Climate Readiness for Affordable Housing

March 3, 2021

Tom Chase
New Ecology, Inc.

About New Ecology, Inc.

As a mission-driven nonprofit, New Ecology works nationally to bring the benefits of sustainable development to the community level, with a concerted emphasis on underserved populations.

We seek to make the built environment more efficient, healthy, durable, and resilient.

Binghamton, NY
(1 Development)

New York, NY
(60 Developments)

Washington, DC
(20 Developments)

Boston, Cambridge and Statewide
(1,400+ Developments)

Stamford, CT and Statewide
(5 Buildings)

Long Island, NY
(4 Developments)

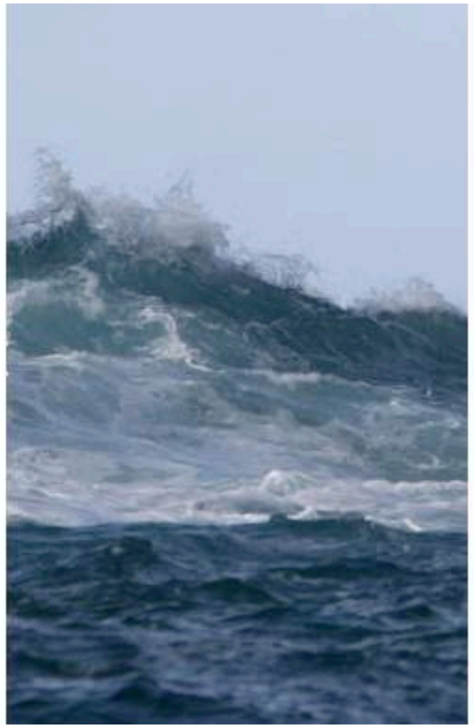
Delaware
(200 Developments)

Agenda

- Climate Projections
- Building and Population Characteristics
- Portfolio Prioritization
- Building and Site Assessments, Capital Planning
- Building and Site Guidelines
- Emergency Preparedness Planning

