NEW ECOLOGY

Community-Based Sustainable Development

Building Resilience
Hazard Assessment and Design

CONNECTICUT GREEN BANK

Peer-to-Peer Network Meeting

Friday, February 15, 2019

COMMUNITY-BASED SUSTAINABLE DEVELOPMENT

New Ecology's work is to bring the benefits of sustainable development to the community level, with a concerted emphasis on underserved populations. A mission-driven non profit, we seek to address global environmental and equity issues by making the built environment more efficient, healthier, durable, and resilient. We are nationally recognized for our work on affordable and mutfifamily housing, community and government buildings, educational facilities, renewable energy and local infrastructure and for the positive effect we have on the people who live and work in these places.

NEW ECOLOGY

Binghamton, NY
(1 Development)

New York, NY
(60 Developments)

Washington, DC
(20 Developments)

Cambridge, MA and Statewide
(1,300+ Developments)

Stamford, CT and Statewide
(5 Buildings)

Long Island, NY
(4 Developments)

Delaware
(200 Developments)

Outline

- What and why?
- Mapping - Communities, Governments, and Institutions
- Hazard Assessment – Vulnerability and Risk
- NEI's Building-Level Approach, Examples, and Design
- Financing Resilience
- Workshop Exercise
- Q&A

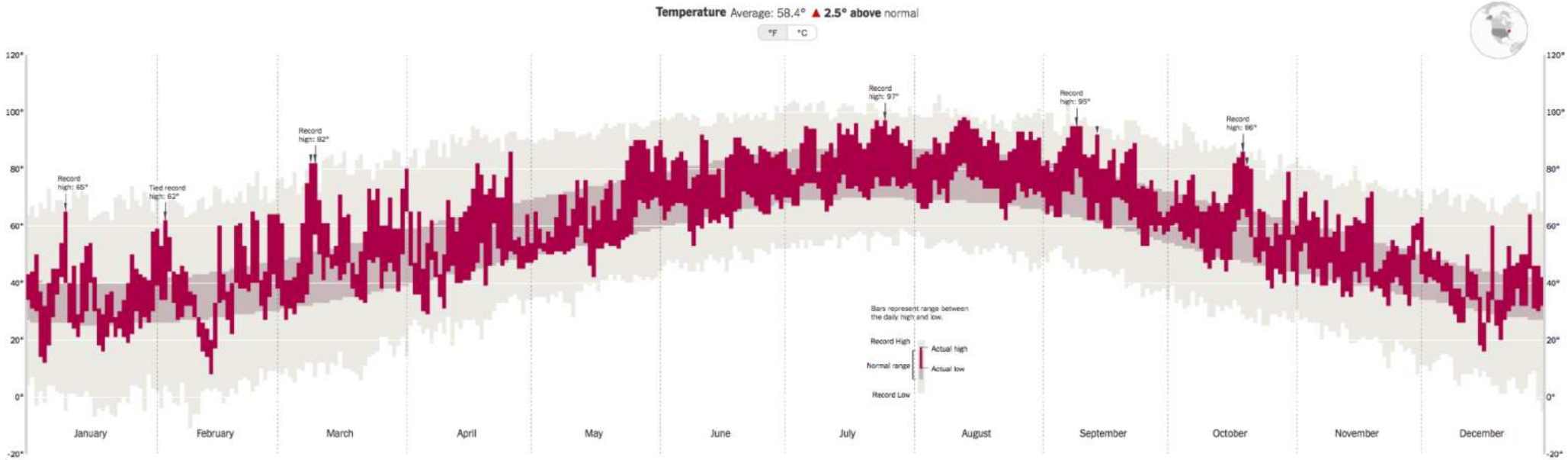
What is Resilience?

Adapting to changing climate.

Why now?

Abnormal is the new normal.

Last year is the hottest year on record for the third consecutive year. In a database of more than 5,000 cities provided by AccuWeather, about 90 percent recorded annual mean temperatures higher than normal. Enter your city below to see how much warmer (or cooler) it was.



Cumulative monthly precipitation, in inches, compared with normal. Precipitation totals are rainfall plus the liquid equivalent of any frozen precipitation.

The New York Times

2018 Boston flooding

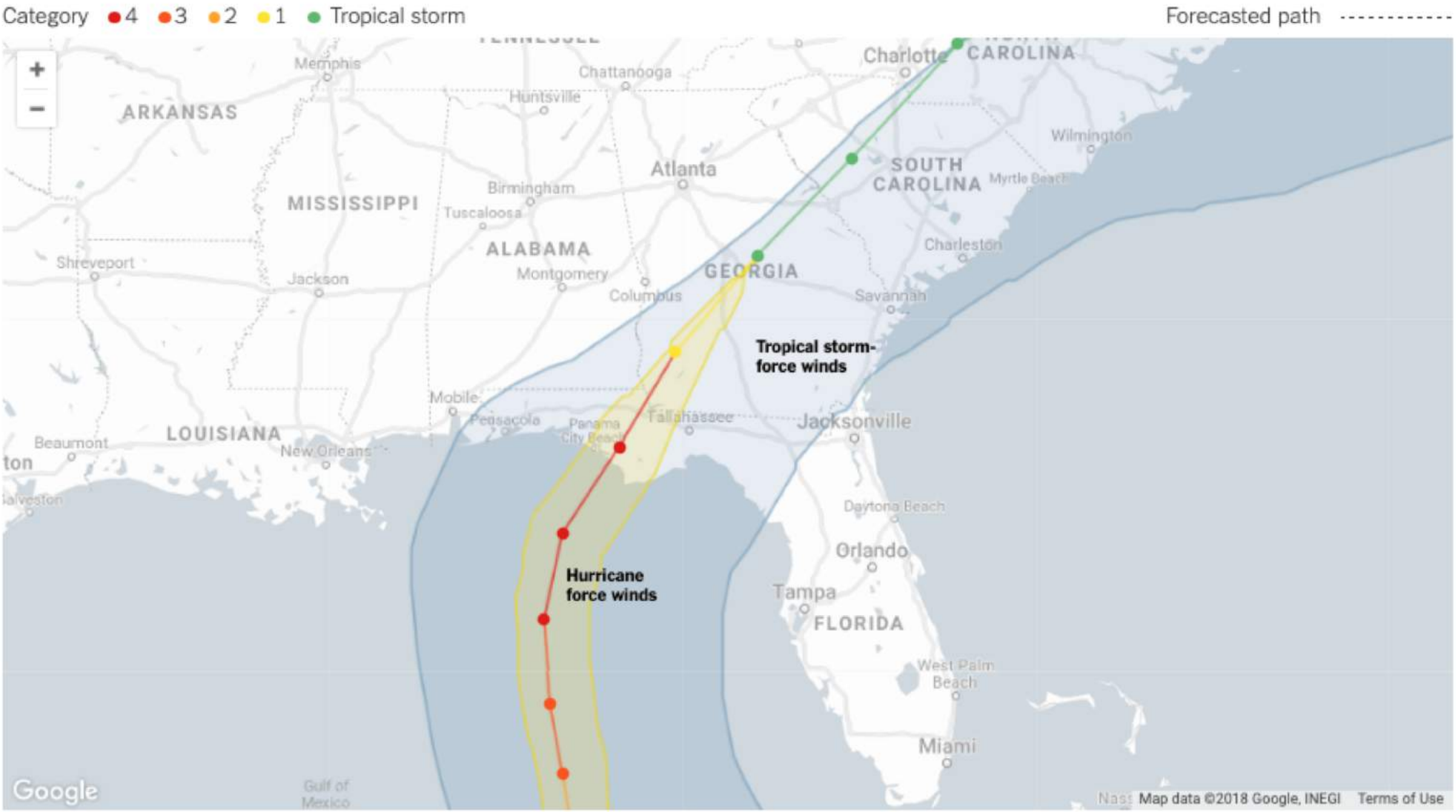
FROM The Boston Globe

GE to sell Fort Point HQ, give back $87 million to state

Work was underway in August on General Electric's Fort Point offices. –*David L. Ryan/The Boston Globe*

