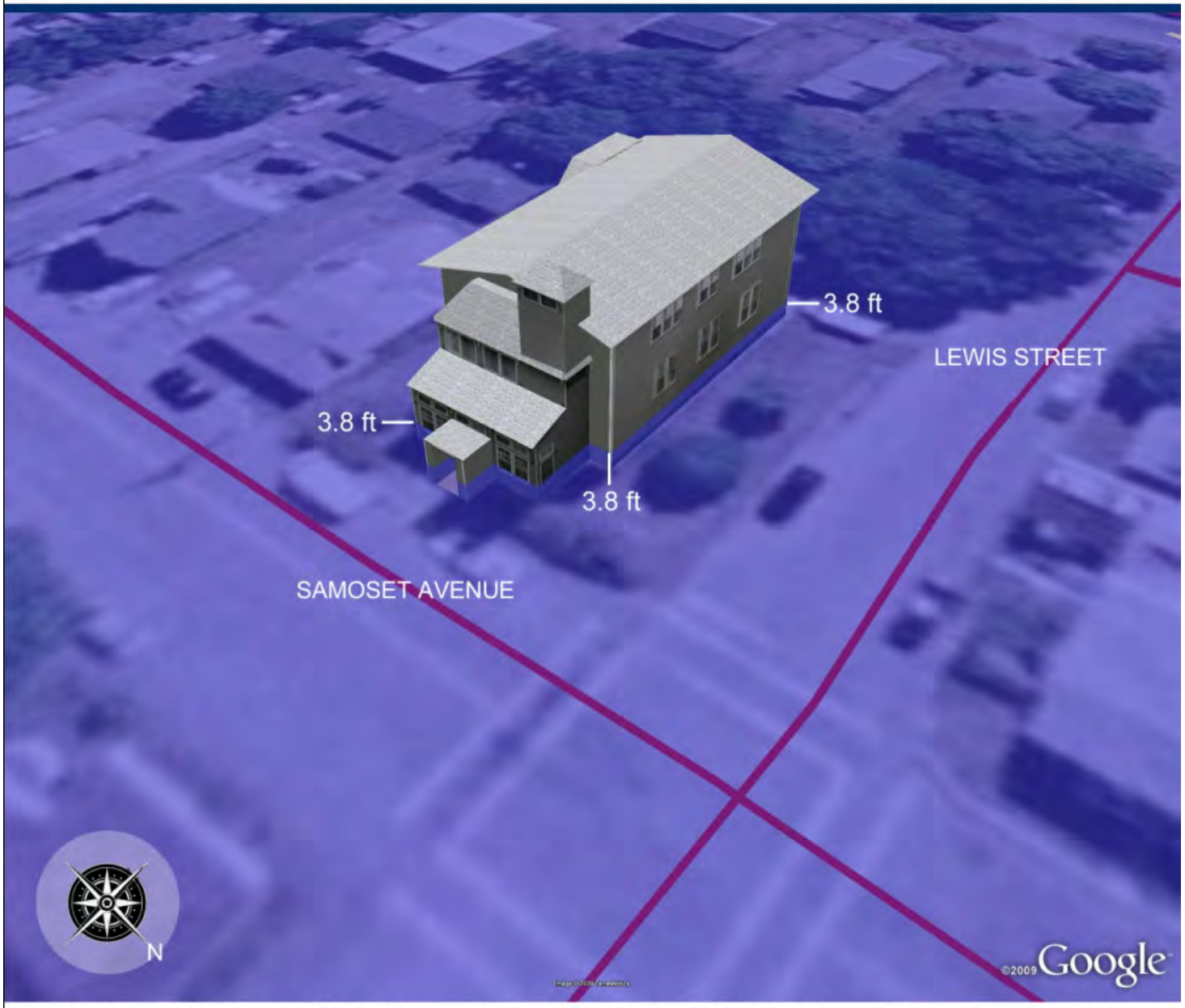
Flooding around critical facility from base flood plus 1.6 feet of sea level rise



Base flood is the flood having a one percent chance of being equaled or exceeded in any given year. Base Flood Elevations were taken from the Federal Emergency Management Agency Preliminary Digital Flood Insurance Rate Map for Plymouth County dated November 7, 2008. Labels represent flood water depths measured from the foundation at ground level. Vertical accuracy is +/- 1.0 ft. Completed October 2009.

Scully Senior Center

Flooding around critical facility from base flood plus 3.3 feet of sea level rise



Base flood is the flood having a one percent chance of being equaled or exceeded in any given year. Base Flood Elevations were taken from the Federal Emergency Management Agency Preliminary Digital Flood Insurance Rate Map for Plymouth County dated November 7, 2008. Labels represent flood water depths measured from the foundation at ground level. Vertical accuracy is +/- 1.0 ft. Completed October 2009.

Patriot’s Day storm 2007

A Street and Nantasket Avenue

Nantasket Beach

Damon Park

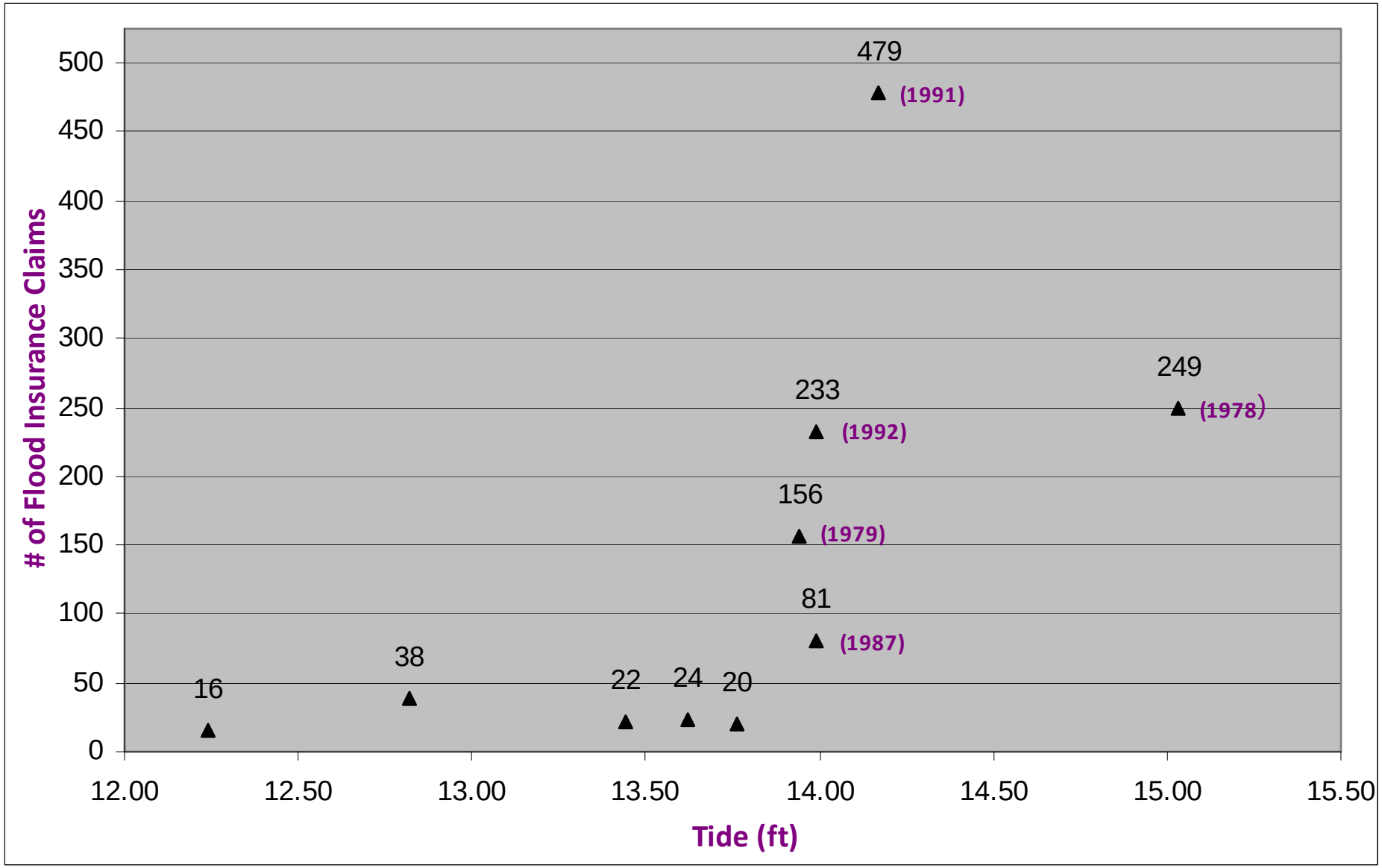
Stoney Beach

Gun Rock

Property damage after the blizzard

Northeast Storms in Hull – Top Ten Flood Insurance Claims

(1978-2007)



Thirty Years of Coastal Storms in Hull
Storms Tides and Flood Insurance Claims

Storm tide	Storms	Claims per storm	Average # of Claims
11-12 feet	5	3-6	4
12-13 feet	7	3-38	13
13-14 feet	9	3-233	61
14-15 feet (1991, 14.17)	1	479	479
15 feet + (1978, 15.03)	1	249	249

Analysis includes 23 coastal storms with at least 3 claims from 1978 to 2007

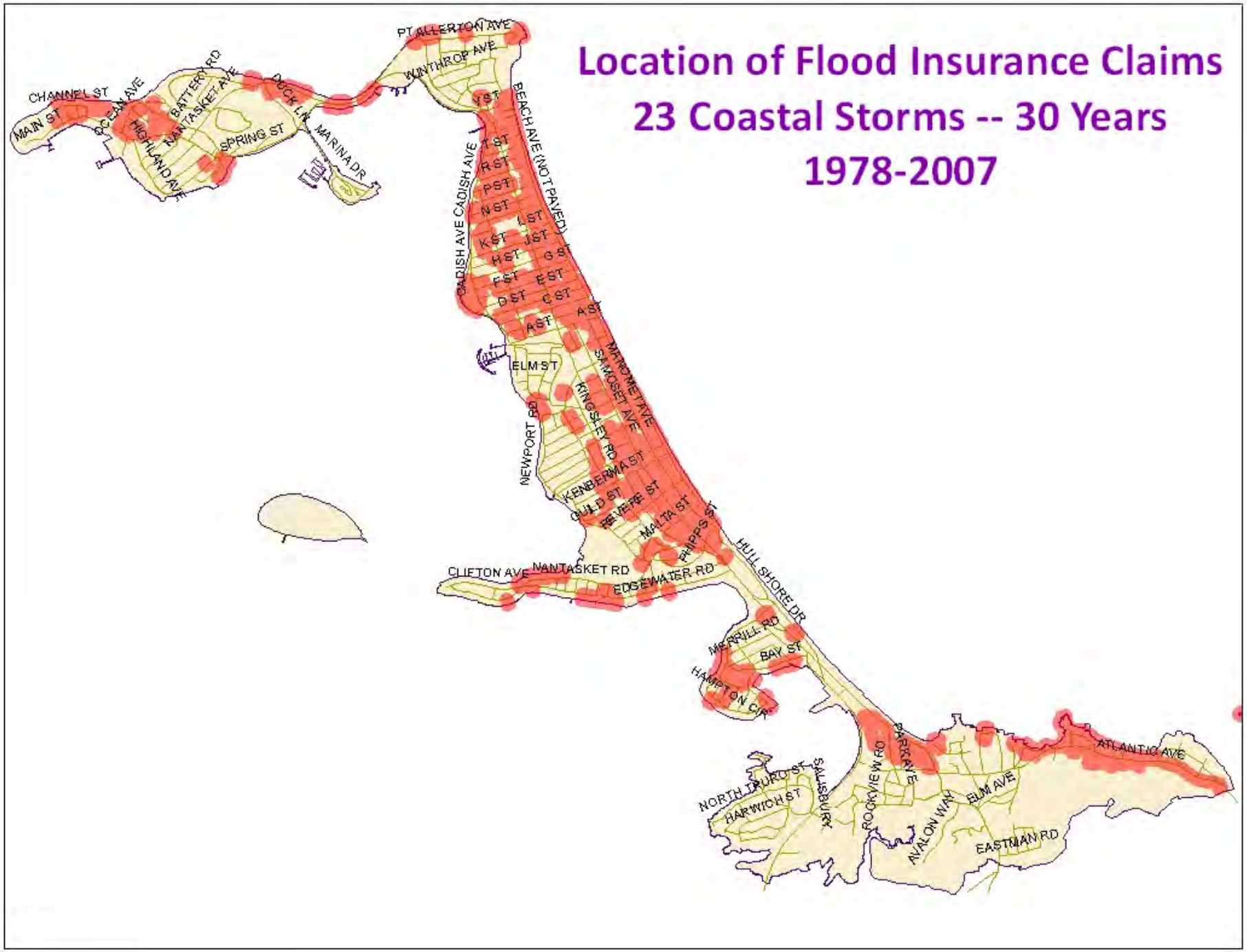
The Cost of Flood Damage

1978 through 2009

- 1,741 paid claims
- $12 million in damages

1991 'No Name Storm': $5 million in damages

Location of Flood Insurance Claims
23 Coastal Storms -- 30 Years
1978-2007



Hull Freeboard Incentive

$500 rebate of building permit fees for any building elevated two feet above state and federal flood zone requirements

Resources

Technical Report: Visualization of Inundation of Critical Coastal Facilities due to Flood Events and Sea Level Rise

Prepared by ASA, Narragansett, RI
for the MA Office of Coastal Zone Management
Contact Julia Knisel, MA CZM, for copies and information
Julia.Knisel@state.ma.us

Hull freeboard incentive information

http://www.town.hull.ma.us/Public_Documents/HullMA_conservation/elevate

Tools and Resources for Climate Change Adaptation

ICLEI Local Governments for Sustainability USA

What ICLEI's Climate Resilient Communities Program Can Offer

WWW.ICLEIUSA.ORG

ICLEI's Mission

Our mission is to build, serve, and drive a movement of local governments to advance deep ***reductions in greenhouse gas emissions*** and achieve tangible ***improvements in local sustainability***.

ICLEI strives to achieve this mission be delivering tools, resources, information, and networking experiences in three programmatic areas: climate mitigation, climate adaptation, and sustainability.