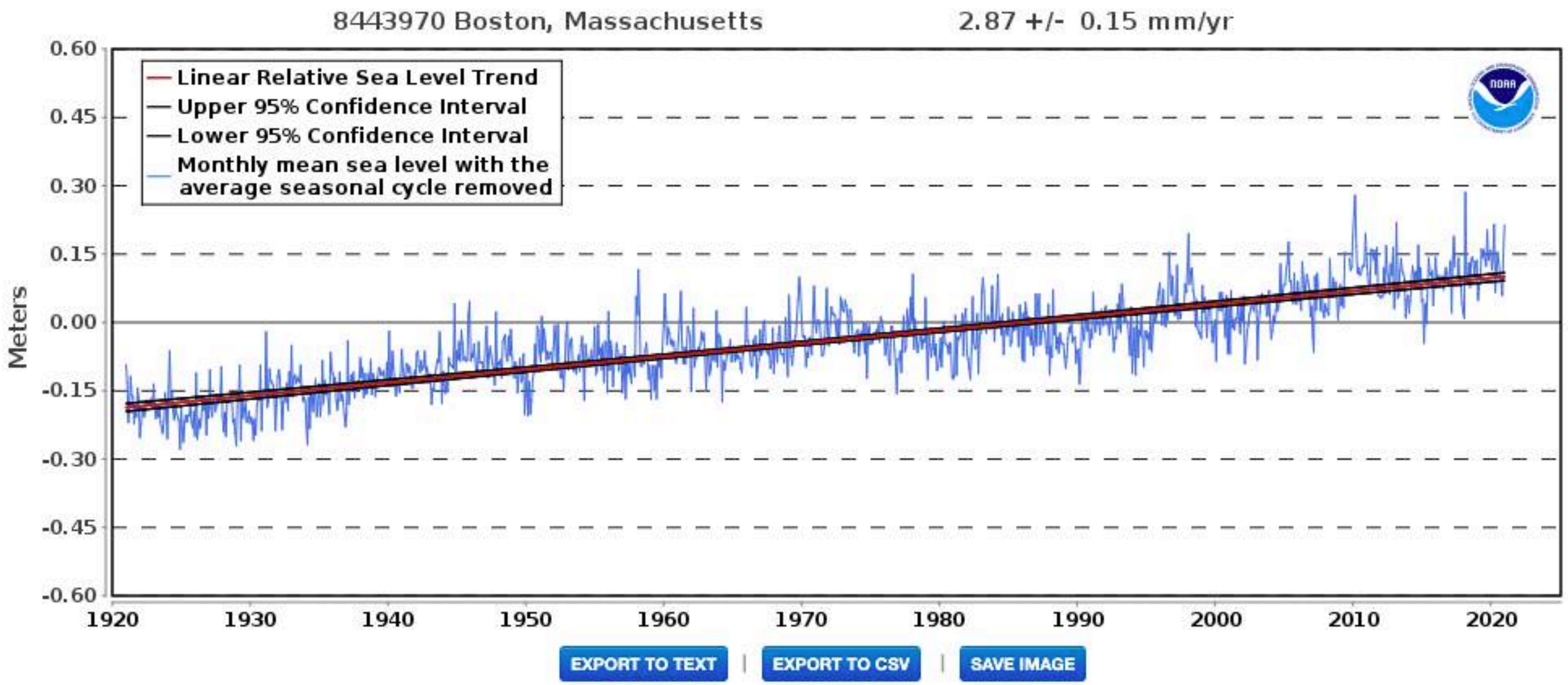
Climate Projections

Climate Projections

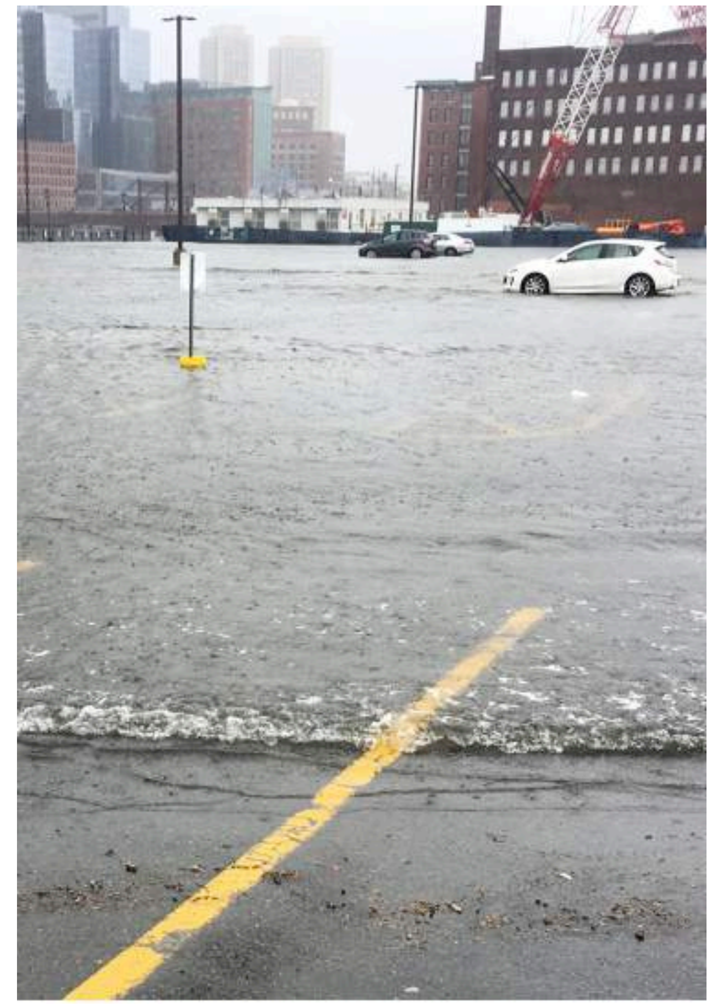


Climate Today

Relative Sea Level Trend
8443970 Boston, Massachusetts

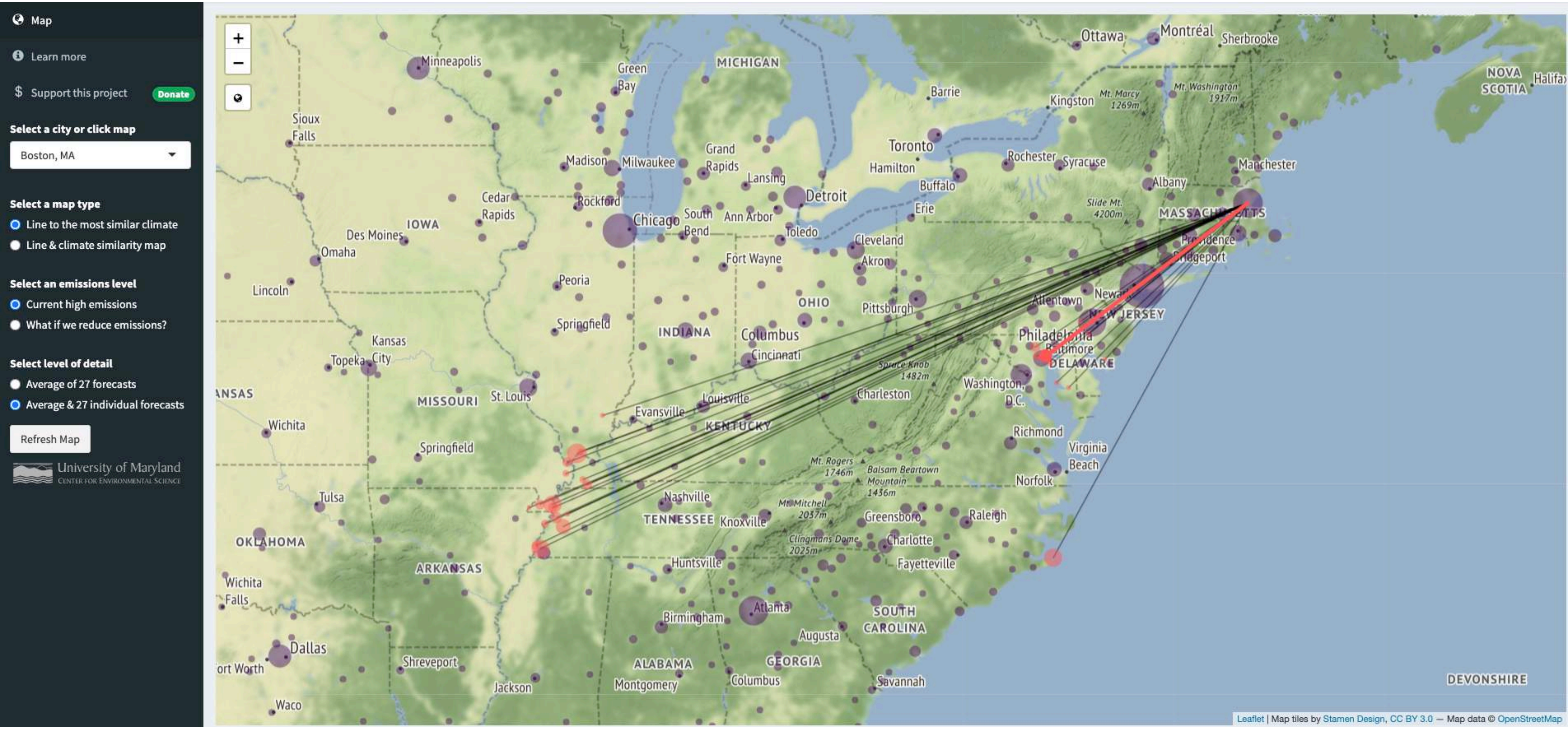


The relative sea level trend is 2.87 millimeters/year with a 95% confidence interval of +/- 0.15 mm/yr based on monthly mean sea level data from 1921 to 2020 which is equivalent to a change of 0.94 feet in 100 years.