By The Boston Globe updated at 2:03 PM

Image: Reuters/Michelle McLoughlin



Source: National Weather Service

Predicted Disasters

Rain and flooding

Snow

Storm

Tornado

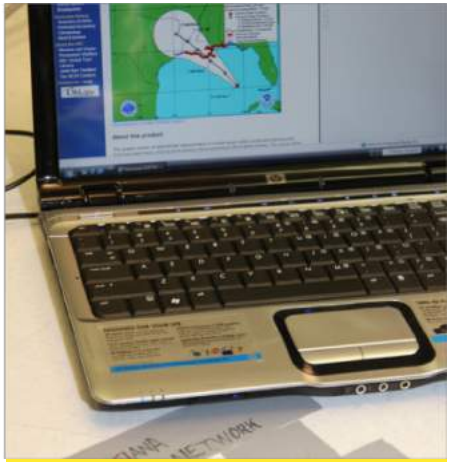
Drought

Sudden Disasters

Fire

Terrorist attack

Mechanical failure

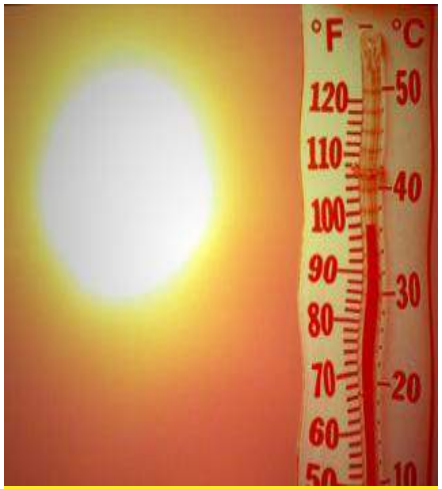


IT security breach

Chronic Hazards

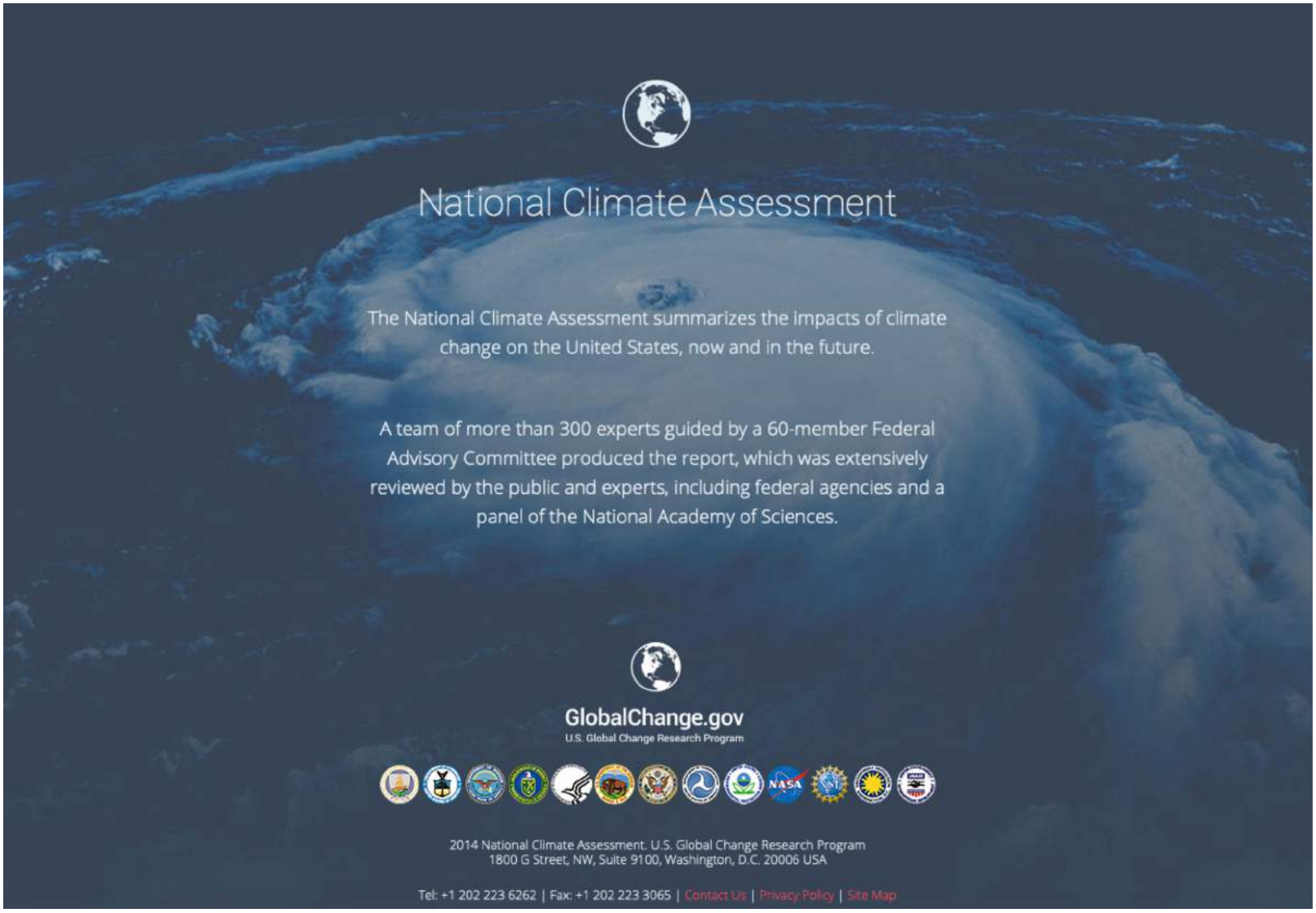
Pests

Mold



Extreme heat

Mapping
Communities, Governments, Institutions


National Climate Assessment
The National Climate Assessment summarizes the impacts of climate change on the United States, now and in the future.
A team of more than 300 experts guided by a 60-member Federal Advisory Committee produced the report, which was extensively reviewed by the public and experts, including federal agencies and a panel of the National Academy of Sciences.
GlobalChange.gov
U.S. Global Change Research Program
2014 National Climate Assessment. U.S. Global Change Research Program
1800 G Street, NW, Suite 9100, Washington, D.C. 20006 USA
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resilient MA

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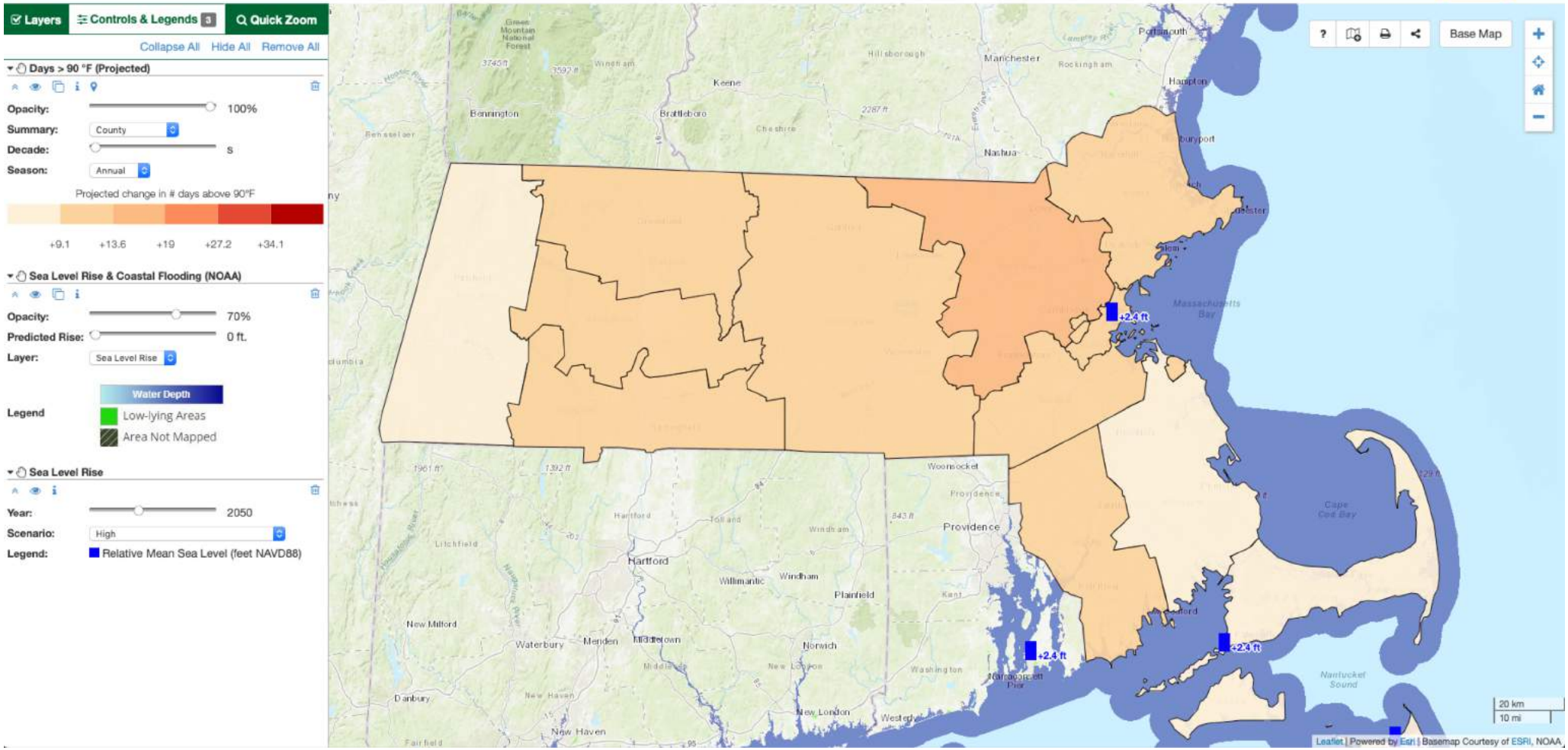


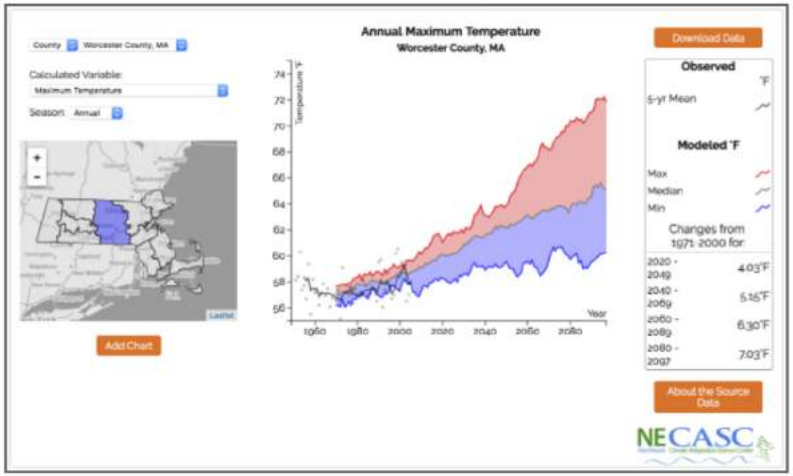
resilient MA

Climate Change Clearinghouse for the Commonwealth

Explore Sectors → Identify Changes → Take Action

Maps | Data | Documents

Search for resources... Search



Climate Data Grapher

User-generated time series graphs of climate data, both observed and projected (future and historical.) A video tutorial on how to use the Climate Data Grapher can be found here.