Where do our tools come from

In 2005 members articulated a need to prepare for climate change

Conducted successful pilot planning process in 2007 (with funding from NOAA) leading some key resources

Adaptation Steering Committee

- 22 Local Governments
- Range in size and region

Experts Advisory Committee

- 12 International experts
- Range of expertise

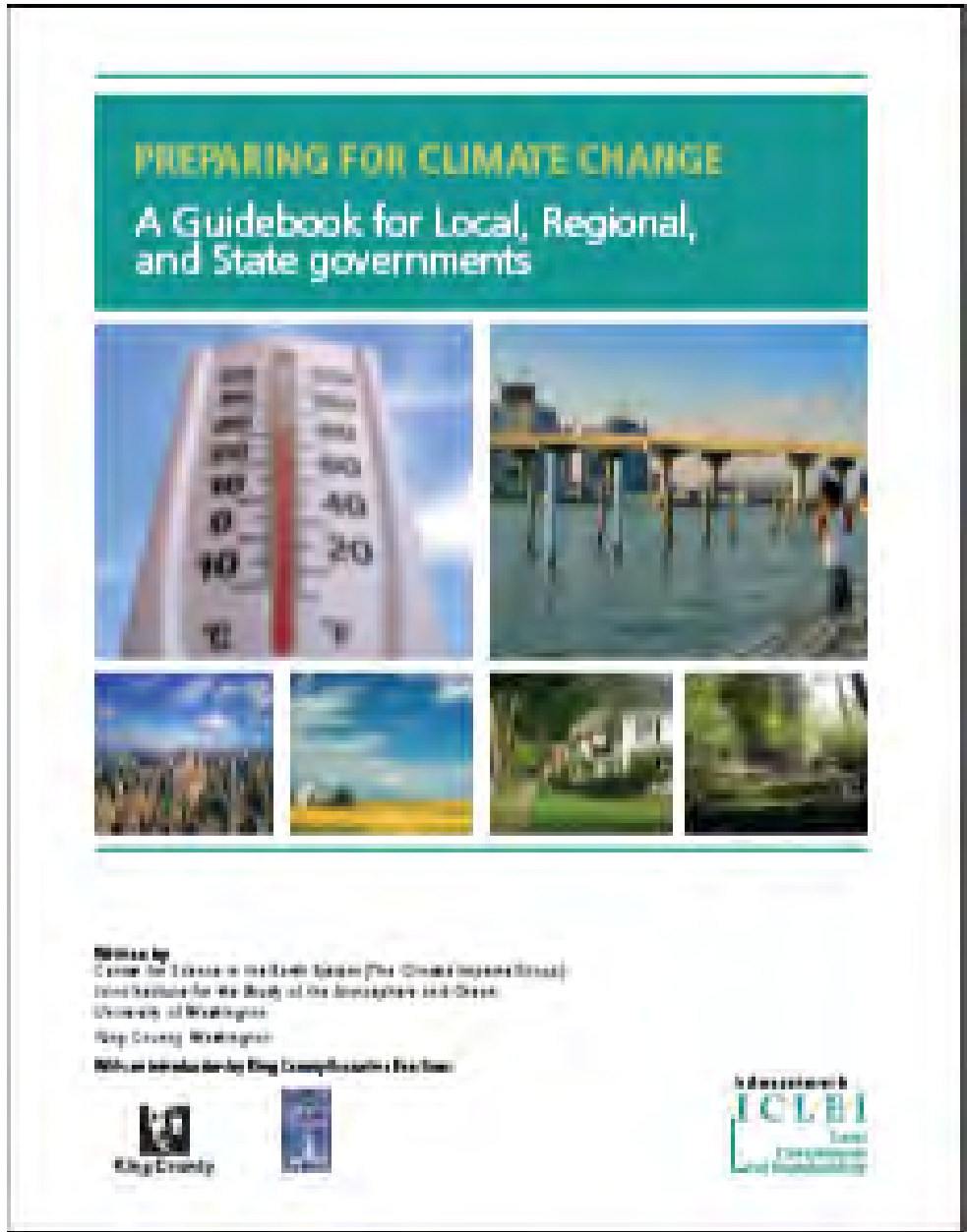
The Guidebook

Preparing for Climate Change: A Guidebook for Local, Regional and State Governments

Created in partnership with climate impacts group and King County WA

Launched in 2008

Provides detailed guidance on how to plan for climate change adaptation

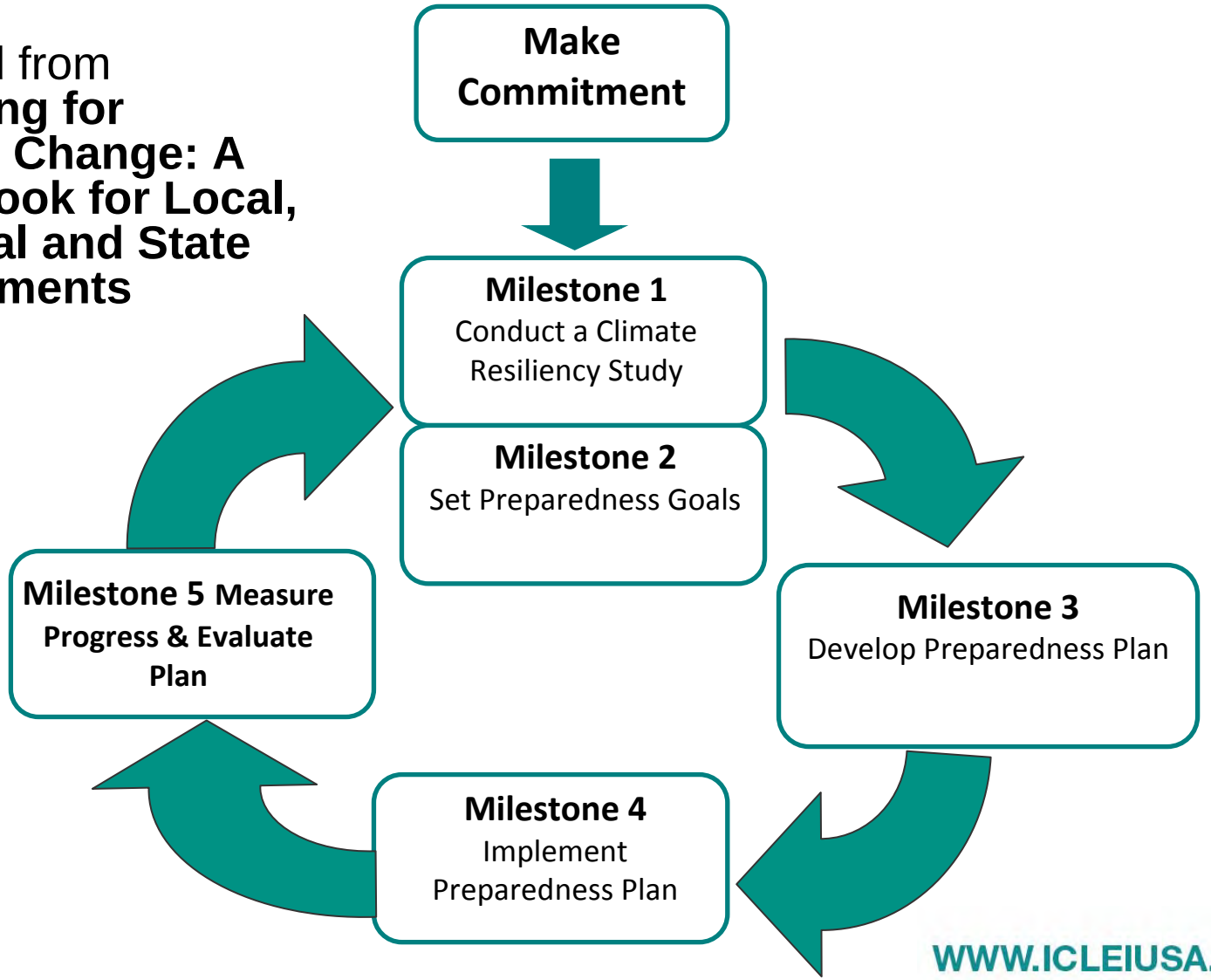


ADAPT – Adaptation Database and Planning Tool

What It Is	What It Is Not
An adaptation planning methodology	A decision support tool
A web based guide through the process	A climate science provider
A prioritization system	An expert in all fields

Five Milestones for Climate Adaptation

Adapted from **Preparing for Climate Change: A Guidebook for Local, Regional and State Governments**



WWW.ICLEIUSA.ORG

A First Look at Impacts

Primary Region Select your region of the U.S. from the drop down ↓	Reference	Primary Planning area likely to be impacted	Additional Planning Areas Likely to be Impacted	Relevant to my community?
Southeast		Select planning area in your community that is vulnerable to the identified impact ↘		
CURRENT IMPACTS				
Since 1970, the annual average temperature has risen about 2°F, with the greatest seasonal increase in temperature occurring during the winter months.	Source: NOAA 2009 - Unified Synthesis Product: Global Climate Change Impacts in the United States			
Average autumn precipitation has increased by 30 percent for the region since 1901.	Source: NOAA 2009 - Unified Synthesis Product: Global Climate Change Impacts in the United States			
There has been an increase in heavy downpours in many parts of the region, while the percentage of the region experiencing moderate to severe drought increased over the past three decades.	Synthesis Product: Global Climate Change Impacts in the United States			
The area of moderate to severe spring and summer drought has increased by 12 percent and 14 percent, respectively, since the mid-1970s.	Source: NOAA 2009 - Unified Synthesis Product: Global Climate Change Impacts in the United States			
The destructive potential of Atlantic hurricanes has increased since 1970, correlated with an increase in sea surface temperature. A similar relationship with the frequency of land falling hurricanes has not been established.	Synthesis Product: Global Climate Change Impacts in the United States			
PROJECTED IMPACTS	Source: NOAA 2009 - Unified Synthesis Product: Global Climate Change Impacts in			
The projected rates of warming are more than double those experienced in the Southeast since 1975, with the greatest temperature increases projected to occur in the summer months.	Synthesis Product: Global Climate Change Impacts in the United States			
average temperature. Under a lower emissions scenario, average temperatures in the region are projected to rise by about 4.5°F by the 2080s, while a higher emissions scenario yields about 9°F of average warming	Source: NOAA 2009 - Unified Synthesis Product: Global Climate Change Impacts in			

Introduction / Terminology / Overview / **PM1.1 First Look at Impacts** / PM1.2 Survey Staff / PM1.3 Opening Statements / PM1.4 Spread Prepar. Mes

Conducting a Vulnerability Assessment

Understanding Vulnerability

Vulnerability: The degree to which a system is susceptible to (sensitivity), and unable to cope with (adaptive capacity), adverse effects of climate change (including climate variability and extremes)

Sensitivity: The degree to which a built, natural, or human system is directly or indirectly affected by changes in climate conditions or specific climate change impacts. If a system is likely to be affected as a result of climate change, it should be considered sensitive to climate change

Adaptive Capacity: The ability of a system to adjust to climate change, to moderate potential damages, to take advantage of opportunities, or to cope with consequences

Assessing Vulnerability

To assess vulnerability, a user needs to know:

1. How the climate is changing
2. What systems could be affected by changes in climate
3. How those changes could (or already are) leading to impacts in identified systems

From here, users assess the sensitivity and adaptive capacity of systems likely to be impacted by climate change



Adaptation Resource Toolbox (ART)

Will conduct a needs assessment for the resources desired

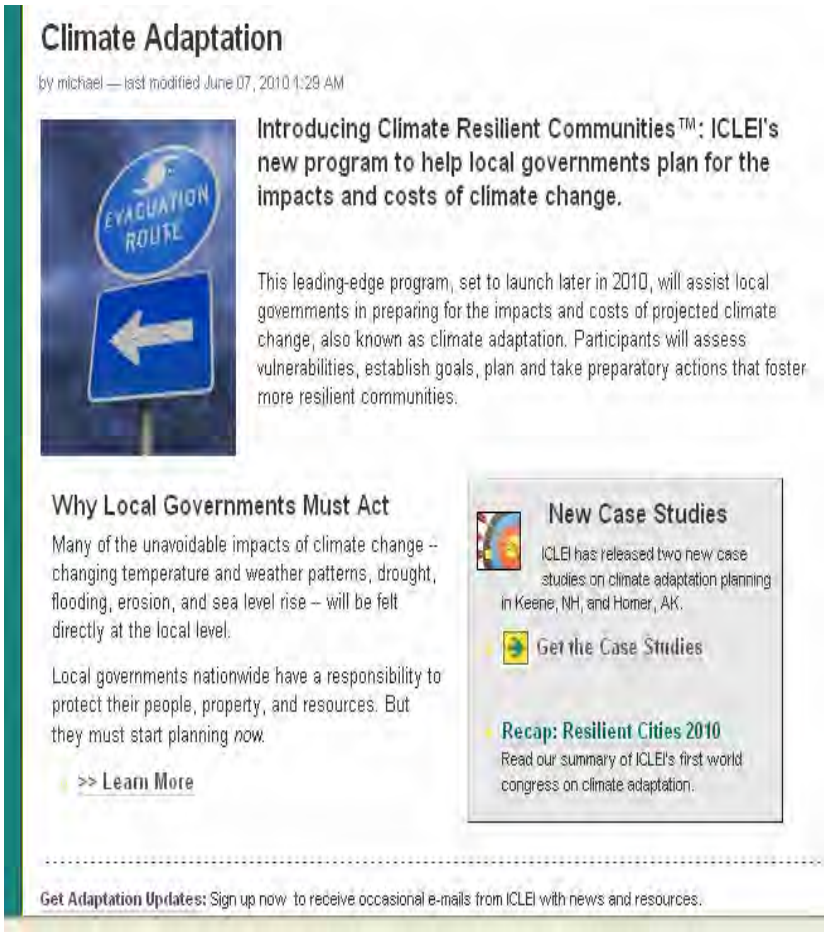
Will be a single source for accessing all adaptation tools

Will interact with ADAPT, but will provide different information

Will be coming out in a year

Other ICLEI Adaptation Tools

- Series of FAQs and discussion documents
- Case Studies on Keene, NH and Homer, AK
- *Mitigation-Adaptation Connection: Milestones, Synergies and Contradictions*
- Adaptation Talking Points
- Networking with other local governments



Climate Adaptation

by michael — last modified June 07, 2010 1:29 AM

Introducing Climate Resilient Communities™: ICLEI's new program to help local governments plan for the impacts and costs of climate change.

This leading-edge program, set to launch later in 2010, will assist local governments in preparing for the impacts and costs of projected climate change, also known as climate adaptation. Participants will assess vulnerabilities, establish goals, plan and take preparatory actions that foster more resilient communities.

Why Local Governments Must Act

Many of the unavoidable impacts of climate change -- changing temperature and weather patterns, drought, flooding, erosion, and sea level rise -- will be felt directly at the local level.

Local governments nationwide have a responsibility to protect their people, property, and resources. But they must start planning *now*.

>> Learn More

New Case Studies

ICLEI has released two new case studies on climate adaptation planning in Keene, NH, and Homer, AK.

Get the Case Studies

Recap: Resilient Cities 2010

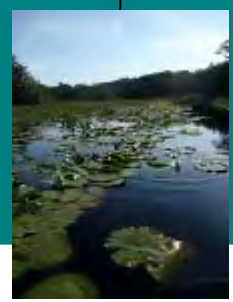
Read our summary of ICLEI's first world congress on climate adaptation.

Get Adaptation Updates: Sign up now to receive occasional e-mails from ICLEI with news and resources.