2018 Boston flooding


AUBURN
BOSTON
NORTH END
Boston
CAMBRIDGEPORT
FINANCIAL DISTRICT
ALLSTON
N Beacon St
CHINATOWN
BACK BAY
BRIGHTON
SEAPORT
COOLIDGE CORNER
FENWAY
SOUTH END
Point Shirley
E Broadway
RESERVOIR
SOUTH BOSTON
E Sixth St
Brookline
ROXBURY
UPHAMS CORNER
SAVIN HILL
GROVE HALL
JAMAICA PLAIN
Approx. 19.3K properties have a **0.2% chance** of some amount of water reaching their building in 2021.
properties
6,000
4,000
2,000
0
0
1
2
3
Depth of flooding (feet)
Sat
Map
mapbox
© Mapbox © OpenStreetMap Improve this map © Maxar


Map
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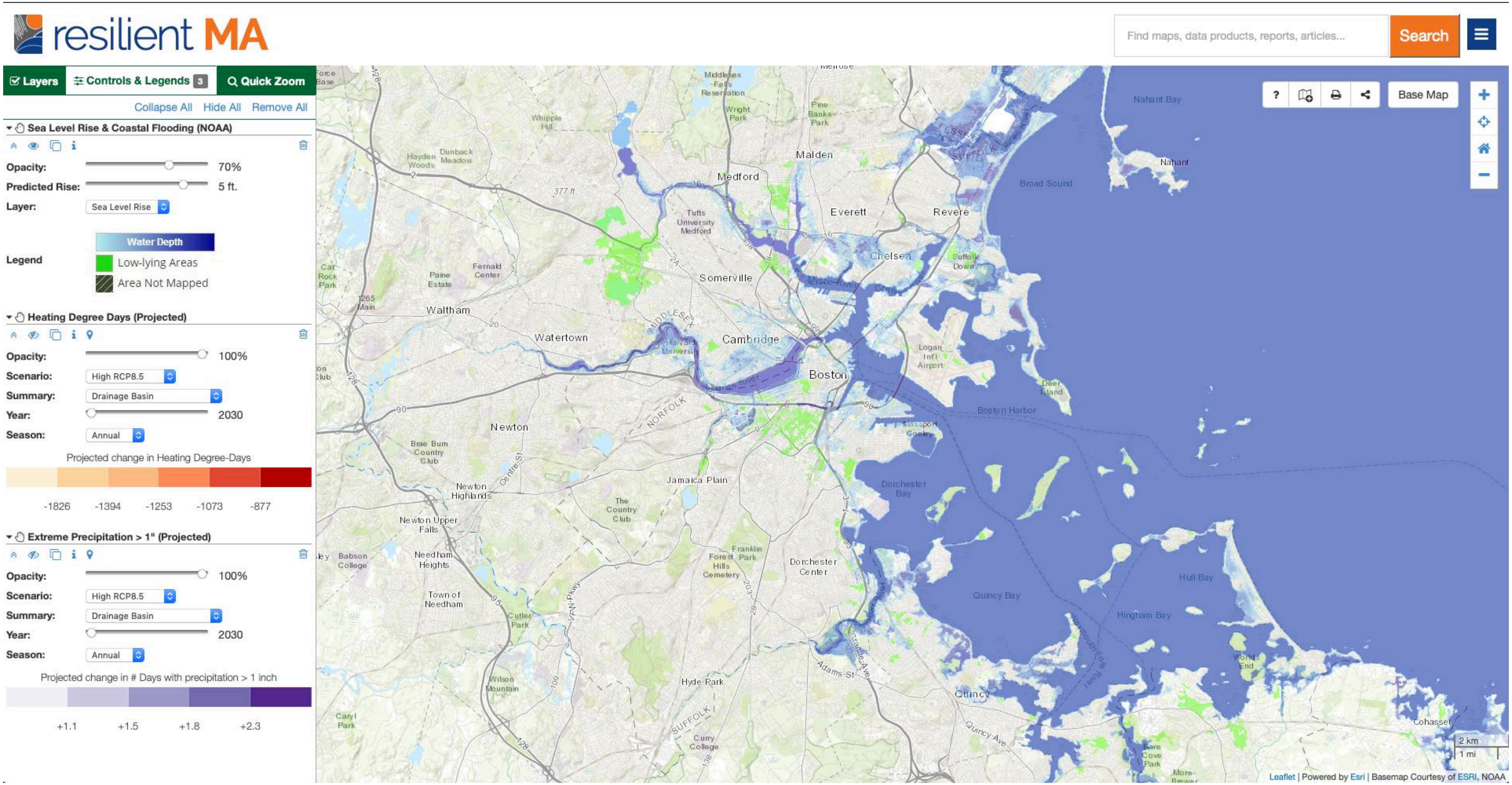
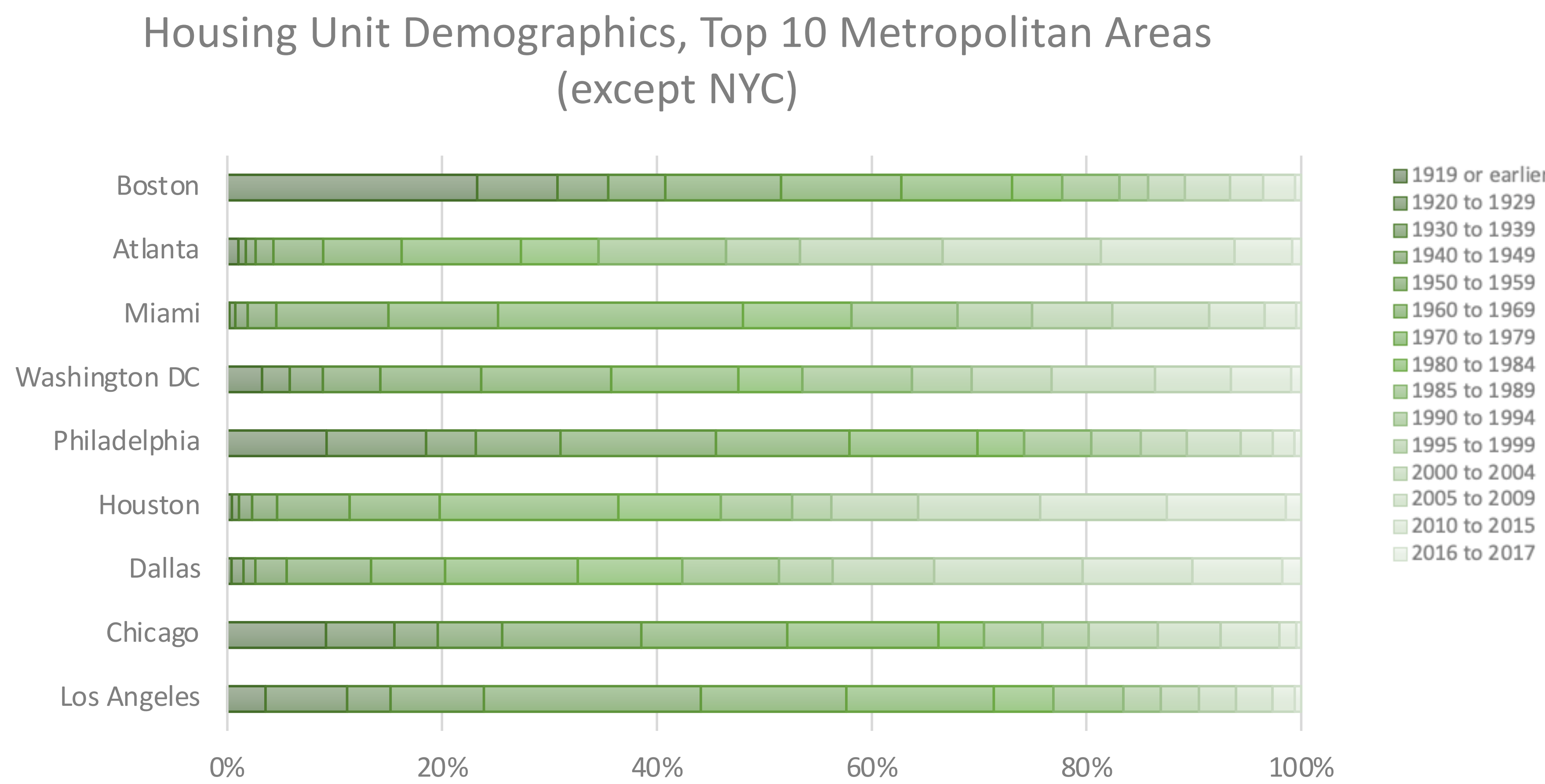
Select a city or click map
Boston, MA
Select a map type
Line to the most similar climate
Line & climate similarity map
Select an emissions level
Current high emissions
What if we reduce emissions?
Select level of detail
Average of 27 forecasts
Average & 27 individual forecasts
Refresh Map
University of Maryland
Center for Environmental Science
Leaflet | Map tiles by Stamen Design, CC BY 3.0 — Map data © OpenStreetMap