More ...

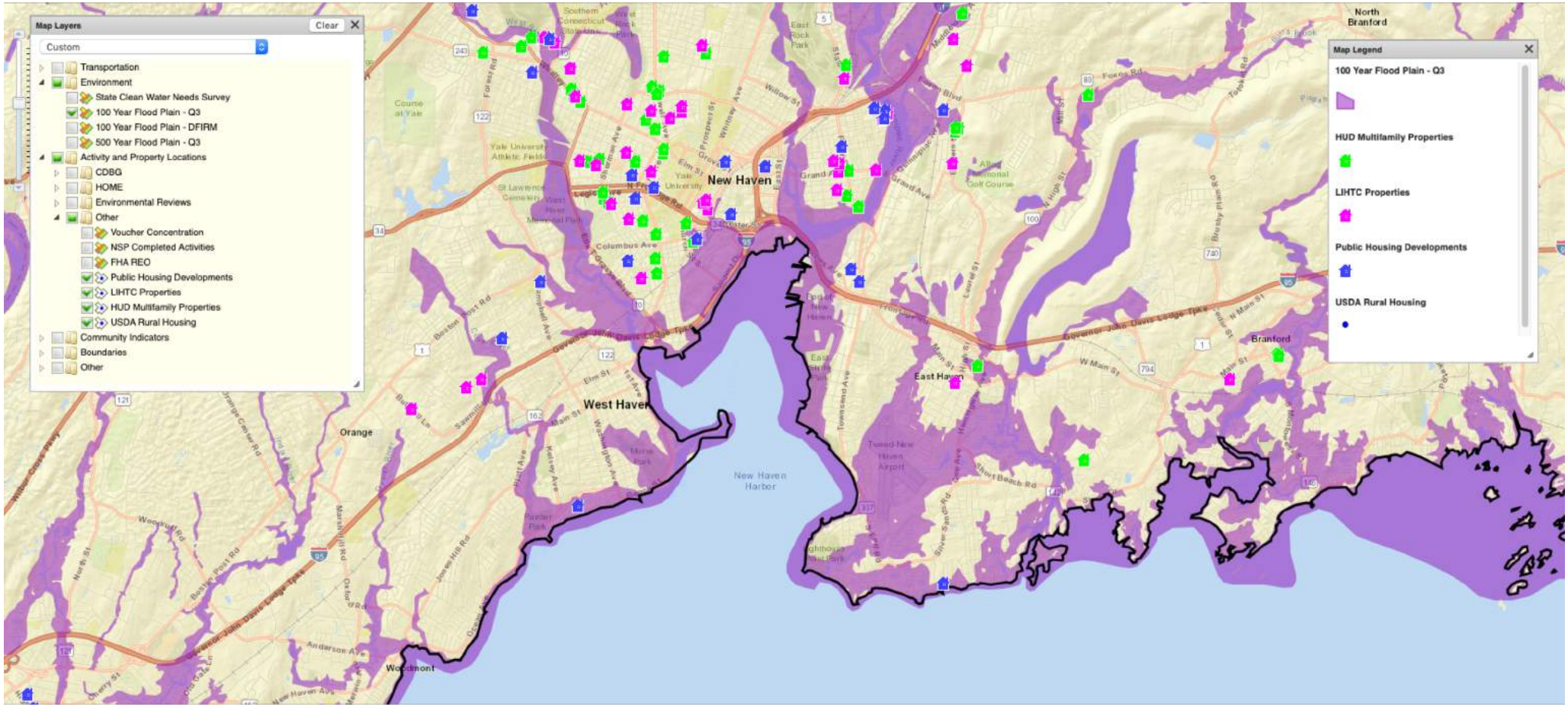
All | Agriculture | Coastal | Energy | Natural Resources | Public Health | Precipitation | Temperature | Flooding

USDA Northeast Climate Hub

Global Warming Solutions Act (GWSA) Dashboard: Massachusetts' Progress

StormSmart Coasts - Massachusetts Shoreline Change Project

Massachusetts Wildlife Climate Action Tool


Map Layers
Clear
Custom
Transportation
Environment
State Clean Water Needs Survey
100 Year Flood Plain - Q3
100 Year Flood Plain - DFIRM
500 Year Flood Plain - Q3
Activity and Property Locations
CDBG
HOME
Environmental Reviews
Other
Voucher Concentration
NSP Completed Activities
FHA REO
Public Housing Developments
LIHTC Properties
HUD Multifamily Properties
USDA Rural Housing
Community Indicators
Boundaries
Other
Map Legend
100 Year Flood Plain - Q3
HUD Multifamily Properties
LIHTC Properties
Public Housing Developments
USDA Rural Housing
New Haven
West Haven
East Haven
Branford
North Branford
Orange
Woodmont
New Haven Harbor

Connecticut Institute for Resilience & Climate Adaptation (CIRCA)

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CREST Maps

The results of the mapping tasks associated with the CREST project can be found in the Map Viewer.

There are four main sections of maps.

1. and 2. Old Saybrook Study Area and New Haven Study Area

Two 4-mile pilot areas were selected and studied in detail. Each area contains:

- Detailed analysis of existing coastal structures, defined here as either shore or inland, either hard, medium or soft, and as either natural or not. MHW stands for Mean High Water.
- Shoreline photos were taken in high density along the two pilot areas and are indicated by a yellow dot. In the map viewer, click on each yellow dot to view the photo. Click on the photo itself to make it bigger.

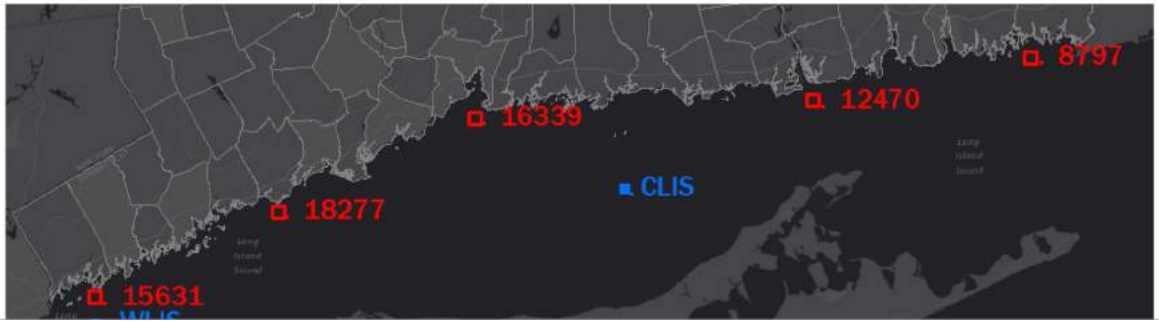
To go directly to the study areas in the map viewer, look for this button in the upper right.

Structure Display
- inland hard
- inland hard natural
- inland medium
- inland medium natural
- inland soft
- inland soft natural
- shore MHW
- shore MHW natural
- shore hard
- shore hard natural
- shore medium natural

NOAA CREST Home
About
Maps
Wave Research
Wave Points

3. Wave Nodes and NOAA Buoys

Five points distributed along the shore of Connecticut in Long Island Sound were chosen as locations for reporting results from the wave modeling work. They are shown by a red square and are numbered. There is a page for each point, 8797, 12470, 15631, 16339, 18277, as well as some information in the map when the point is clicked. The blue squares are two NOAA buoys.