Adaptation – Mitigation Synergies

Energy	
Mitigation	**Adaptation**
Reduce emissions by expanding use of renewable sources	Reduce vulnerability to widespread power grid outages by encouraging distributed generation from multiple renewable sources (solar, wind, biogas, landfill methane, etc.)

Water	
Mitigation	**Adaptation**
Reduce emissions by reducing water use (less energy required for treating and transporting water)	Conserve water so more is available during more frequent and severe droughts



Questions

Daniella Hirschfeld
Program Officer – ICLEI USA
daniella.hirschfeld@iclei.org

Missy Stults
Adaptation Manager – ICLEI USA
Missy.stults@iclei.org

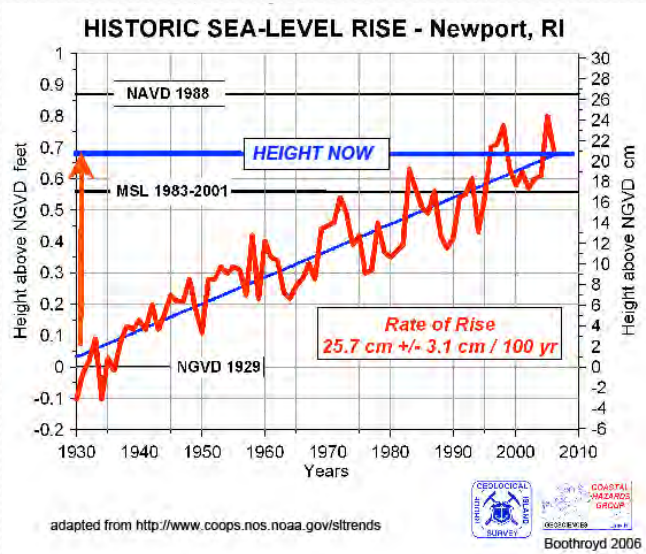
Resources for Local Officials

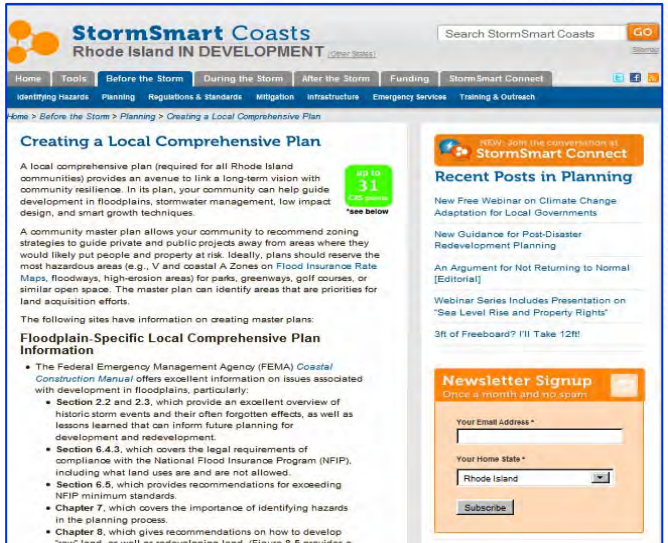
Pam Rubinoff
URI Coastal Resources Center
RI Sea Grant