resilient MA
Find maps, data products, reports, articles...
Search
Layers
Controls & Legends 3
Quick Zoom
Collapse All
Hide All
Remove All
Sea Level Rise & Coastal Flooding (NOAA)
Opacity: 70%
Predicted Rise: 5 ft.
Layer: Sea Level Rise
Legend
Water Depth
Low-lying Areas
Area Not Mapped
Heating Degree Days (Projected)
Opacity: 100%
Scenario: High RCP8.5
Summary: Drainage Basin
Year: 2030
Season: Annual
Projected change in Heating Degree-Days
-1826 -1394 -1253 -1073 -877
Extreme Precipitation > 1" (Projected)
Opacity: 100%
Scenario: High RCP8.5
Summary: Drainage Basin
Year: 2030
Season: Annual
Projected change in # Days with precipitation > 1 inch
+1.1 +1.5 +1.8 +2.3
Base Map
Malden
Medford
Everett
Revere
Nahant
Broad Sound
Chelsea
Somerville
Cambridge
Boston
Waltham
Watertown
Newton
Boston Harbor
Jamaica Plain
Dorchester Bay
Dorchester Center
Quincy Bay
Hull Bay
Hingham Bay
Quincy
Hyde Park
Cohasset
2 km
1 mi
Leaflet | Powered by Esri | Basemap Courtesy of ESRI, NOAA

Building and Population Characteristics

Old buildings, new climate.