LATEST RESILIENCE NEWS

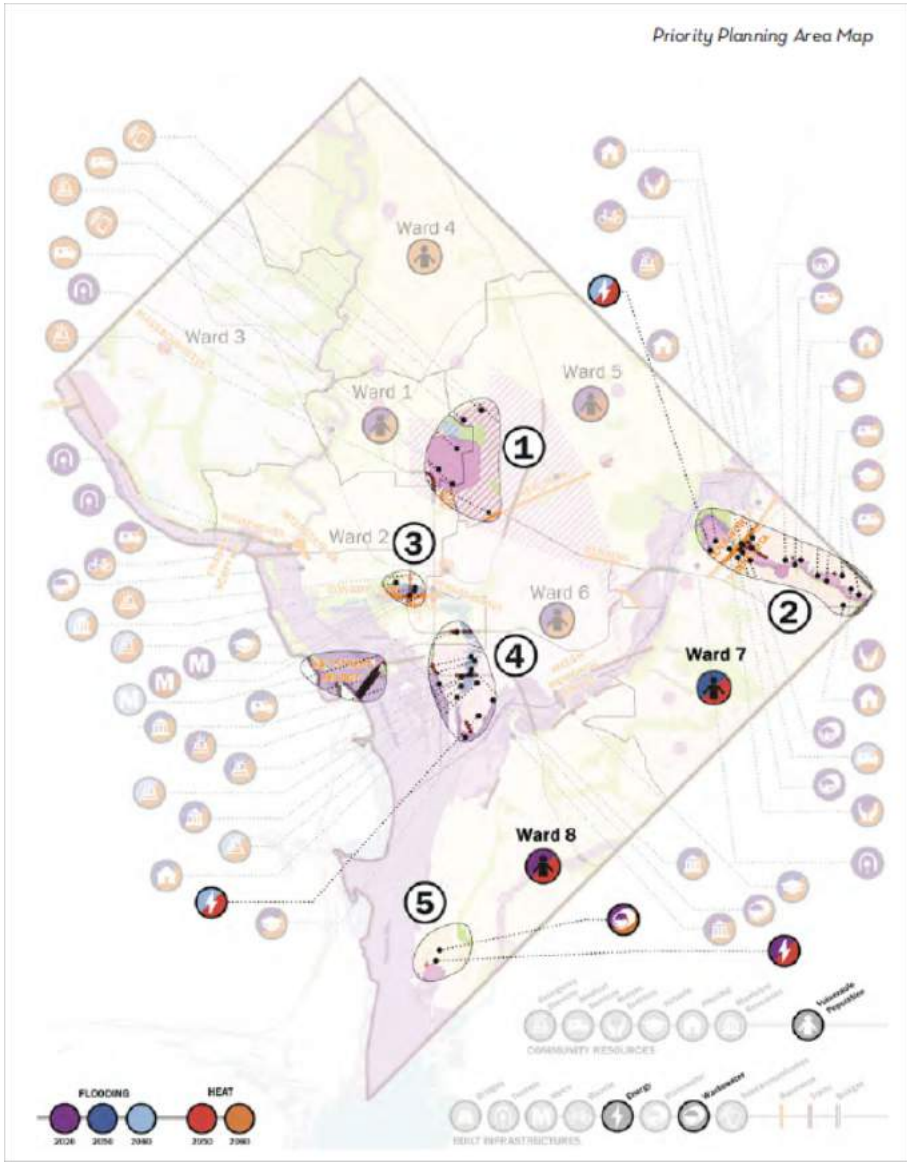
OCTOBER 15, 2018

A Sustainable Future for People and Nature? It's Still

United States Resilience

CLIMATE READY DC

The District of Columbia's Plan to Adapt to a Changing Climate



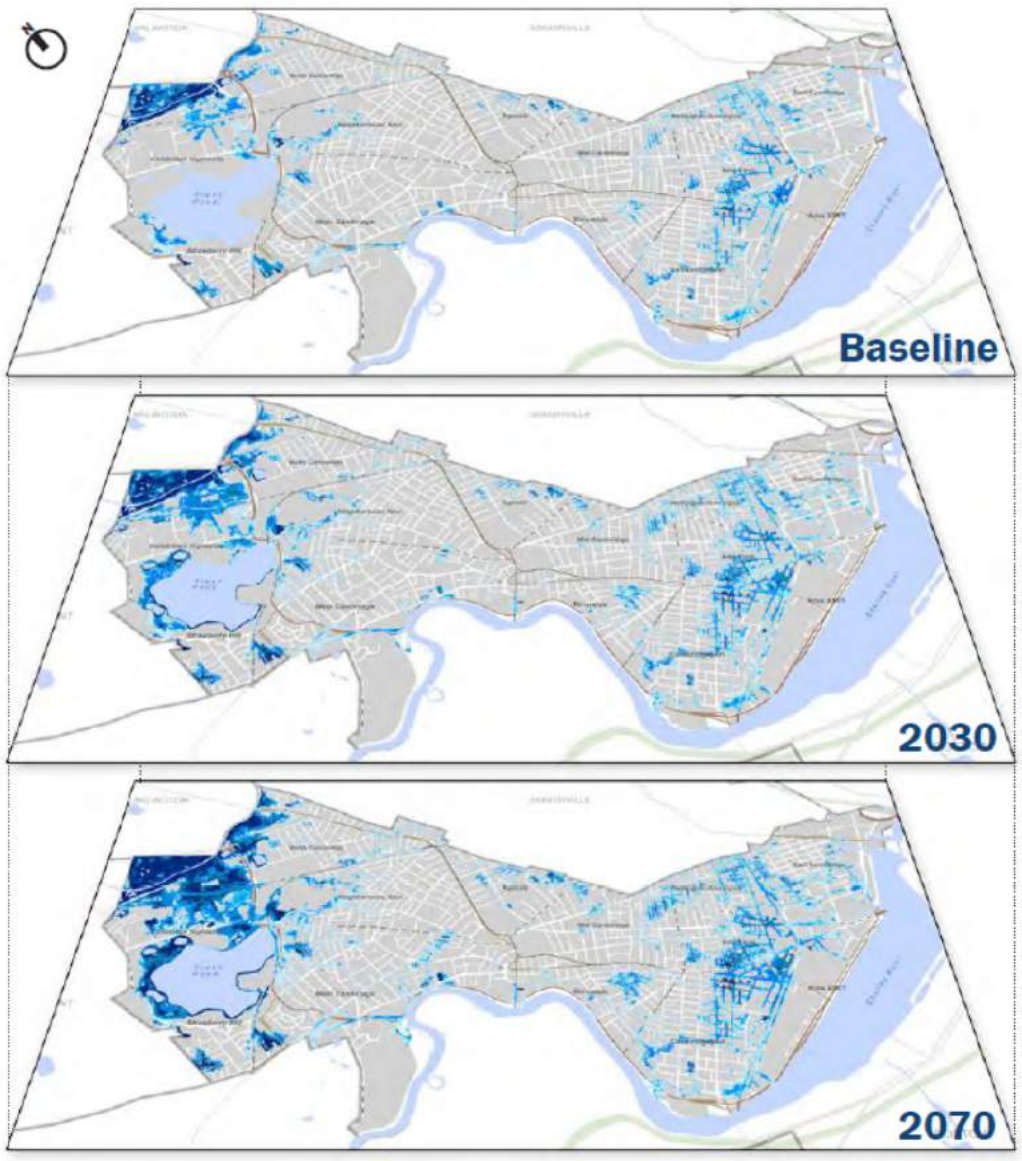


Fig. 10 **Inland Flooding – 100-year 24-hour storm** (Source: Kleinfelder with manhole flooding by MWH, riverine flooding by VHB, November 2015)

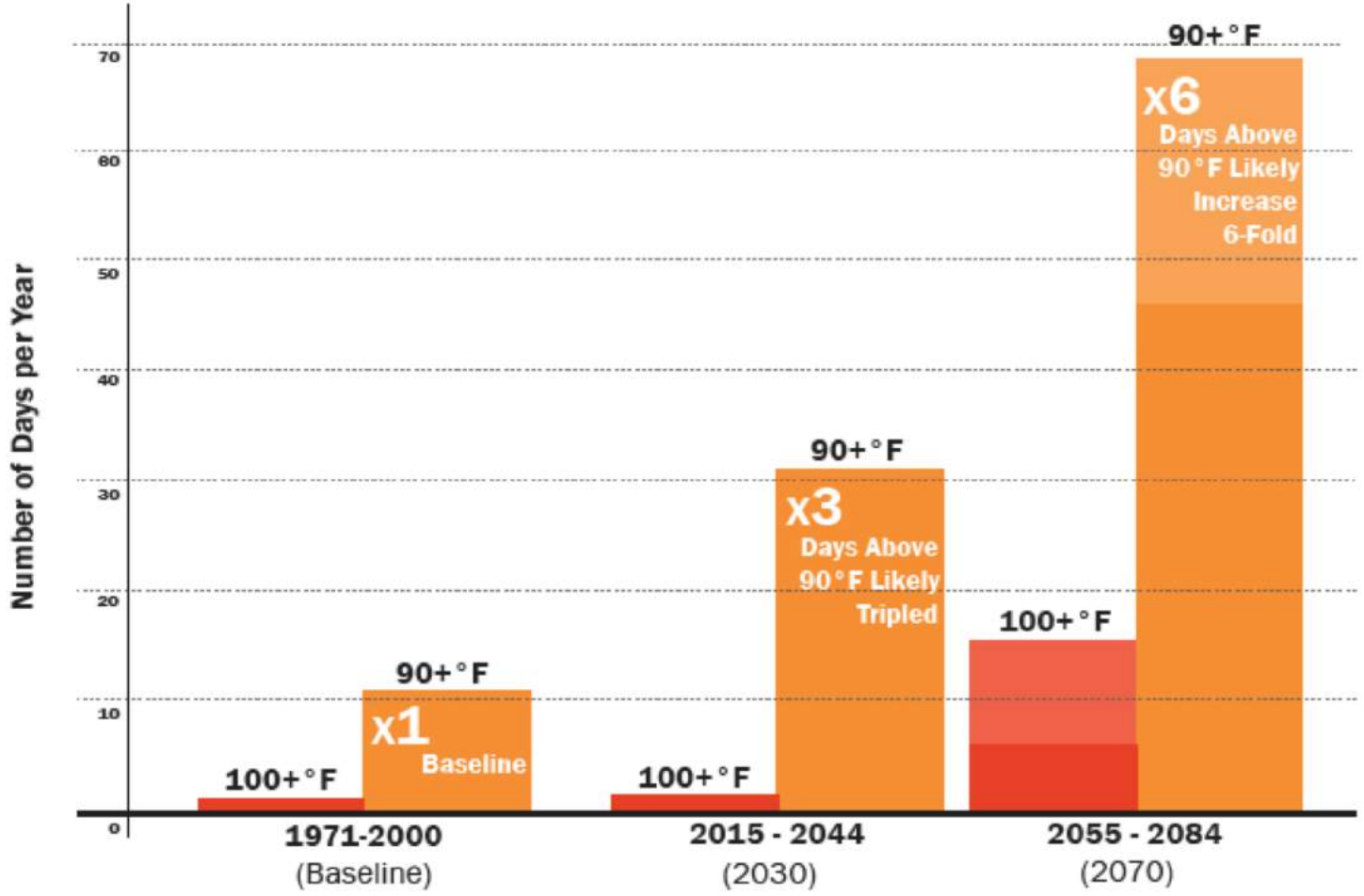


Fig. 15 **Number of days above 90ºF** (Source: Kleinfelder based on ATMOS research, November 2015)