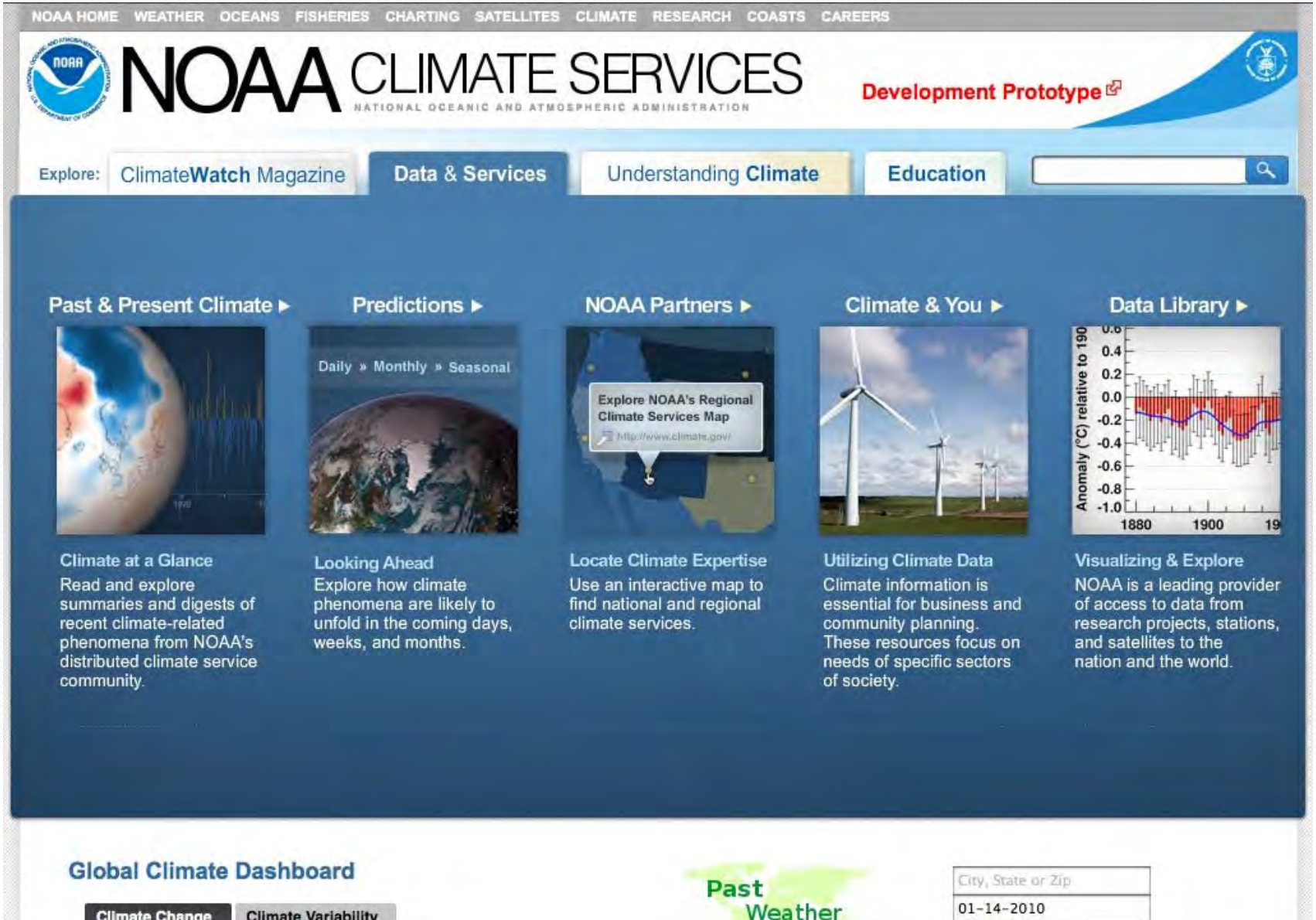
Local Resources

- Science
- Management
- Outreach
- Research

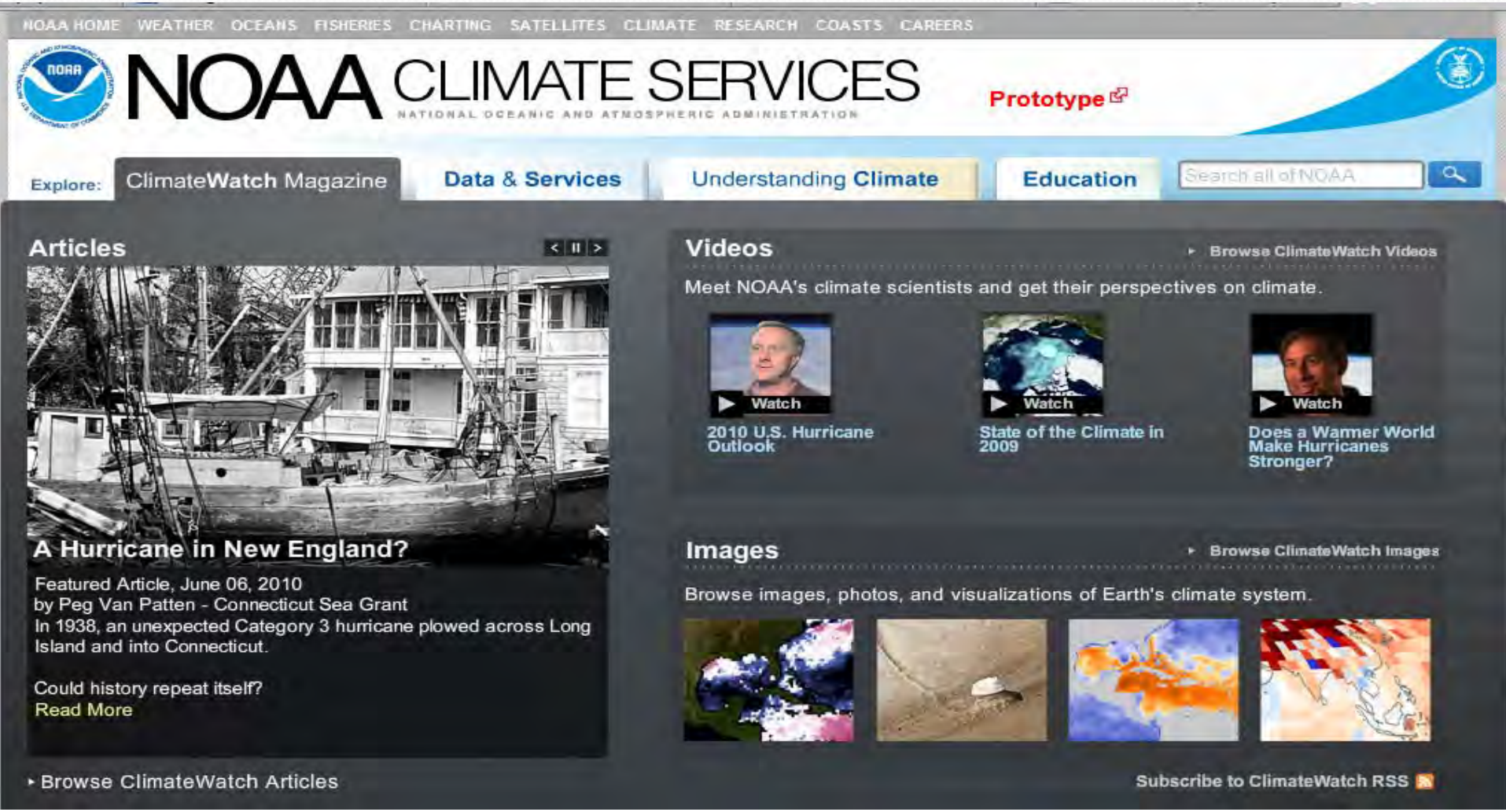




www.Climate.gov



Diverse Media



Daily tide conditions

Wickford, September 10, 2010

Photo: Teresa Crean

Daily tide conditions
Wickford, September 10, 2010

Photo: Teresa Crean


Angela Wilson RI Sea Grant

3 feet above high tide

Angela Wilson RI Sea Grant

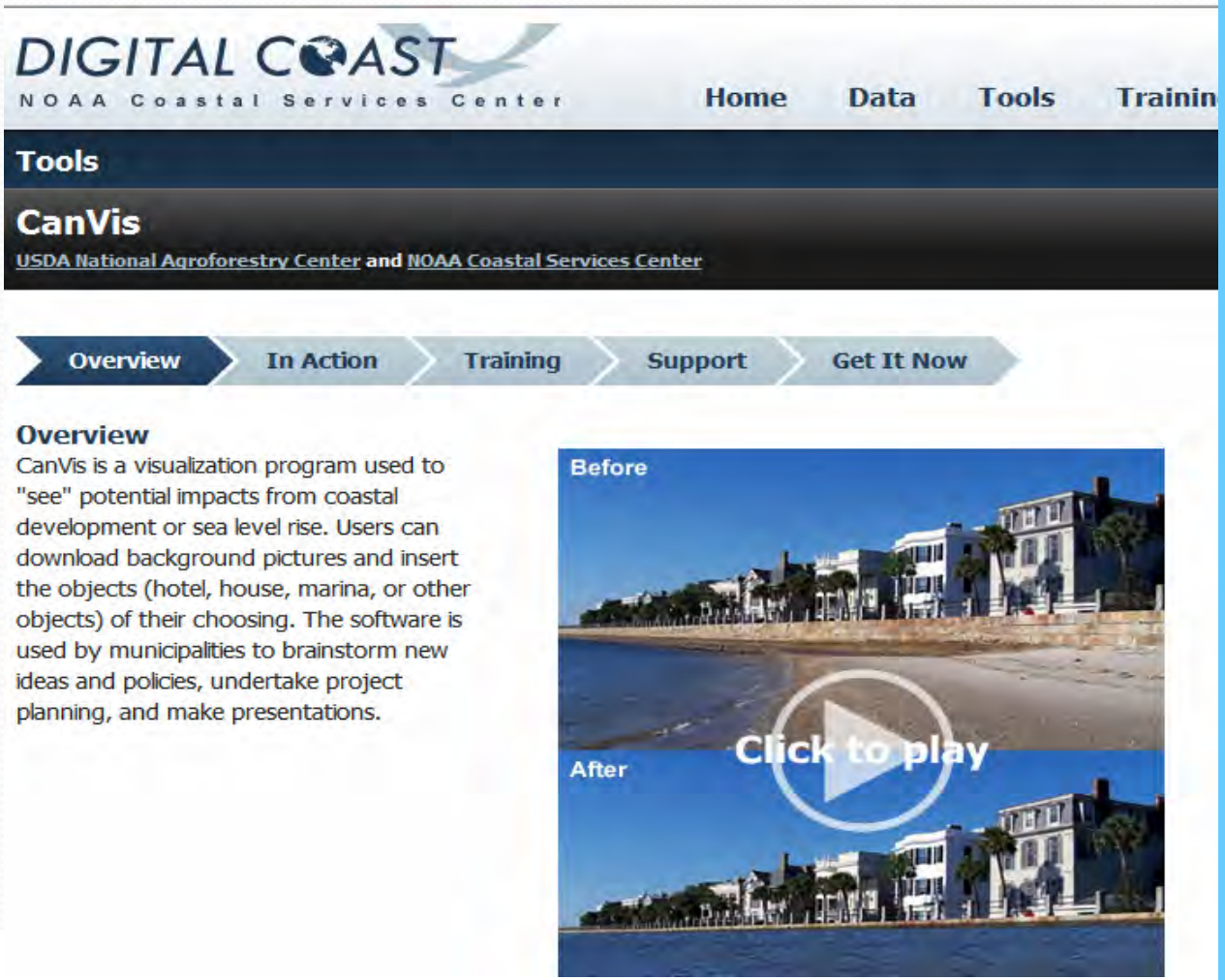
3 feet over spring

Angela Wilson RI Sea Grant

5 feet above spring

Angela Wilson RI Sea Grant

Visualizations



http://www.csc.noaa.gov/digitalcoast/tools/canvis/

RI Visualizations

N. Kingstown

S. Kingstown

Charlestown

Westerly

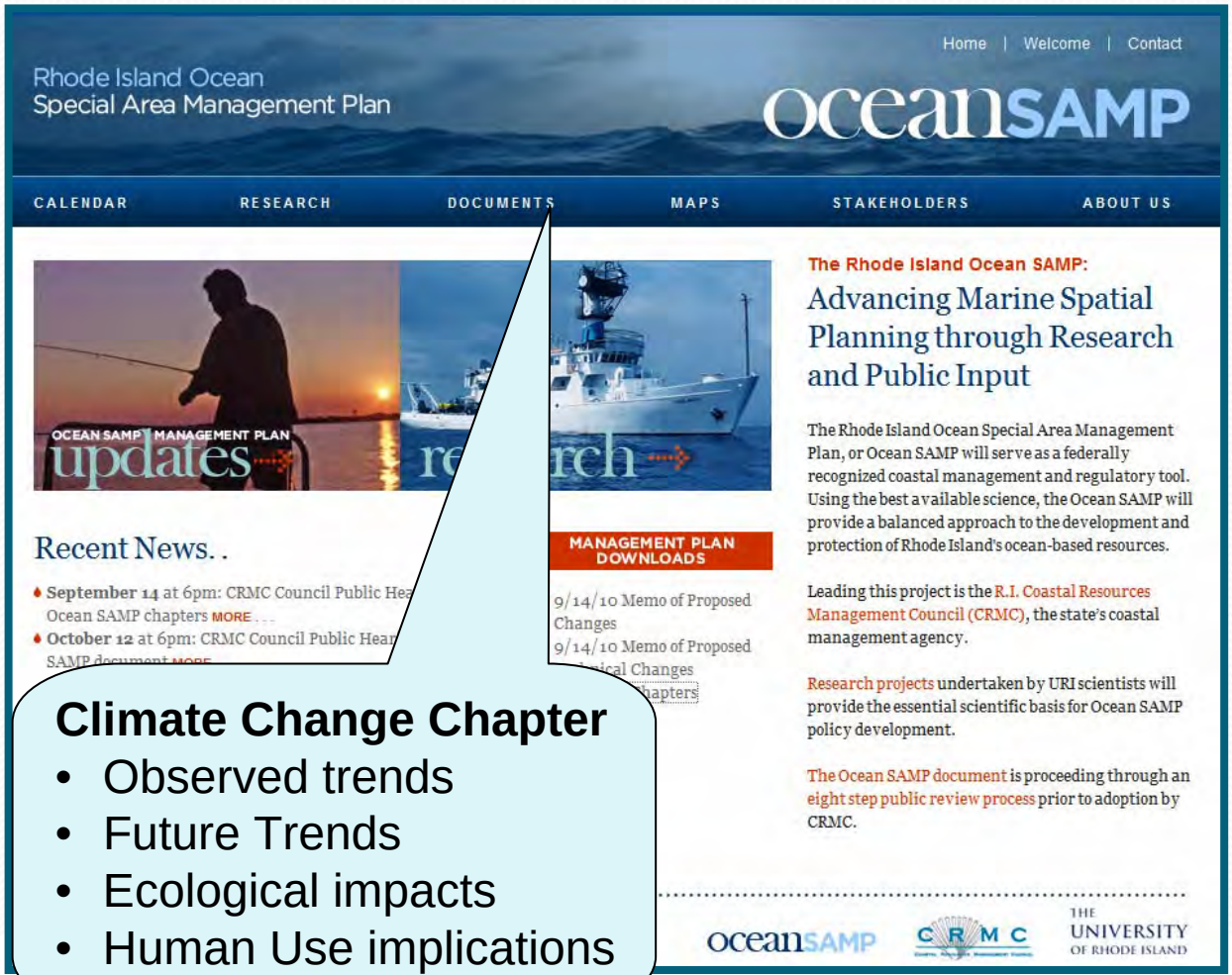
Newport

Providence

East Providence

Pawtucket

Rhode Island Information



Climate Change Chapter

- Observed trends
- Future Trends
- Ecological impacts
- Human Use implications

Summary: Preliminary Assessment of Rhode Island's Vulnerability to Climate Change and its Options for Adaptation Action

Brown Center for Environmental Studies

www.seagrant.gso.uri.edu/oceansamp/

www.seagrant.gso.uri.edu/coasts

Rhode Island **Sea Grant**

FUNDING OPPORTUNITIES
BAIRD SYMPOSIUM
SITE MAP
CONTACT

HOME | ABOUT | RESEARCH | NEWS | COASTAL COMMUNITIES | FISHERIES | LAW | BOOKSTORE | STAFF

PROGRAM AREAS

Ecosystem Based Management

+ RI Ocean SAMP
+ Aquidneck Island SAMP
+ Metro Bay SAMP
+ Greenwich Bay SAMP

Vibrant Waterfronts

+ Newport Harbor
+ RI Ports & Harbors Inventory
+ Coastal Smart Growth

Climate Change & Coastal Hazards

Climate Change & Coastal Hazards

Rhode Island, like many places worldwide, is taking steps to meet the impacts of changing climate and weather patterns. These impacts, whether the result of abrupt storms or gradual sea level rise, stand to alter shoreline areas significantly. Sea Grant helps coastal communities by crafting, testing, and building support for planning policies that speak to the stages of confronting coastal hazards -- preparation, immediate recovery, and long term adaptation.

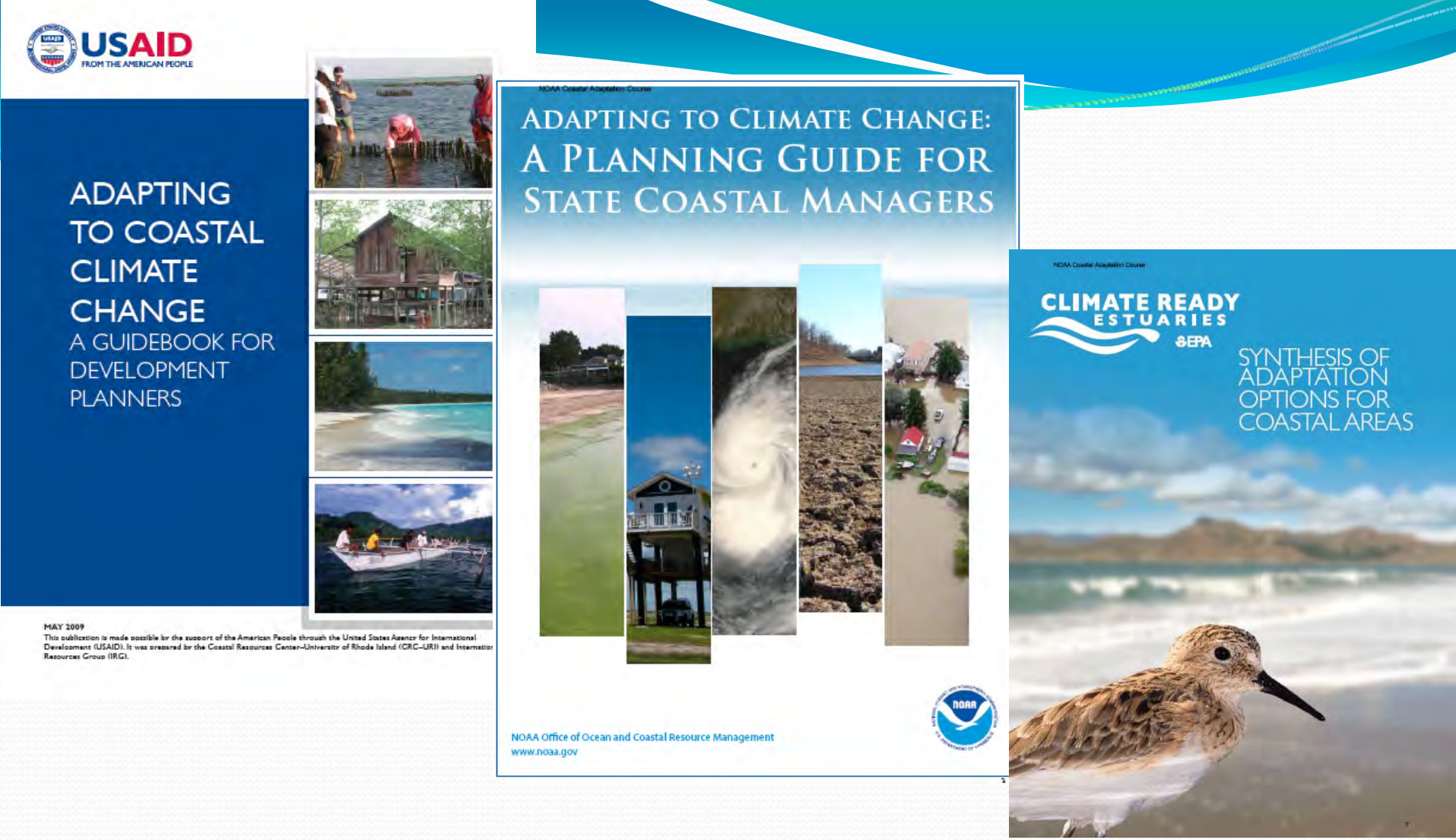
Sea Grant has engaged local communities in coastal hazards planning for three decades with policies that serve as national models. Efforts include:

- Fostering adoption of the country's first sea level rise policy for coastal development and management.
- Enhancing hurricane recovery efforts by addressing planning needs concerning the storm aspect of climate change

Contact

Pam Rubinoff
Coastal Management Specialist
Tel: (401) 874-6135
Fax: (401) 874-6920
E-mail: rubi@crc.uri.edu

GIVING
TO RI SEAGRANT



www.crc.uri.edu/download/CoastalAdaptationGuide.pdf
www.coastalmanagement.noaa.gov/climate/adaptation.html

www.epa.gov/climatereadyestuaries/downloads/CRE_Synthesis_1.09.pdf

StormSmart Coasts
Rhode Island IN DEVELOPMENT (Other States)

Search StormSmart Coasts GO

Home | Tools | Before the Storm | During the Storm | After the Storm | Funding | StormSmart Connect

About Us | CRS Primer | Newsletter | Current Storm Outlook | 2010 Floods | Where to Begin | No Adverse Impact (NAI) | Legal Introduction

before the storm

preparing your community for weather and climate hazards

(new? start here)

Read More

- Latest News
- Funding
- Before the Storm
- After the Storm
- During the Storm

Before the Storm
Preparing Your Community

Learn what steps your community can take to help prepare for storms.
Learn More

During the Storm
Emergency Contacts

A storm is on top of you: do you know who to call, and where to get the latest information?
Learn More

After the Storm
Safe & Smart Recovery

How to rebuild and recover as quickly and safely as possible.
Learn More

Funding
Where to Find Help

Some of your priorities are going to be both critical and costly. Luckily, there's funding out there: we've gathered it.
Learn More

Latest Posts on StormSmart Coasts

Posted on October 27, 2010

Quick Proof that Building Codes Work [video]

The Institute for Business and Home

NEW: Join the conversation at
StormSmart Connect

Featured Page

Using Freeboard to Elevate Structures Above Predicted Floodwaters

Tools

Following are some of the many tools you may wish to explore in your work to reduce your community's risks. Know of a tool you think should be here? Please let us know.

Current Storm Outlook

How things are looking (weather-wise) in Rhode Island right now.

Current Rhode Island Storm Outlook

Hurricane Tracker

A closer look at potential extreme weather.

Hurricane Tracker

NEW: Join the conversation at StormSmart Connect

Upcoming Events

Tomorrow

Post-Disaster Redevelopment Planning Workshop (FL)

Nov 01

Collaborative Scientific Research Opportunities Relative to the Gulf Oil Spill

Nov 03

Get The Grant! Insider Tips for Writing and Winning Community Resiliency, Green Infrastructure and Coastal Restoration Grants

Nov 04

Get the Grant! Funding Your Community Resiliency, Green Infrastructure or Coastal Restoration Project

WEBINAR: Recreational Boating and Submerged Lands

» More events

StormSmart Coasts
Rhode Island IN DEVELOPMENT (Other States)

Search StormSmart Coasts GO

Sitemap

Home | Tools | Before the Storm | During the Storm | After the Storm | Funding | StormSmart Connect

Identifying Hazards | Planning | Regulations & Standards | Mitigation | Infrastructure | Emergency Services | Training & Outreach

Creating a Local Comprehensive Plan
Creating a Multi-Hazard Mitigation Plan
Creating Risk Mitigation Strategies
Creating a Multi-Objective Management Plan

Home > Before the St

Planning

Planning is a pc community to protect its people and property by taking proactive steps—like preventing growth in hazardous areas—that ultimately safeguard your community and its financial resources. For example, well-planned development is less likely to necessitate costly evacuations or lead to damaged infrastructure.

Below is a menu of planning options.

General Planning

- Creating a community master plan that outlines your community's general land use goals and priorities.
- Creating a multi-hazard mitigation plan that describes what hazards your community faces, and what it plans to do about them.

Risk Analysis and Management

- Creating risk mitigation strategies that provide a more detailed look at your hazards and the specific ways that your community can work to protect itself from them.

Multi-Objective Management

- Creating a multi-objective management plan that provides a comprehensive approach to how your community intends to meet all of its goals, including economic, preservation, and hazard-related.

Image: NOAA Coastal Services Center.

NEW: Join the conversation at StormSmart Connect

Recent Posts in Planning

New Free Webinar on Climate Change Adaptation for Local Governments

New Guidance for Post-Disaster Redevelopment Planning

An Argument for Not Returning to Normal [Editorial]

Webinar Series Includes Presentation on "Sea Level Rise and Property Rights"

3ft of Freeboard? I'll Take 12ft!

Newsletter Signup

Once a month and no spam

Your Email Address *

Your Home State *

Rhode Island

Subscribe

Creating a Local Comprehensive Plan

A local comprehensive plan (required for all Rhode Island communities) provides an avenue to link a long-term vision with community resilience. In its plan, your community can help guide development in floodplains, stormwater management, low impact design, and smart growth techniques.

up to 31 CRS points
*see below

A community master plan allows your community to recommend zoning strategies to guide private and public projects away from areas where they would likely put people and property at risk. Ideally, plans should reserve the most hazardous areas (e.g., V and coastal A Zones on Flood Insurance Rate Maps, floodways, high-erosion areas) for parks, greenways, golf courses, or similar open space. The master plan can identify areas that are priorities for land acquisition efforts.