Source: U.S. Census Bureau, American Housing Survey

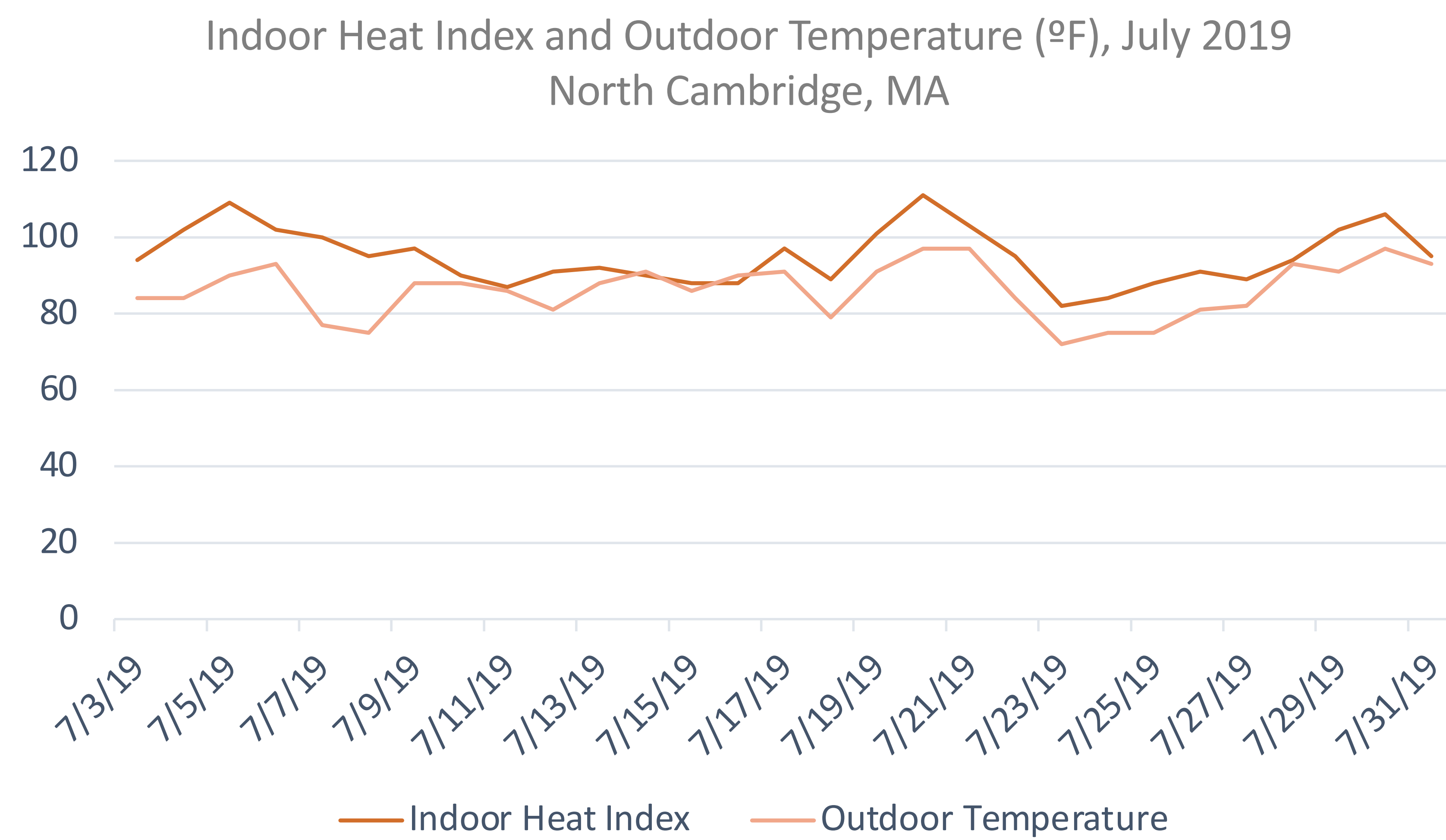
NWS Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger



Portfolio Prioritization

Workplan

Risk and Vulnerability Assessment

Pilot Site Assessments

Resilient Design Guidelines

DHCD State-Funded
Public Housing Portfolio

1,430 developments

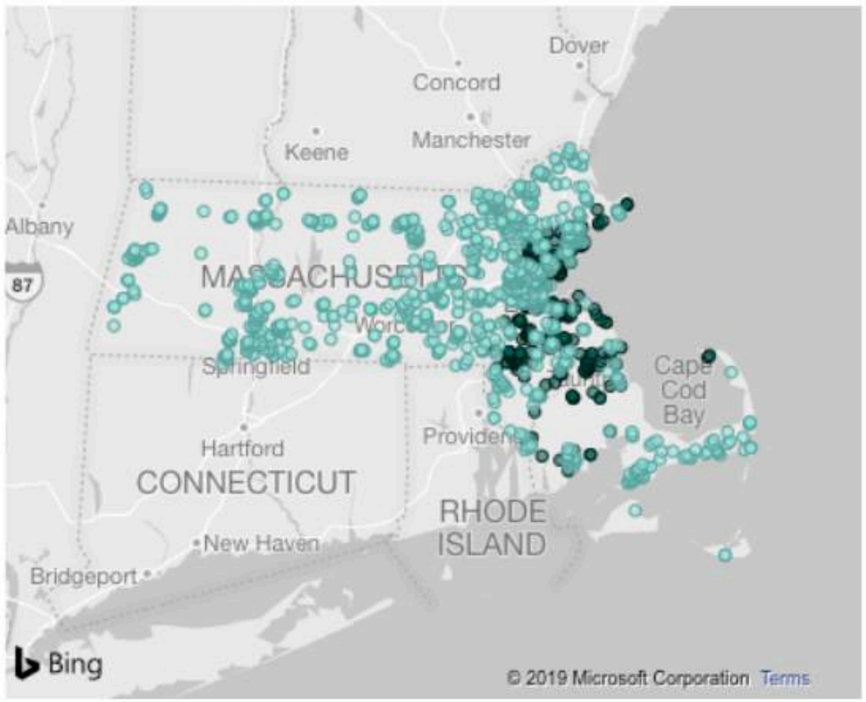
45,300 apartments

80,000 residents

Probability – Hazard Mapping

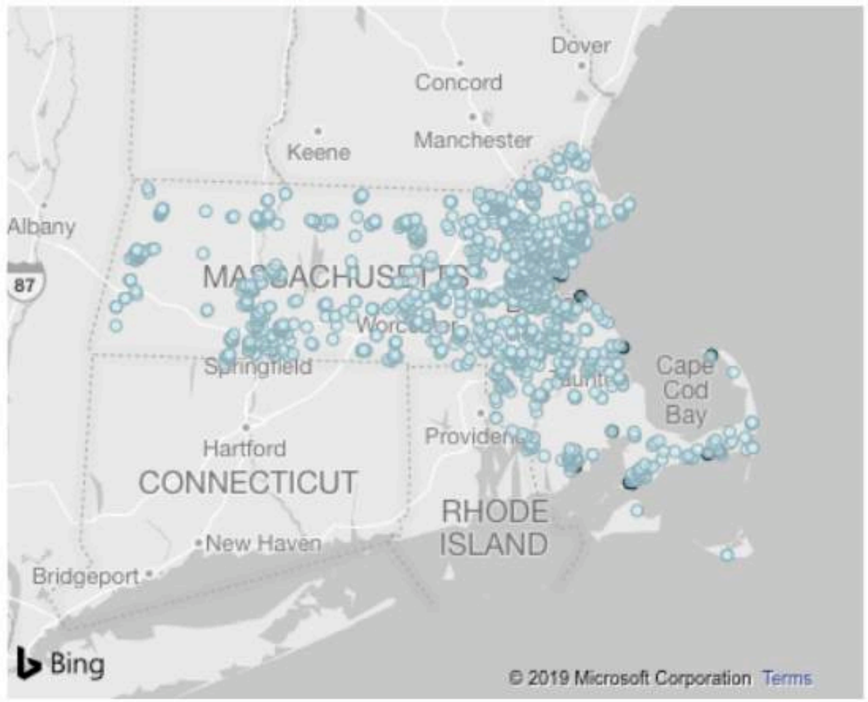
Precipitation Probability

ProbPrecip ● High ● Low



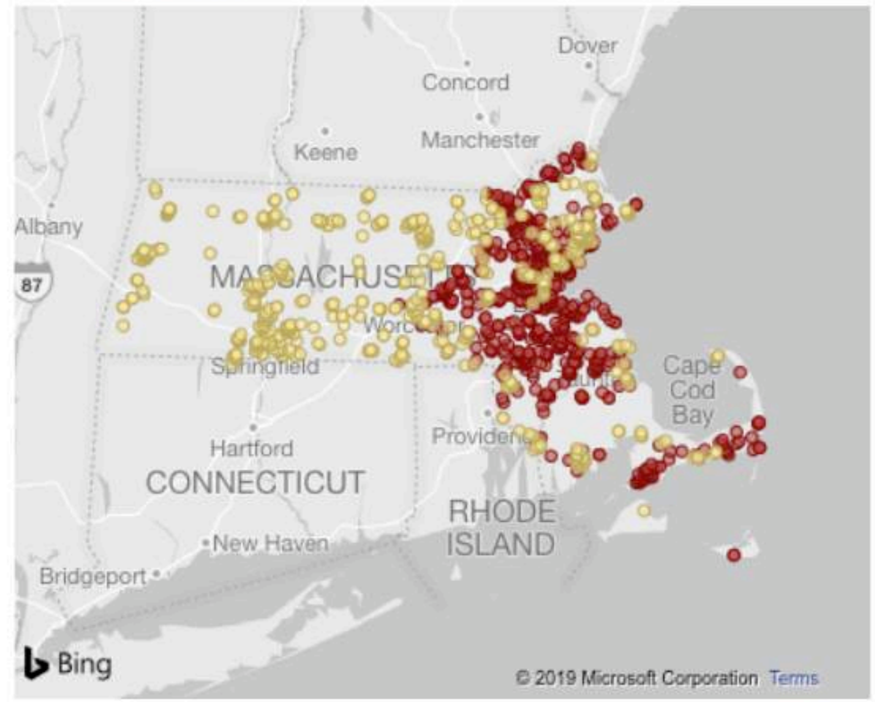
Sea Level Rise and Storm Surge Probability