The CCVA Report

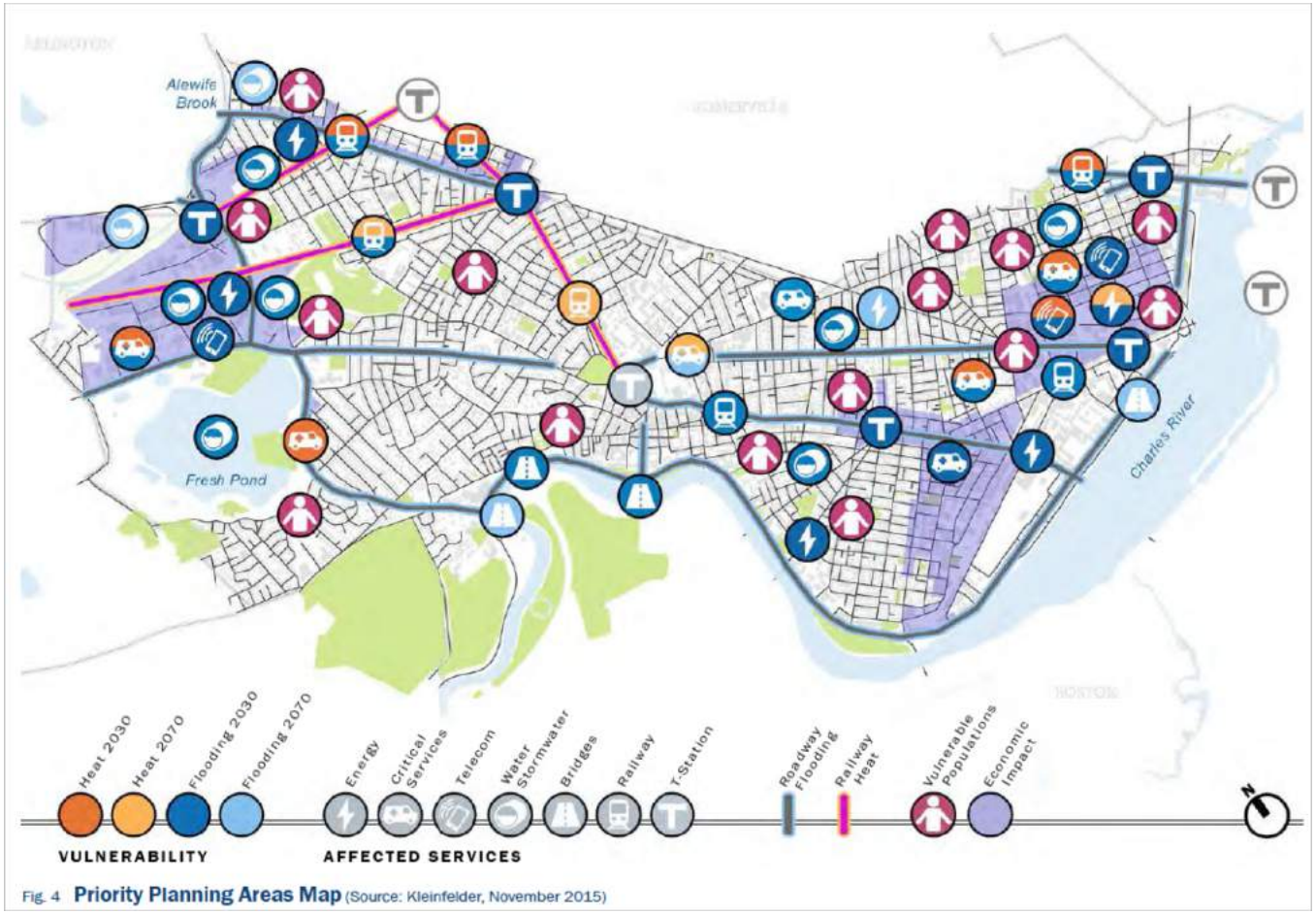


Fig. 4 **Priority Planning Areas Map** (Source: Kleinfelder, November 2015)

Hazard Assessment
Vulnerability and Risk

Identify Hazards

Primary	Secondary
Coastal Flooding	Carbon Monoxide Poisoning
Coastal Erosion	Disease
Drought	Emergency Communications Failure
Inland Flooding and Stormwater	Heat Outage
Extreme Heat	Mold
Extreme Cold	Pest Range Expansion
Major Thunderstorm	Power Outage
Snow or Ice Storm	Toxin Exposure
Terrorist Attack	Water Outage
Tornado	
Urban Fire	

Vulnerability and Risk Assessment

Vulnerability – **Sensitivity** to a hazard and the **capacity to adapt** to the hazard.

Image: Virginia Living Museum

Image: Flood Panel

Vulnerability and Risk Assessment

Risk – **Likelihood** and **consequence** of a hazard.

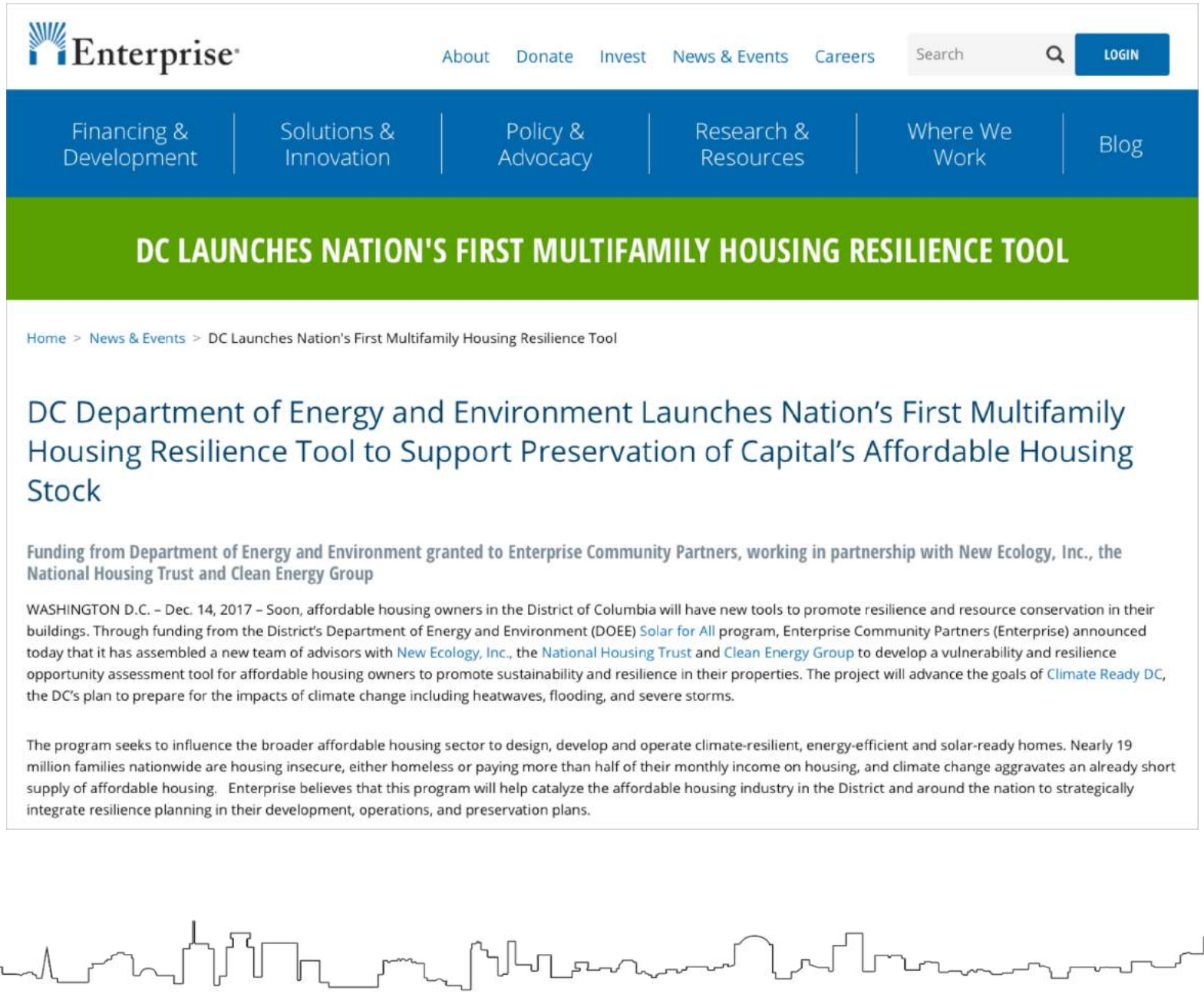
Image: FEMA

Image: Houston Chronicle

Vulnerability and Risk Assessment

Hazard	Vulnerability		Risk	
	Sensitivity	Adaptive Capacity	Likelihood	Impact
Stormwater Flooding	**Medium**	**Low**	**High**	**High**
Sewer Backup	Medium	Low	High	Medium
Tornado	Medium	Low	High	High
High Winds	Medium	Low	Low	High
Extreme Heat	Medium	Medium	Medium	Medium
Extreme Cold	Medium	Low	Medium	Medium
Extended Electric Outage	High	Low	Low	Medium
Extended Water Outage	High	Low	Medium	Medium

NEI's Approach: Existing Buildings



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DC LAUNCHES NATION'S FIRST MULTIFAMILY HOUSING RESILIENCE TOOL

Home > News & Events > DC Launches Nation's First Multifamily Housing Resilience Tool

DC Department of Energy and Environment Launches Nation's First Multifamily Housing Resilience Tool to Support Preservation of Capital's Affordable Housing Stock

Funding from Department of Energy and Environment granted to Enterprise Community Partners, working in partnership with New Ecology, Inc., the National Housing Trust and Clean Energy Group

WASHINGTON D.C. – Dec. 14, 2017 – Soon, affordable housing owners in the District of Columbia will have new tools to promote resilience and resource conservation in their buildings. Through funding from the District's Department of Energy and Environment (DOEE) Solar for All program, Enterprise Community Partners (Enterprise) announced today that it has assembled a new team of advisors with New Ecology, Inc., the National Housing Trust and Clean Energy Group to develop a vulnerability and resilience opportunity assessment tool for affordable housing owners to promote sustainability and resilience in their properties. The project will advance the goals of Climate Ready DC, the DC's plan to prepare for the impacts of climate change including heatwaves, flooding, and severe storms.