The following sites have information on creating master plans:

Floodplain-Specific Local Comprehensive Plan Information

- The Federal Emergency Management Agency (FEMA) *Coastal Construction Manual* offers excellent information on issues associated with development in floodplains, particularly:
  - **Section 2.2** and **2.3**, which provide an excellent overview of historic storm events and their often forgotten effects, as well as lessons learned that can inform future planning for development and redevelopment.
  - **Section 6.4.3**, which covers the legal requirements of compliance with the National Flood Insurance Program (NFIP), including what land uses are and are not allowed.
  - **Section 6.5**, which provides recommendations for exceeding NFIP minimum standards.
  - **Chapter 7**, which covers the importance of identifying hazards in the planning process.
  - **Chapter 8**, which gives recommendations on how to develop "raw" land, as well as redeveloping land. (Figure 8-5 provides a

Town or City Council or Town Manager

As community Chief Executive Officer you are responsible for administering the essential functions of the municipality, such as selecting appointed officials, hiring staff, and paying bills. Depending on which community you serve, you may also have special permit issuance authority.

The members of your community look to you to protect its people, property, and tax dollars. Improving the way your community manages its floodplains can help meet all these goals.

Following are some of the ways that you can take action:

Hazard Identification and Mapping

- Interpreting Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies
- Understanding the limitations of Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies
- Sharing emergency information

Planning

- Creating risk mitigation strategies
- Creating a multi-objective management plan

Regulation and Development Standards

- Keeping public infrastructure outside of damage-prone areas
- Using freeboard to elevate structures above predicted floodwaters

Mitigation

- Using non-structural shore protection
- Using flood and erosion control structures
- Retrofitting existing structures
- Relocating existing structures
- Acquiring existing structures

Featured Page

Using Freeboard to Elevate Structures Above Predicted Floodwaters

Training & Outreach

If local officials are unaware of the extent of their risk or what they can do about it, they cannot make the best possible decisions. The same holds true for citizens (whose votes may be needed for zoning changes and budget increases aimed at improving a community's safety), and visitors who need to know how to prepare for and respond to a major hazard event.

Helping your residents understand their risks is a key part of making your community safe.

From specialized (and often free) training for local officials to general printed information for citizens, all of these resources can be used for a successful education and outreach campaign. Nonprofit organizations may be of particular help with outreach, including regional planning agencies, watershed associations, conservation organizations, and state agencies.

Below is a list of education and outreach topics.

- General hazard awareness
- Hazard training for local officials
- Sources for outreach materials

NEW: Join the conversation at StormSmart Connect

Recent Posts on Training & Outreach

Quick Proof that Building Codes Work [video]

Quick and Easy Way to Create Storm Surge Maps

New Free Webinar on Climate Change Adaptation for Local Governments

Training: Basic Concepts for Floodplain Management [December 14-15, Virginia]

Facebook vs Twitter: Which to Use for What in Emergency Management

Webinar Series Includes Presentation on "Sea Level Rise and Property Rights"

Ideas on How to Engage Your Businesses in Emergency Preparedness

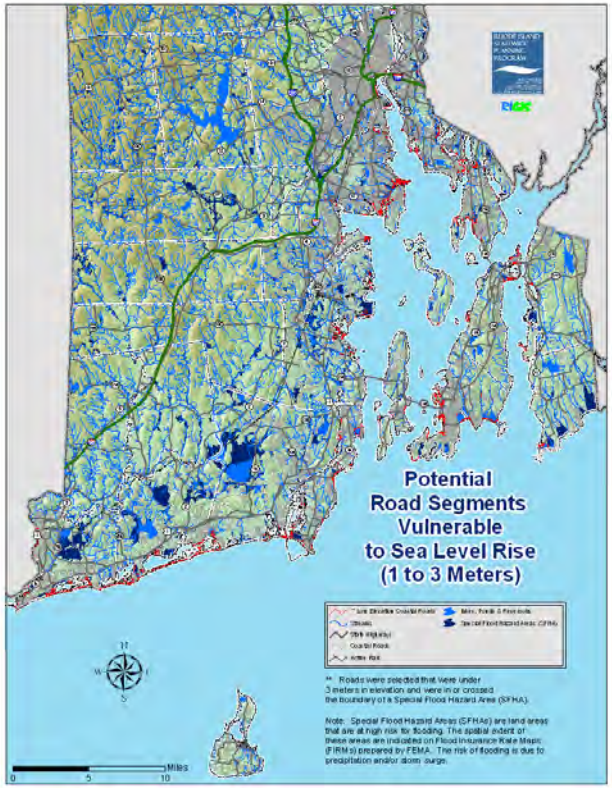
Are You Using Social Media for Emergency Management? Your Citizens Are!

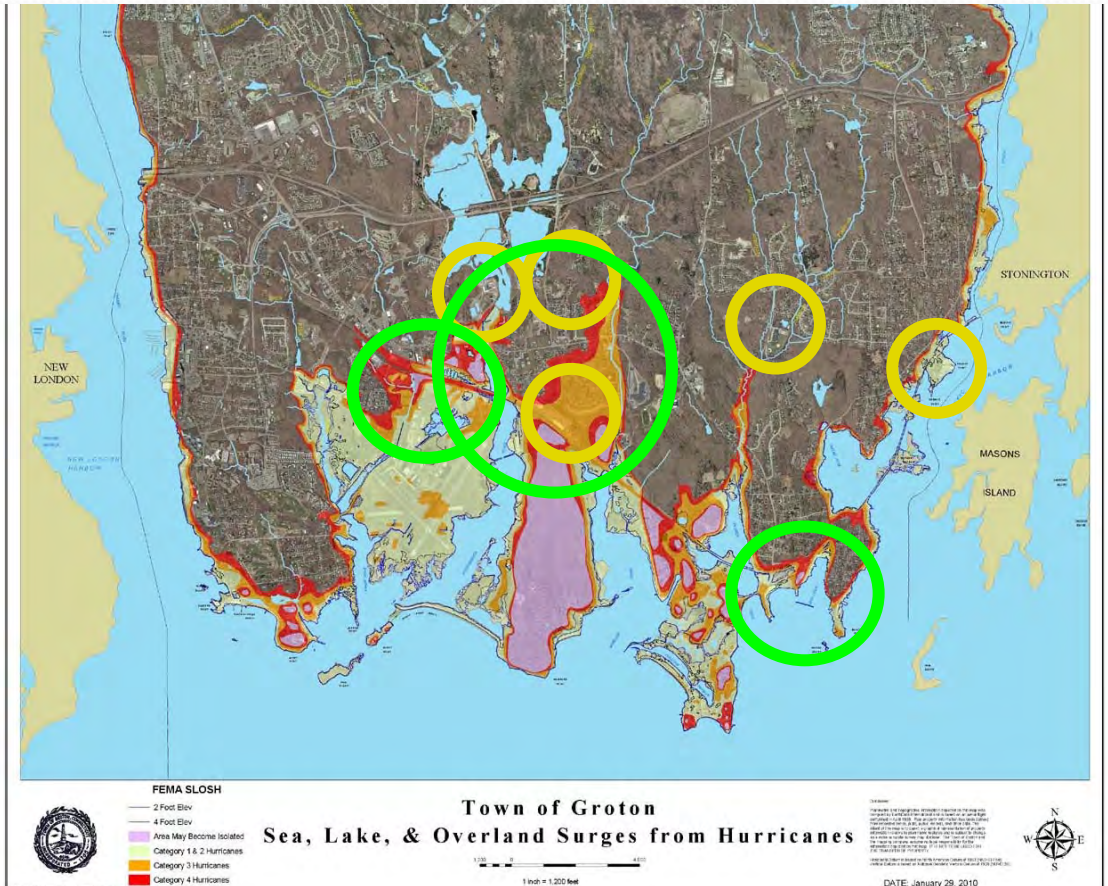
Webinar: Climate Resilient Coastal Communities (Wednesday July 28)

Introducing StormSmart Connect

Coming soon….

Maps of Rhode Island's Assets Vulnerable to Sea Level Rise





Coming soon…

Potential Wetlands Advancement

In progress

- Research on stages of behavior change for climate adaptation:

  Support policy/programs, educate yourself, take action

- Update the science
- Communication tools
- Share with key stakeholder groups

Your input would be useful

1. *List 3 specific ways planners/local officials can take to prepare for flooding and erosion from accelerated sea level rise and increased storminess?*

Sea level rise, increased storminess

2. *What can your constituents do to adapt?*

•Support policy/programs
• educate yourself
•take action

3. *What can you do, as a citizen, to adapt?*

Thank You

For More information Contact

Pam Rubinoff
URI Coastal Resources Center/RI Sea Grant
rubi@crc.uri.edu

Planning for Community Climate Change Adaptation

Rhode Island Climate Change Programs: Implications for Local Planning Efforts

October 28, 2010

CRMC
Coastal Resources Management Council

December 12, 2008

What We Know:

- Global climate is changing – it is getting warmer
- Sea level is rising as a result of global warming
- Coastal properties, public infrastructure, and natural resources are at or will be at risk with rising sea levels

Patriot's Day Nor'easter
April 2007
Tides 3 feet above normal

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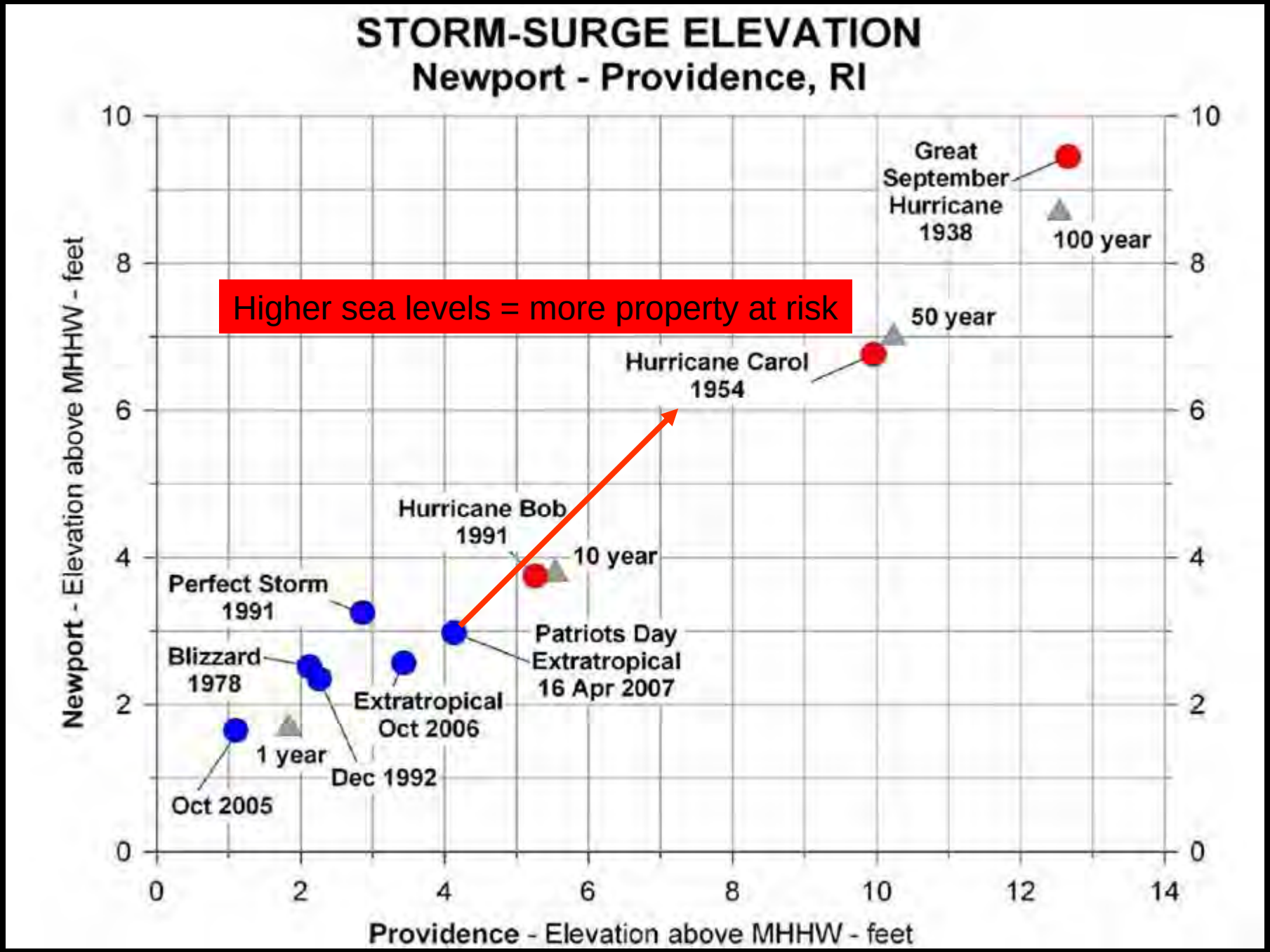

Graphic courtesy of Jon Boothroyd URI

What to expect in the future

- Shorelines will continue to erode
- Higher storm surges due to higher sea levels
- Storm surge impacts will be felt farther inland