ProbSLRSS ● High ● Low



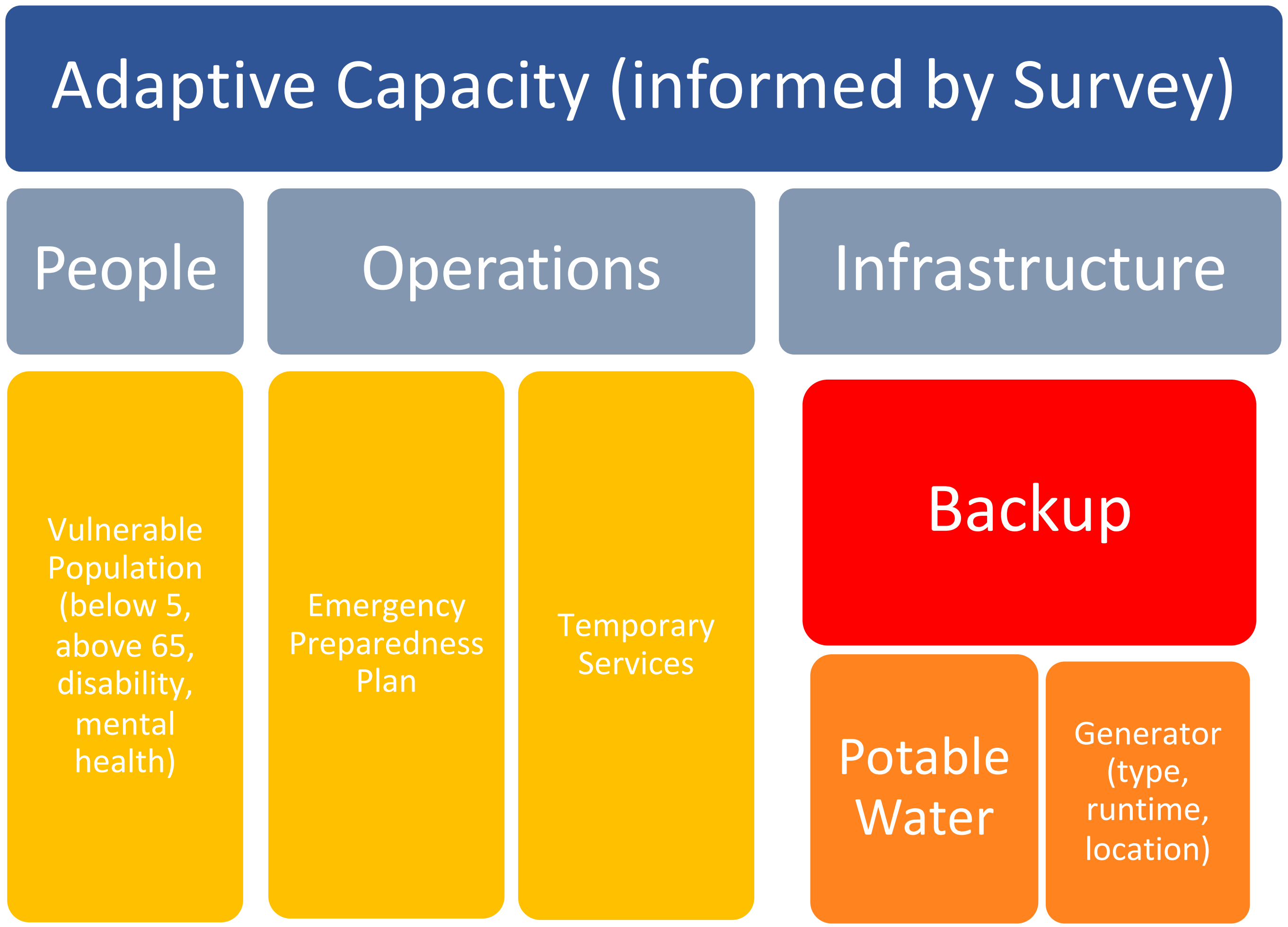
Temperature Probability

ProbTemp ● High ● Low

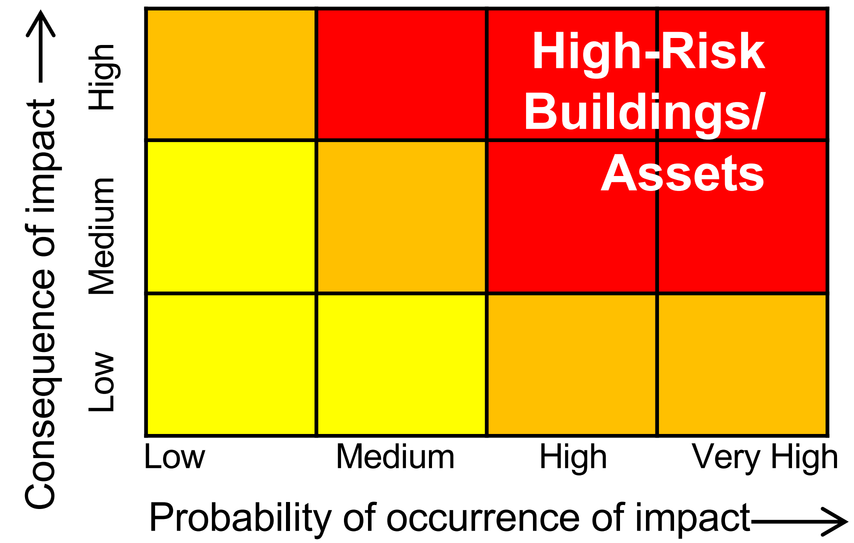


Adaptive Capacity and Vulnerability

Vulnerability is defined by a person's or asset's exposure, sensitivity and capacity to adapt.