The program seeks to influence the broader affordable housing sector to design, develop and operate climate-resilient, energy-efficient and solar-ready homes. Nearly 19 million families nationwide are housing insecure, either homeless or paying more than half of their monthly income on housing, and climate change aggravates an already short supply of affordable housing. Enterprise believes that this program will help catalyze the affordable housing industry in the District and around the nation to strategically integrate resilience planning in their development, operations, and preservation plans.

Example 1

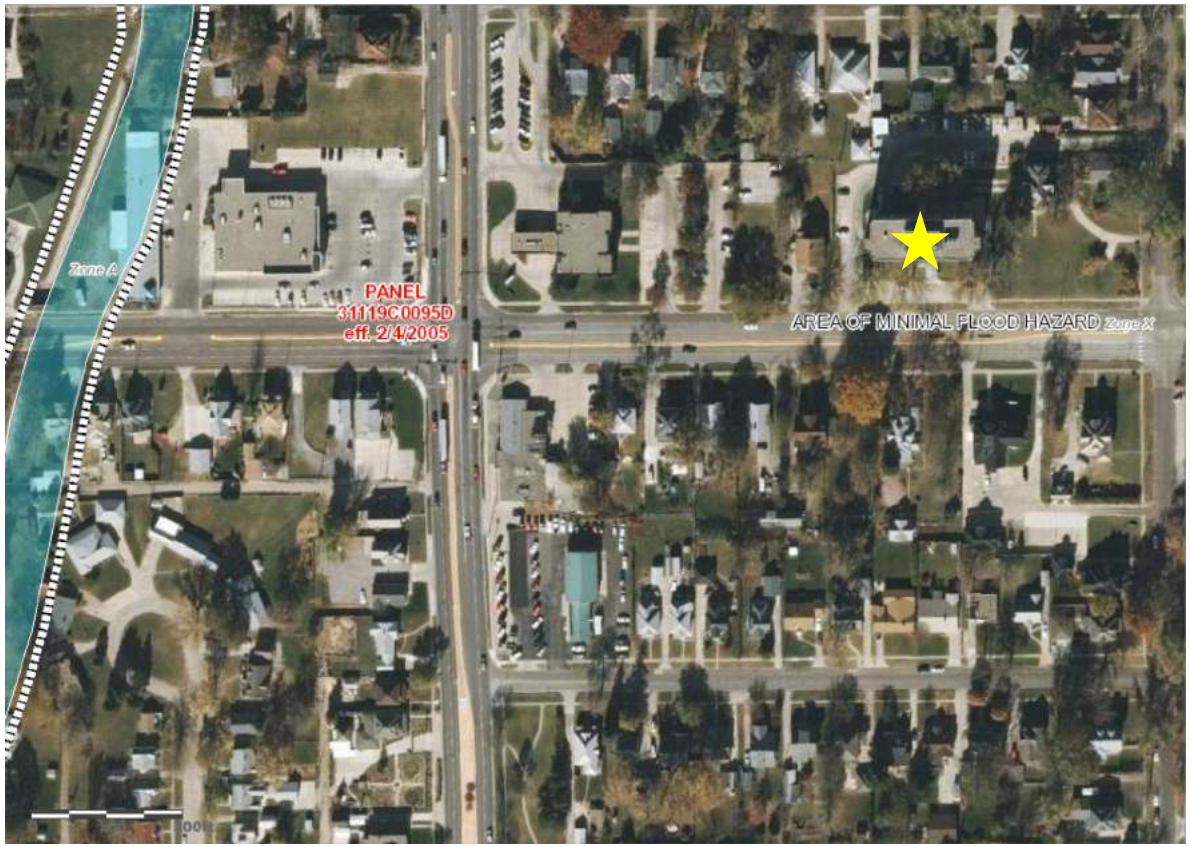
Masonry Multifamily High Rise

Building Characteristics

- Norfolk, NE
- Fork in the Elkhorn River, FEMA 1% Annual Chance Flood Zone behind Unaccredited Levee
- Built in 1972
- 9 Floors
- 92 1BR Affordable Units

Hazards

- Stormwater Flooding and Sewer Backup
- Tornado and High Winds
- Extreme Heat and Cold
- Extended Electric, Gas, and Water Outage



Example Audit 1

Masonry Multifamily

High Rise

Vulnerability and Risk

Hazard	Vulnerability		Risk	
	Sensitivity	Adaptive Capacity	Likelihood	Impact
Stormwater Flooding	**Medium**	**Low**	**High**	**High**
Sewer Backup	Medium	Low	High	Medium
Tornado	Medium	Low	High	High
High Winds	Medium	Low	Low	High
Extreme Heat	Medium	Medium	Medium	Medium
Extreme Cold	Medium	Low	Medium	Medium
Extended Electric Outage	High	Low	Low	Medium
Extended Water Outage	High	Low	Medium	Medium

Develop and Implement Measures

Rank	Hazard	Measures
1	Stormwater Flooding	Flood Barriers, Perimeter Drains, Elevate Electrical Panels, Relocate Hazardous Chemicals, Elevator Controls
2	Tornado	Structural and Glazing Wind Loading Review, Remove Roof Ballast Stone
2	Sewer Backup	Backflow Preventer
3	Extended Water Outage	Potable Water Storage
4	Extreme Cold	Insulate, Air Seal, Replace Windows
4	Extreme Heat	(see Extreme Heat)
5	High Winds	Structural and Glazing Wind Loading Review, Remove Roof Ballast Stone
6	Extended Electric Outage	Backup Generator

Scenario: Flood

- Unaccredited Levee
- 1% Annual Chance Flood
- History of Flooding
- Continued Occupancy and Building Systems Operations
- Rapid Removal of Water and Repair

Images: Floodsax.

Example 2

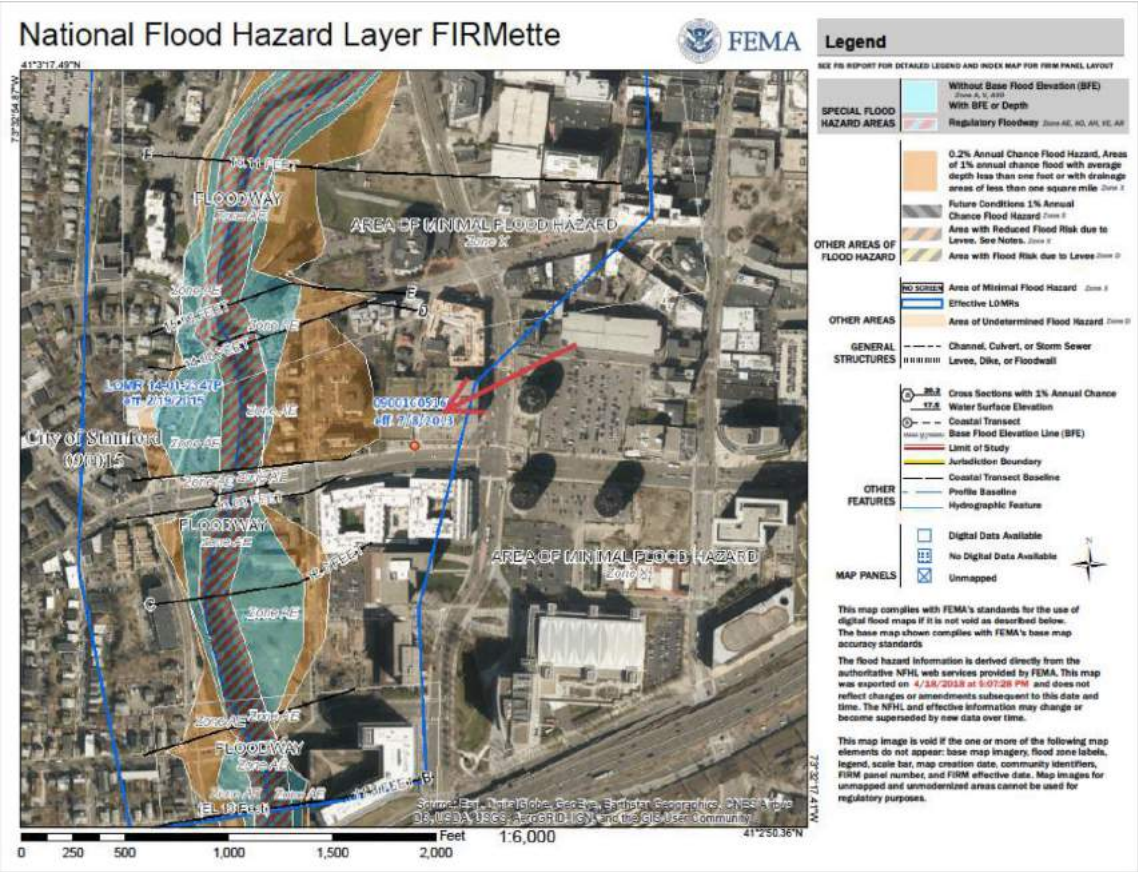
Commercial Office Building

Building Characteristics

- Stamford, CT
- Close Proximity to Rippowam River
- Built in 1986
- 10 Floors
- 250,000 Square Feet
- City Emergency Operations Center