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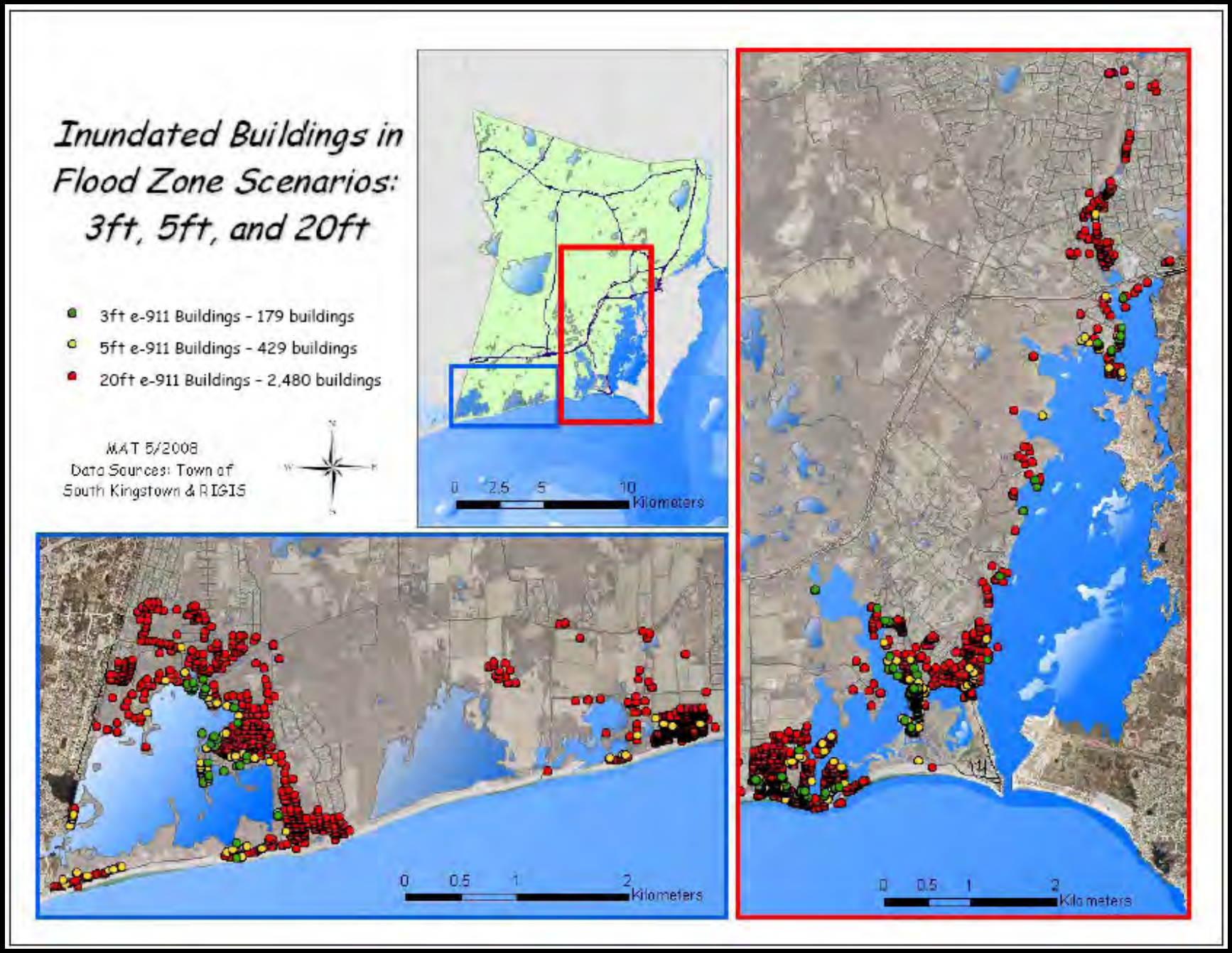
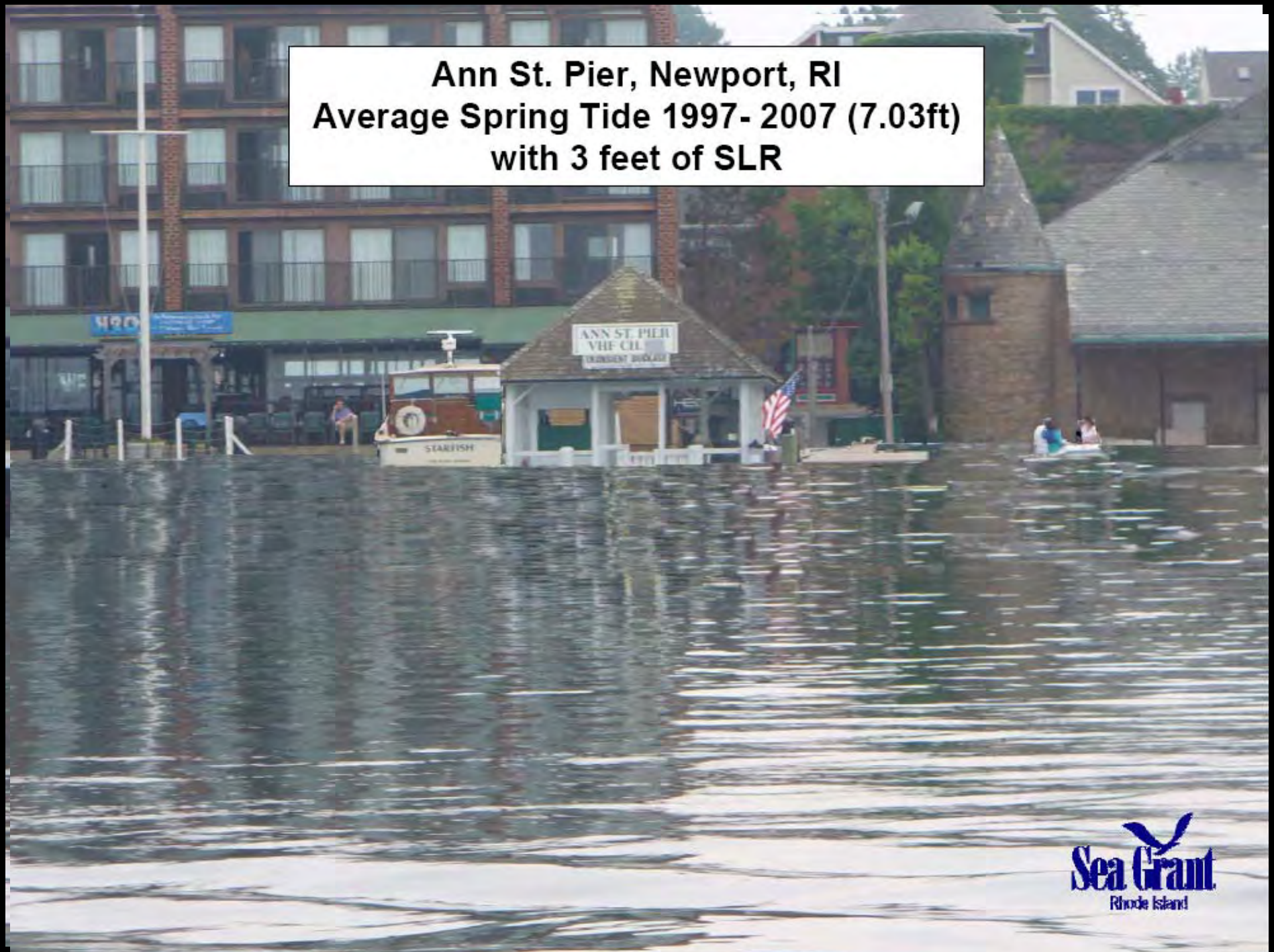
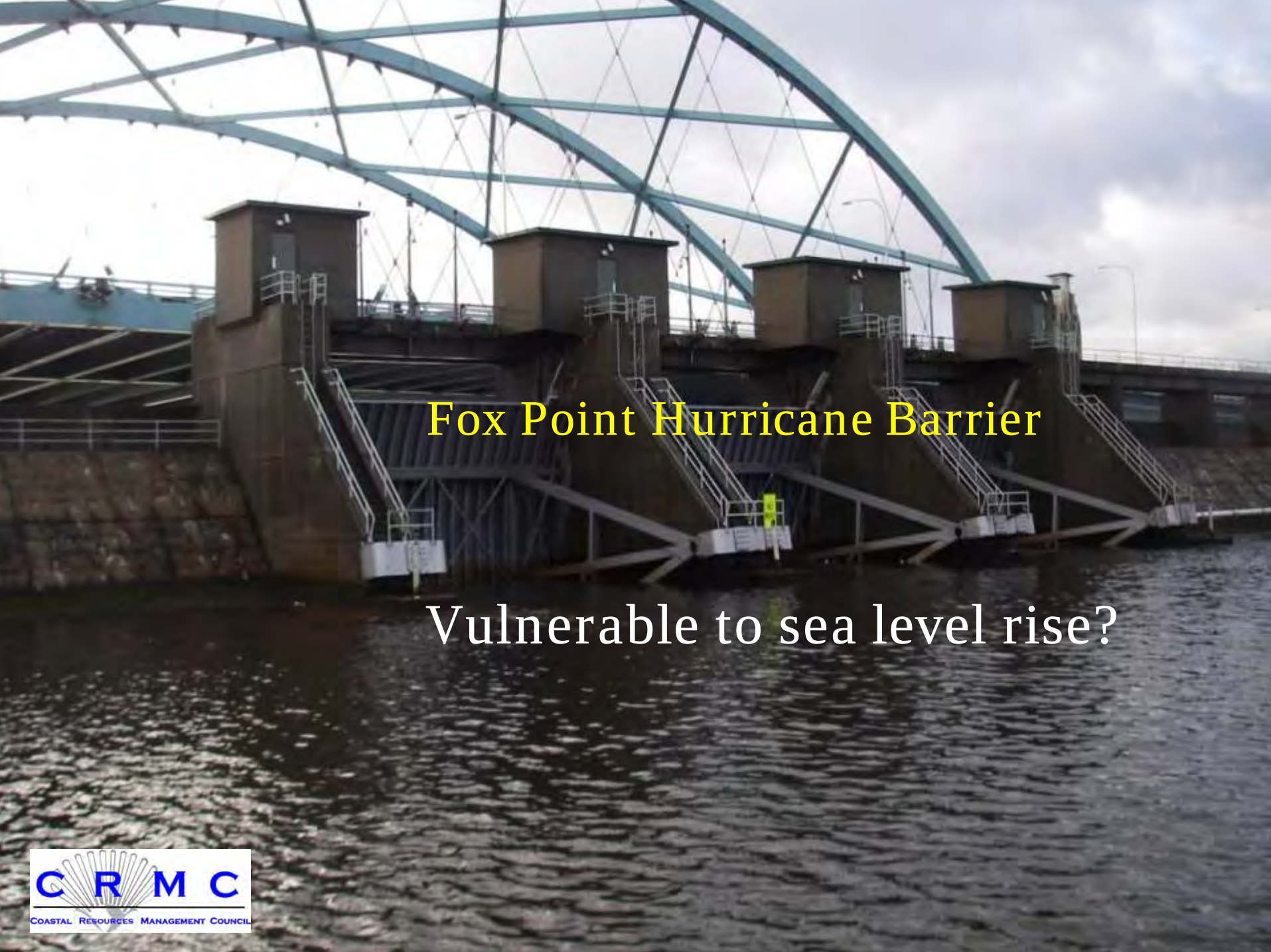


Source: Thompson, 2008 http://www.ci.uri.edu/ciip/projects/gccinri/


Ann St. Pier, Newport, RI
Average Spring Tide 1997- 2007 (7.03ft)
with 3 feet of SLR
ANN ST. PIER
VHF CH.
STARFISH
Sea Grant
Rhode Island


Fox Point Hurricane Barrier
Vulnerable to sea level rise?
CRMC
Coastal Resources Management Council


Providence Hurricane Barrier, Providence, RI
Storm Surge (17.5 ft MLLW) Hurricane of 1938
Plus 3 ft of SLR
Sea Grant
Rhode Island

Coastal Resources Management Plan
Section 145 Climate Change & Sea Level Rise
(Adopted January 2008)

Policy:

- Proactively plan for climate change and sea level rise
- Expect a base rate of 3 to 5 feet of sea level rise by 2100
- Revisit the science to assess SLR rates

Standards: (built environment and natural resources)

- Meetings with stakeholders & agencies (SBC, RIEMA, RIDOT) for structural design considerations
- State coastal habitat protection initiatives (CELCP)
- Living shoreline policy (partners STB & TNC)
    - Shoreline characterizations (25% hardened)
    - Pilot projects to assess effectiveness

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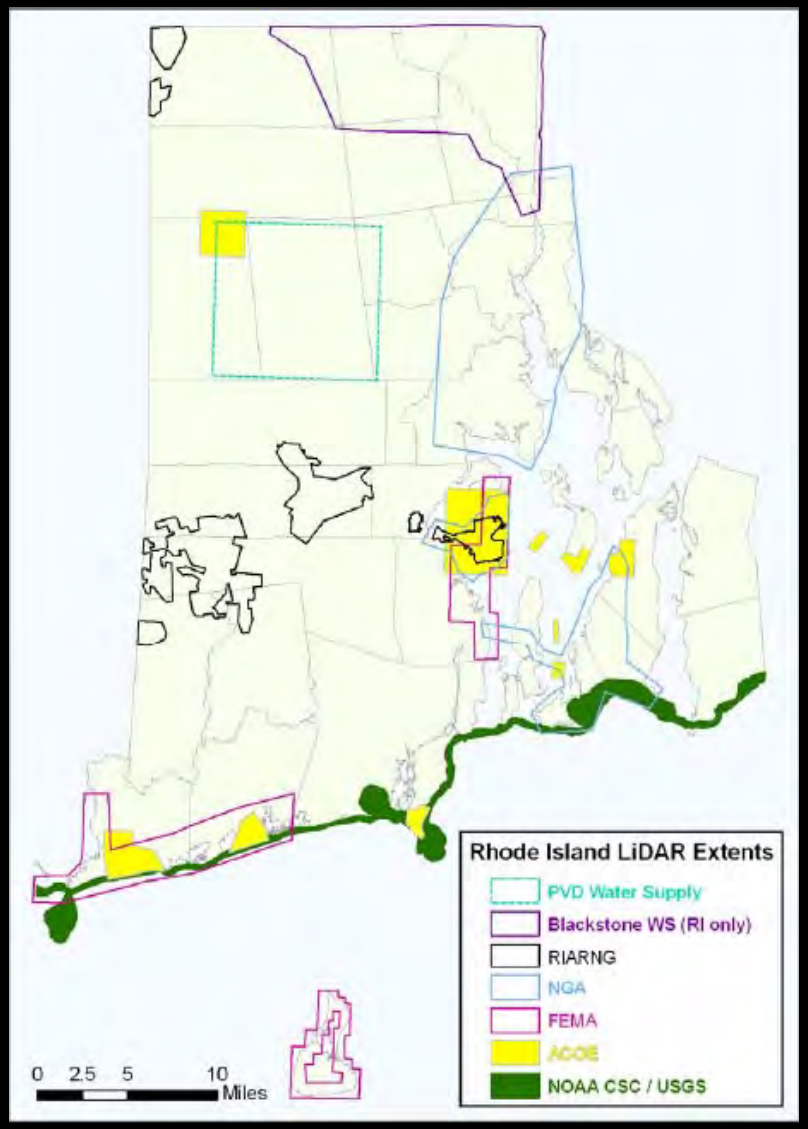
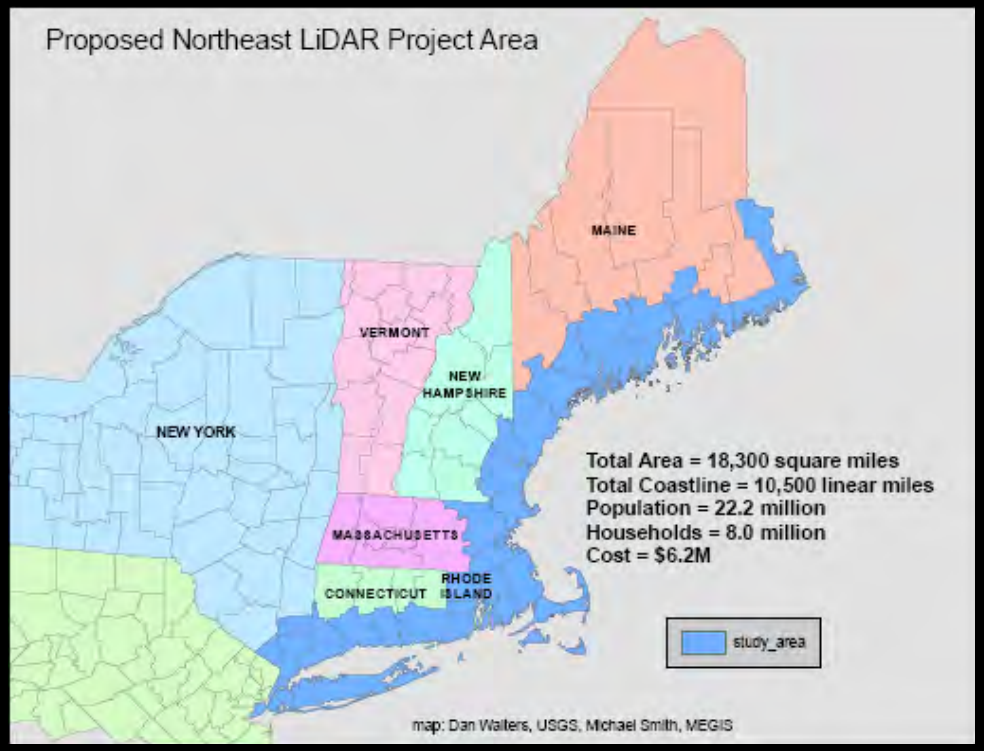
Existing Rhode Island LiDAR