Hazards

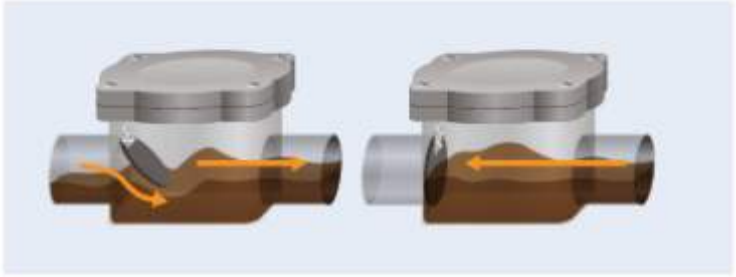
- Coastal Flooding, Stormwater Flooding and Sewer Backup
- Extreme Heat
- Extended Electric Outage



Develop and Implement Measures

Rank	Hazard	Measures
1	All	Emergency Management Manual
2	Extreme Heat	Cool Roof, Window Shading, Window Replacement
2	Flooding	Backwater Valves, Surface Stormwater Management
3	Extended Power Outage	Quick Connects for Mobile Equipment, Solar+Storage
4	Extended Water Outage	Potable Water Storage

Backwater valves are installed where the wastewater pipe exits the building, so sewage only flows outward. Valves have a hinged flapper that remains open to allow outward flow, but seals tightly if there is backpressure.

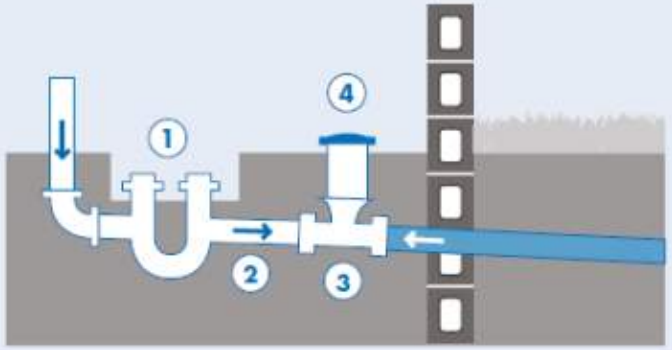


Backwater valves are situated above the external sewer line and should be installed in buildings that have sewer connections below the highest manhole cover in the sewer system, especially if the property is within the Special Flood Hazard Area (SFHA). Although sewer blockage can occur any time, it is most likely to happen during storms when large amounts of water and debris move through the system.

least 2 ft. of un-branched pipe upstream of the backwater valve.

1. Backwater valves should be installed on the street side of the house trap.
2. There should be 2 ft. of unbranched pipe at a 2 percent slope upstream of the backwater valve.
3. Backwater valves stop backflow from the municipal sewer system.
4. An access hatch allows cleaning and maintenance.

Image: Samantha Yost / Matthew Goodrich.



Co-Benefits: Cost Savings

Solar PV + Battery Storage

- Reduced electricity demand charges, backup power supply, more electricity generated on site used on site

Example 3

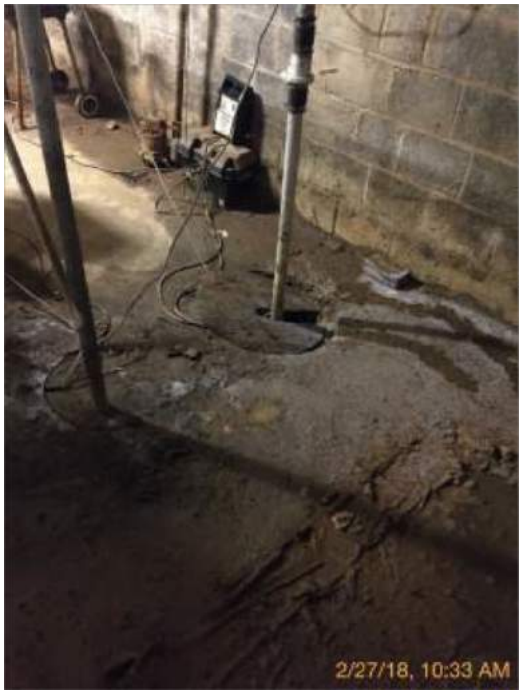
Multifamily Low Rise

Year Built: 1963
Most Recent Year Rehabbed: 2000
Total Square Feet: 118,716
Total # Apartments: 202
Total # Bedrooms: 329
Total # Stories: 2 and 3
Basement? Conditioned?: Yes, yes
Water Meter Configuration: 1 meter per building
Electric Meter Configuration: 220 tenant, 16 common meters


2/27/18, 9:42 AM


2/27/18, 10:35 AM


2/27/18, 10:33 AM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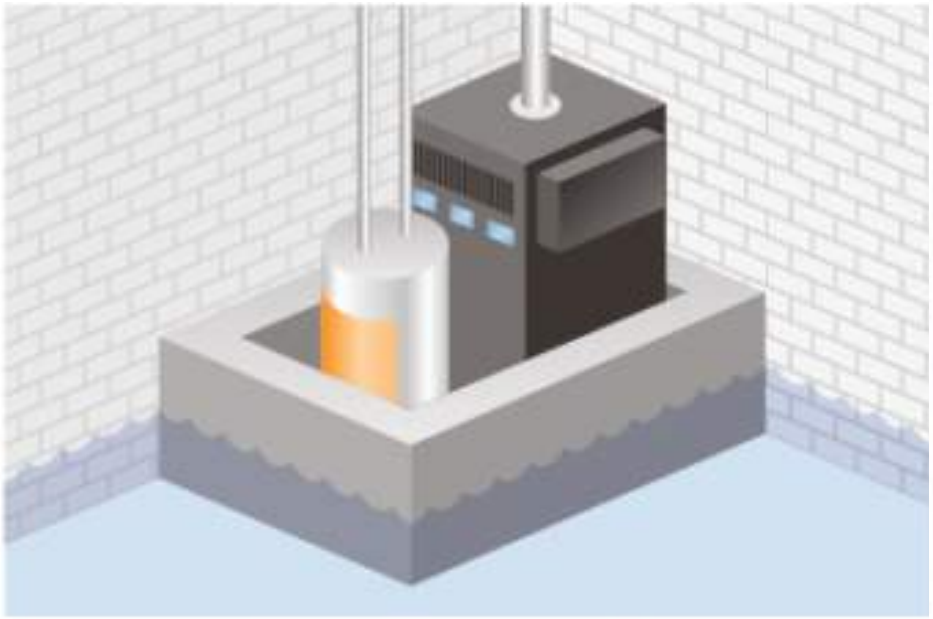


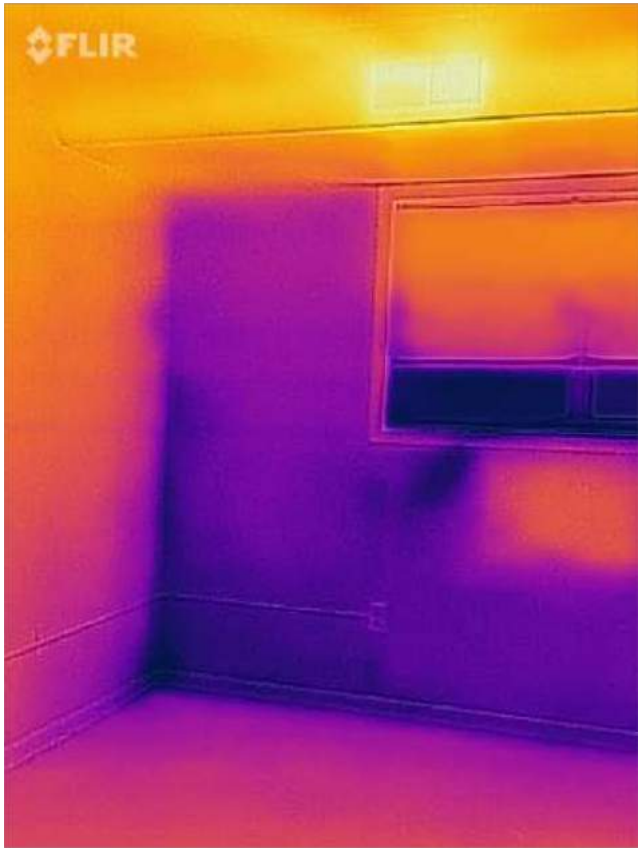
Because of hydrostatic pressure, component floodproofing barriers should designed to a maximum of 3 ft.

Image: Colin Hayes.

Dry component floodproofing is often an effective solution for equipment that cannot be elevated or relocated out of basements.

Image: MAP Architects, New York Engineers.


2/26/18, 3:06 PM


FLIR

Co-Benefits

Measure with Co-Benefits

- Insulation, Air Sealing, and Window Replacement
  - Heating and Cooling Energy Savings, Improved Passive Survivability, Improved Wind Load Performance, Improved Comfort, Improved Functionality, Reduced Maintenance

Measure without Co-Benefits

- Backup Generator
  - Increased Building Services, Increased Operations and Maintenance Costs

Recommended Measure	Estimated Cost
Elevated Electrical Equipment	$50,000
Mold Remediation	$75,000
Sump Pumps	$3,000
Backwater Valves	$55,000
Building Floodproofing	$640,000
Cool Roof	$225,000
Surface Stormwater Management	$165,000
High Efficiency Ventilation	$1,315,000
Develop Emergency Management Manual	O&M

Co-Benefits: Cost Savings

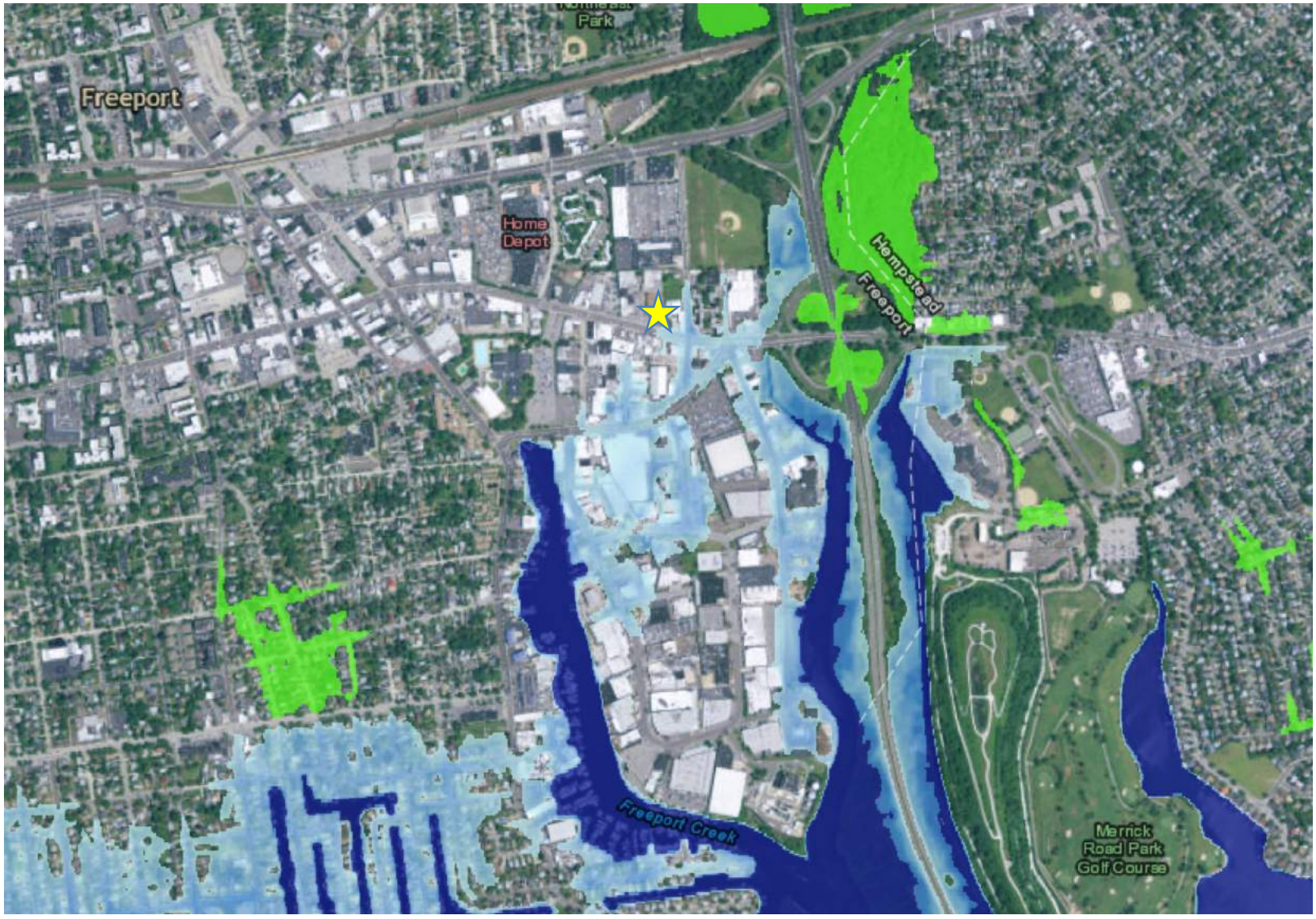
Solar PV + Battery Storage

- Reduced electricity demand charges, backup power supply, more electricity generated on site used on site

NEI's Approach: Design


17


AREA OF MINIMAL FLOOD HAZARD Zone X
ANCE FLOOD HAZARD Zone X
PANEL
36059C0239G
eff. 9/11/2009
Zone AE
(EL 8 Feet)


Freeport
Park
Home Depot
Hempstead Freeport
Freeport Creek
Merrick Road Park Golf Course

HVAC, DHW on Roof

Apartments Above Parking

Passive House Envelope Design

Backup LED Lights, Cell Phone Charging

8’ + 5’ = 13’

BFE = 8’

Conditioned Community Resilience Space

Backflow Prevention

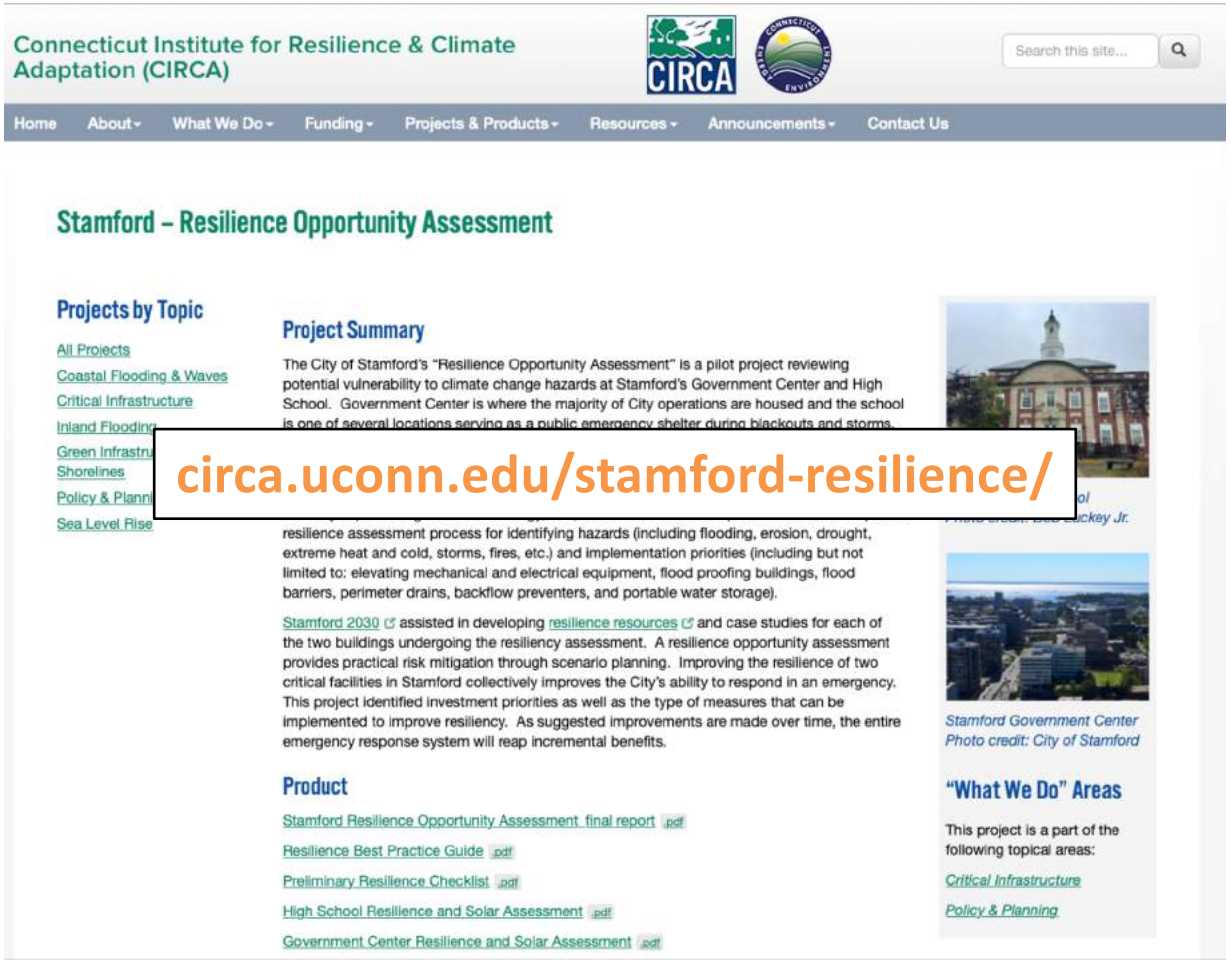
Generator with 72-hour Runtime

Stormwater Storage and Infiltration

Financing Resilience

- Capital planning and investment timing
- Avoids future losses but does not generate cash flows
- Benefit-cost analysis demonstrates the business case
- Relate payments to benefits and account for ability to pay

CT Resilience Resources



Exercise

5	Are ground-level apartments located above the base flood elevation (BFE, the elevation to which floodwaters are expected to rise in a 1% annual chance or 100-year flood)?		1, 11

Strategies		Definitions
1	Wet Floodproofing	FEMA defines wet floodproofing as "Permanent or temporary measures applied to a structure or its contents that prevent or provide resistance to damage from flooding while allowing floodwater to enter the structure or area. Generally, this includes properly anchoring the structure, using flood resistant materials below the Base Flood Elevation (BFE), protection of mechanical and utility equipment, and use of openings or breakaway walls."
11	Elevated Living Spaces	Convert residential units on floors below the BFE to parking, storage, common rooms and community space, or entryways. Ensure equipment in these areas is portable and can be moved to safety before anticipated flooding.

Q&A

Thank you!

Tom Chase

Senior Project Manager

New Ecology, Inc.

chase@newecology.org