Northeast Consortium LiDAR Project Area

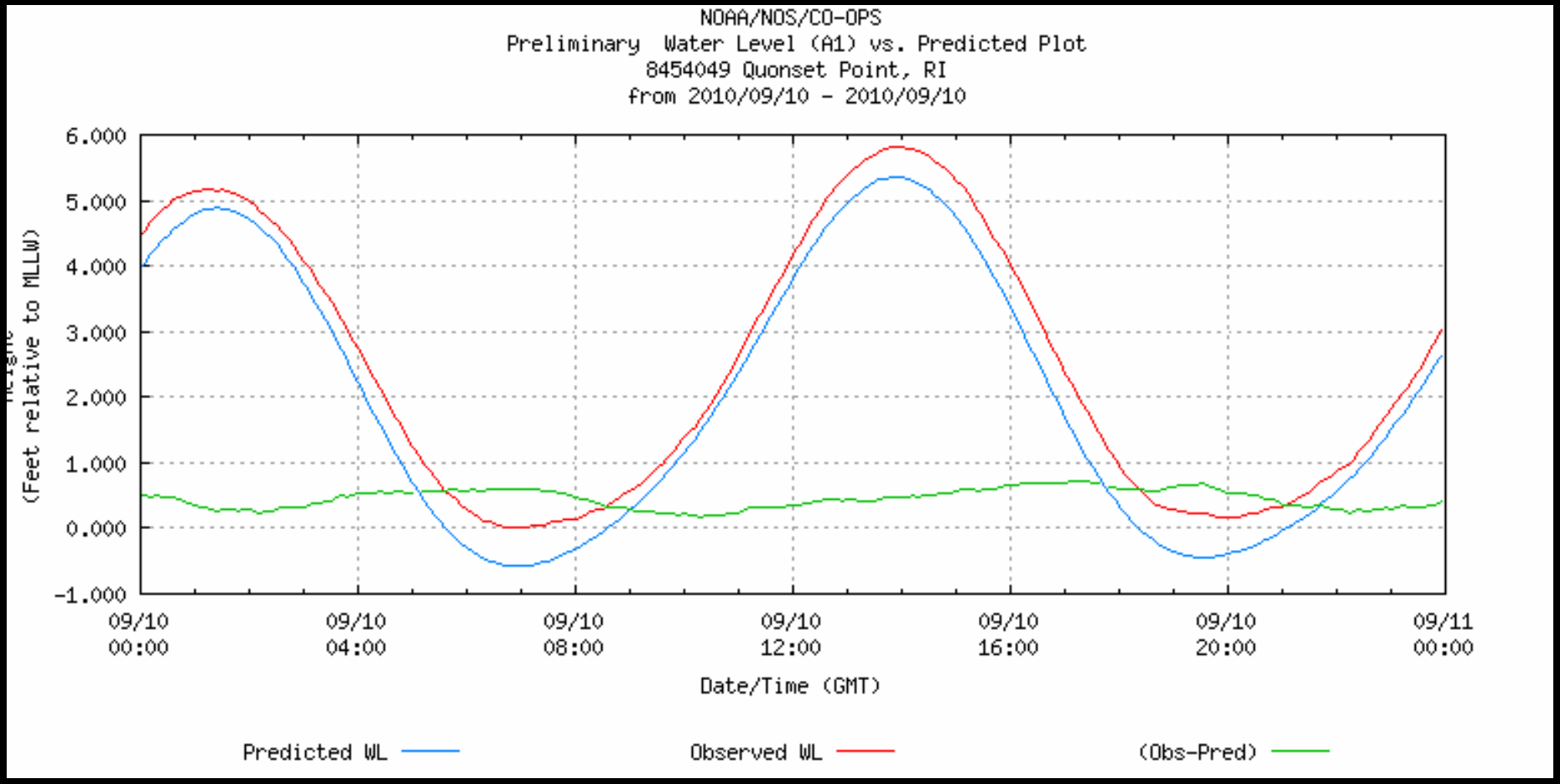


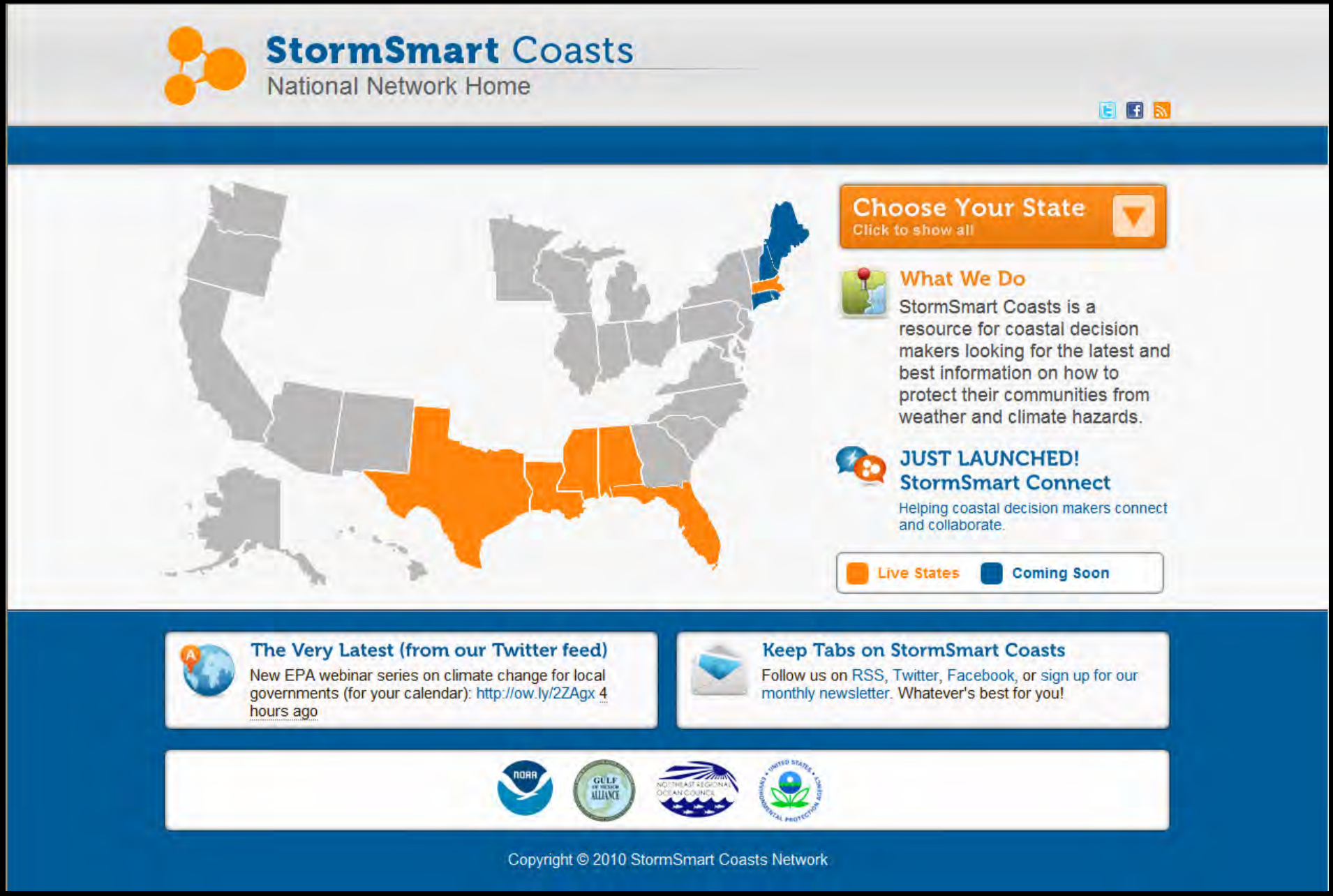
$1.4M in ARRA funds requested to be coupled with $1.3M in contributing funds from NGO, State, and Federal partners. On April 1, 2010 the Northeast Consortium received notice that the project would be awarded $1.4M.

Climate Change Adaptation/LiDAR Project

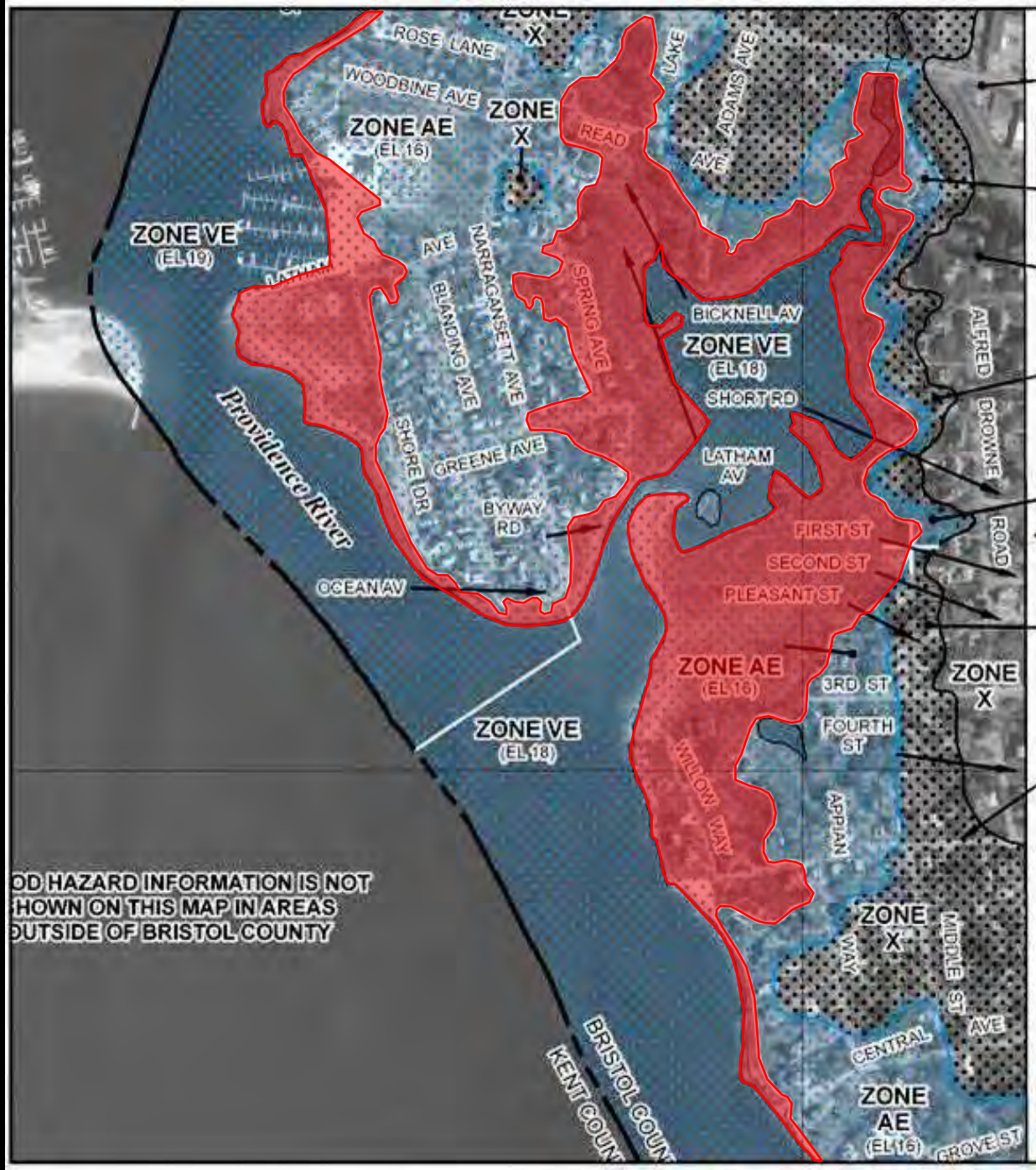
Photo: Teresa Crean Brown Street Bridge, Wickford on September 10, 2010

Monthly Spring Tide Due to New Moon





http://stormsmartcoasts.org



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0005G

FIRM

FLOOD INSURANCE RATE MAP

BRISTOL COUNTY, RHODE ISLAND

ALL JURISDICTIONS

PANEL 5 OF 18

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
BARRINGTON, TOWN OF	440002	0005	G

- NOTE -

THIS MAP INCLUDES COASTAL BARRIER RESOURCES SYSTEM BOUNDARIES ESTABLISHED UNDER THE COASTAL BARRIER RESOURCES ACT OF 1982 AND/OR SUBSEQUENT LEGISLATION.

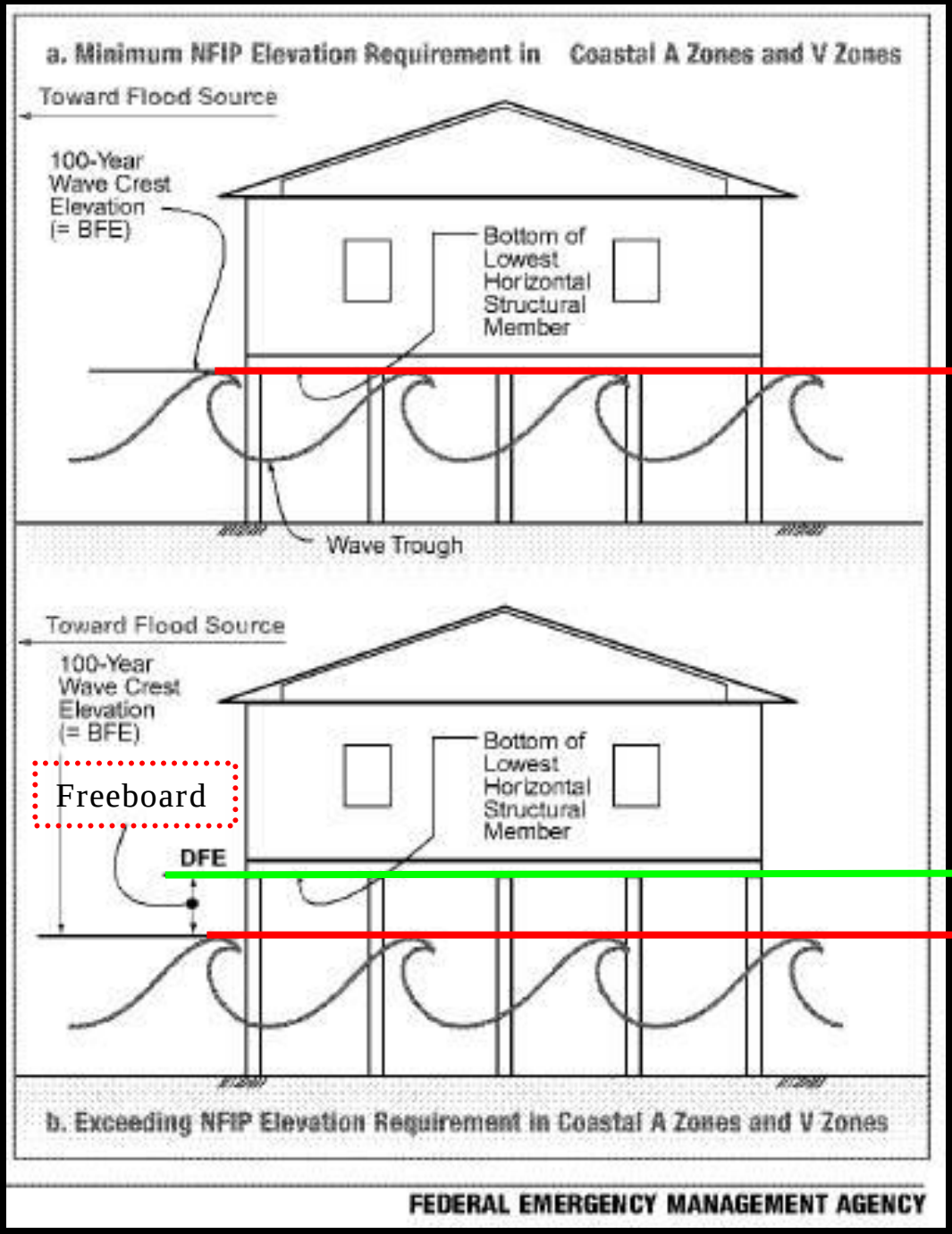
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
44001C0005G

MAP REVISED
NOVEMBER 16, 2006

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



Base Flood Elevation (BFE)

Design Flood Elevation (DFE)

Base Flood Elevation (BFE)

Source: FEMA Coastal Construction Manual 2000

Example of Savings on NFIP Premiums* with Freeboard

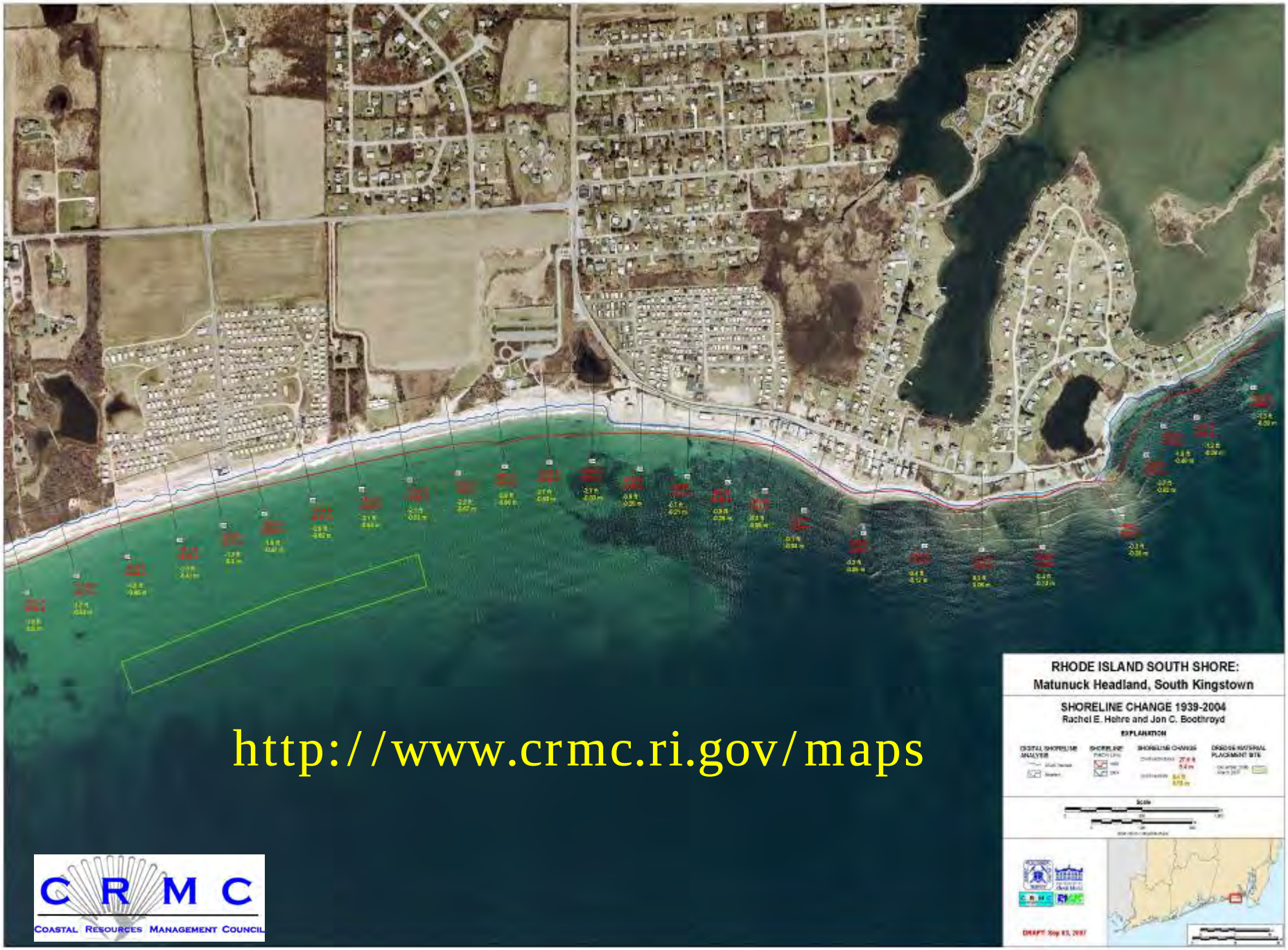
	V Zone		A Zone	
	Annual savings	30-year savings	Annual savings	30-year savings
1' freeboard	$1,360 (25%)	$40,800	$502 (41%)	$15,060
2' freeboard	$2,730 (50%)	$81,900	$678 (55%)	$20,340
3' freeboard	$3,415 (62%)	$102,450	$743 (60%)	$22,290

Massachusetts Office of COASTAL ZONE MANAGEMENT

**NFIP premiums based on May 2007 rates for a one-floor residential structure with no basement built after a FIRM was issued for the community (post-FIRM rates differ from pre-FIRM rates). $500 deductible/ $250,000 coverage for the building/$100,000 for contents.*

The expense of incorporating freeboard into new structures is surprisingly low, generally adding only about 0.25 to 1.5 percent to the total construction costs for each foot of added height, according to a 2006 FEMA-commissioned study *Evaluation of the National Flood Insurance Program's Building Standards*. The minor resulting increase in monthly mortgage payments is generally more than offset by savings on NFIP premiums. Consequently, adding freeboard typically saves homeowners money.

The Rhode Island Climate Risk Reduction Act of 2010
R.I.G.L. § 23-84


RHODE ISLAND SOUTH SHORE:
Matunuck Headland, South Kingstown
SHORELINE CHANGE 1939-2004
Rachel E. Hehre and Jon C. Boothroyd
EXPLANATION
http://www.crmc.ri.gov/maps
CRMC
COASTAL RESOURCES MANAGEMENT COUNCIL

Assess effectiveness of living shorelines as alternative to conventional structural shoreline protection techniques

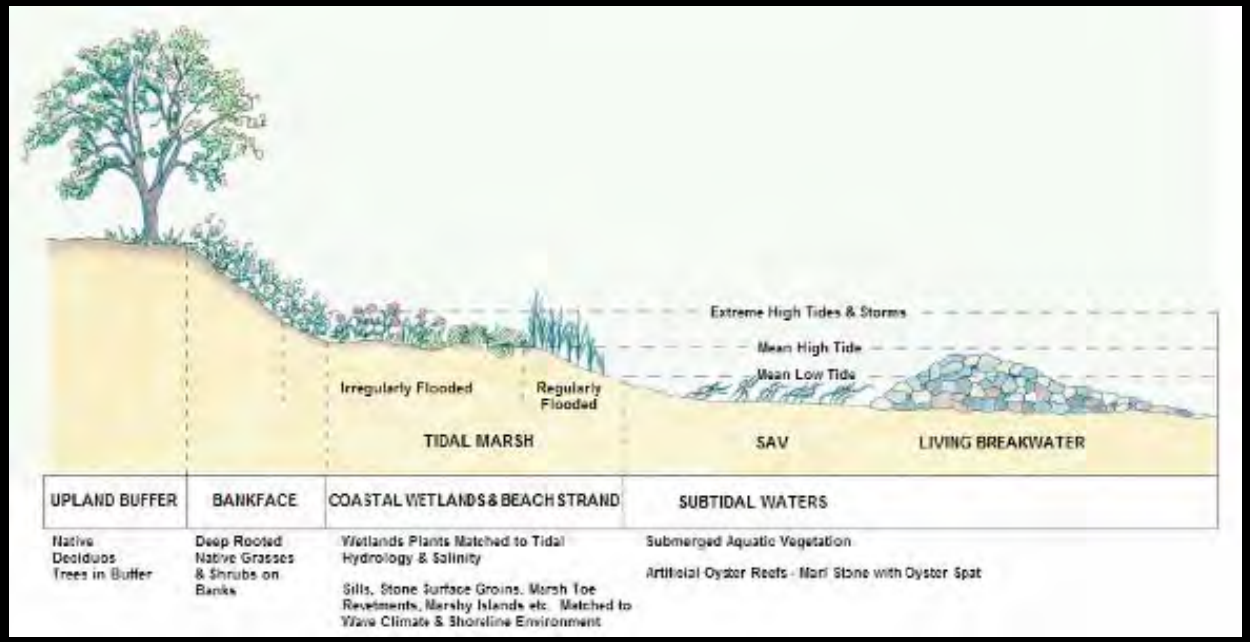
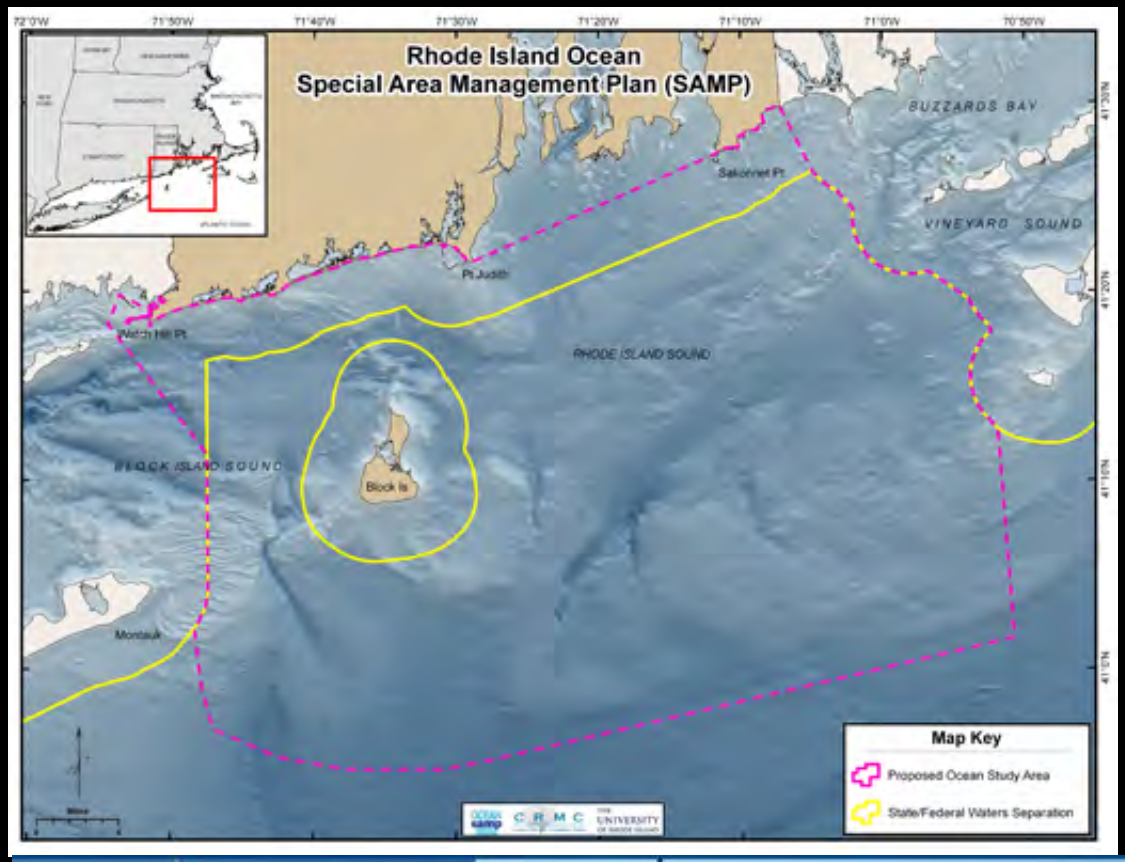


Photo: Chesapeake Bay NERR-Virginia

Photo: Mississippi-Alabama Sea Grant

RI mitigation efforts to offset fossil fuel consumption



Plan through Ocean SAMP process for utility-scale offshore wind turbines to generate at least 15% of RI's electricity needs

Rhode Island OCEAN samp

http://seagrant.gso.uri.edu/oceansamp/

Social Adaptation to Sea Level Rise ?

Photo: NY Times – Venice, Italy – December 1, 2008

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Summary of Rhode Island Actions to Address Climate Change and Sea Level Rise

- Continue to evaluate latest science and findings on climate change and sea level rise
- Work with state and federal partners to obtain LiDAR and develop high resolution Digital Elevation Models
- Engage with local and state partners on pilot CCA/LiDAR project
- Assess vulnerable infrastructure and coastal habitat
- Continue work with RIFACCT on building code outreach
- Amend existing Coastal Resources Management Plan to incorporate additional SLR policies and standards
- Implement the Ocean SAMP for best siting of utility-scale offshore wind farms
- Convene the state Climate Change Commission and develop climate change and SLR adaptation strategies

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Coastal Resources Management Council

James Boyd – Coastal Policy Analyst
RI Coastal Resources Management Council
www.crmc.ri.gov

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