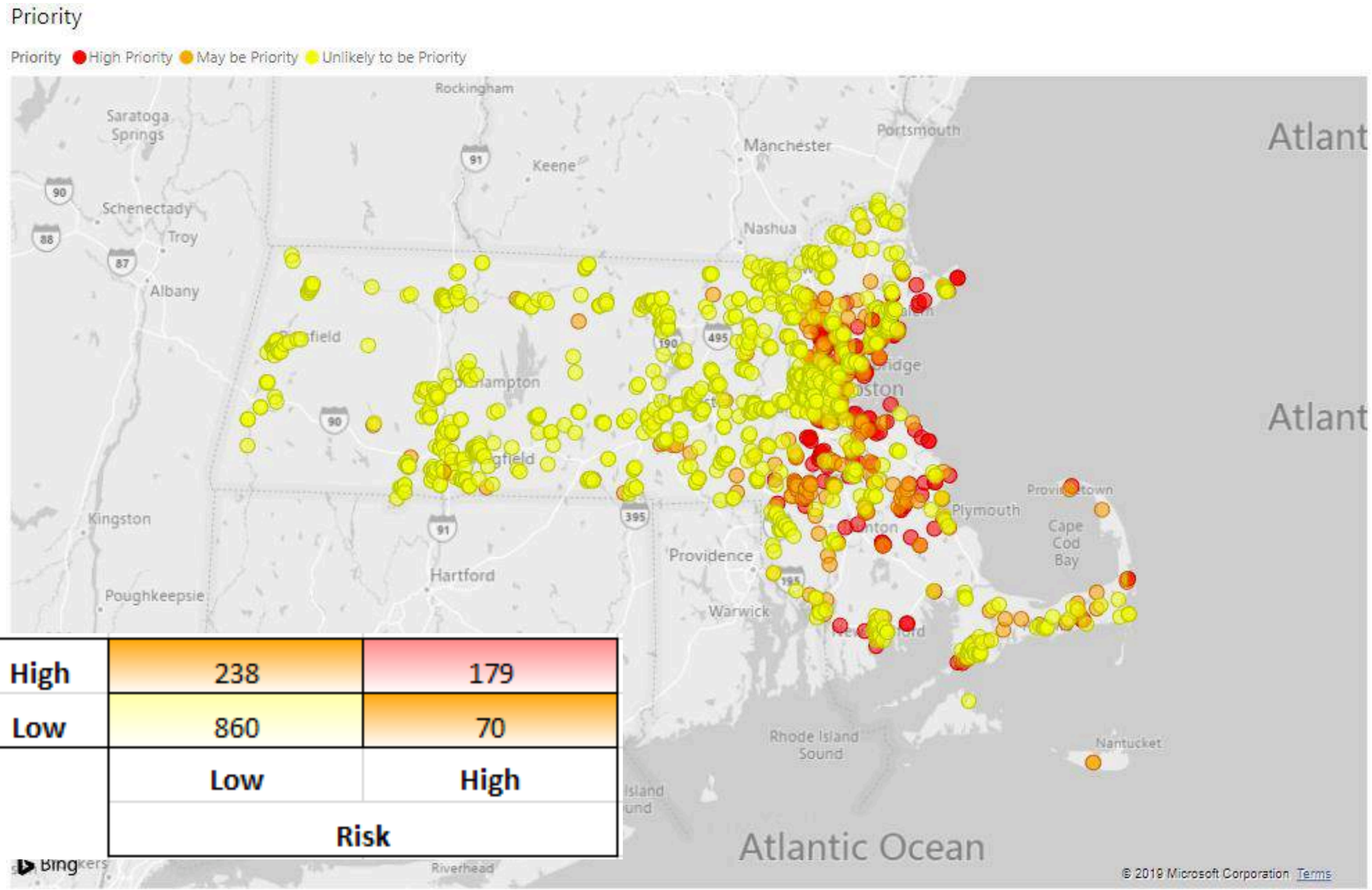


Risk is defined by the extent and probability of harm occurring.



Risk Matrix

RVA Analysis and Findings



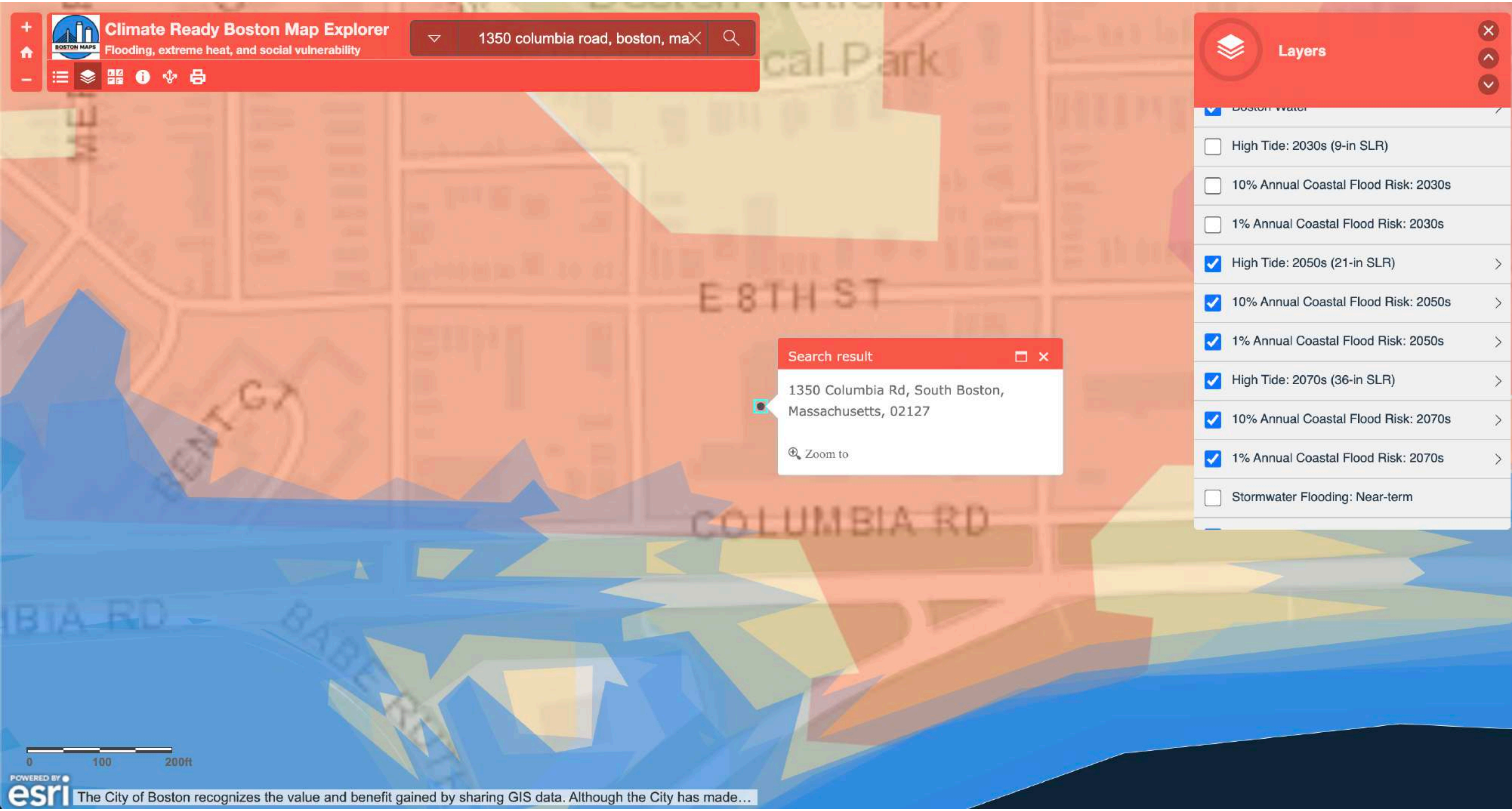
		Risk: Low	Risk: High
Vuln.	**High**	238	179
	Low	860	70

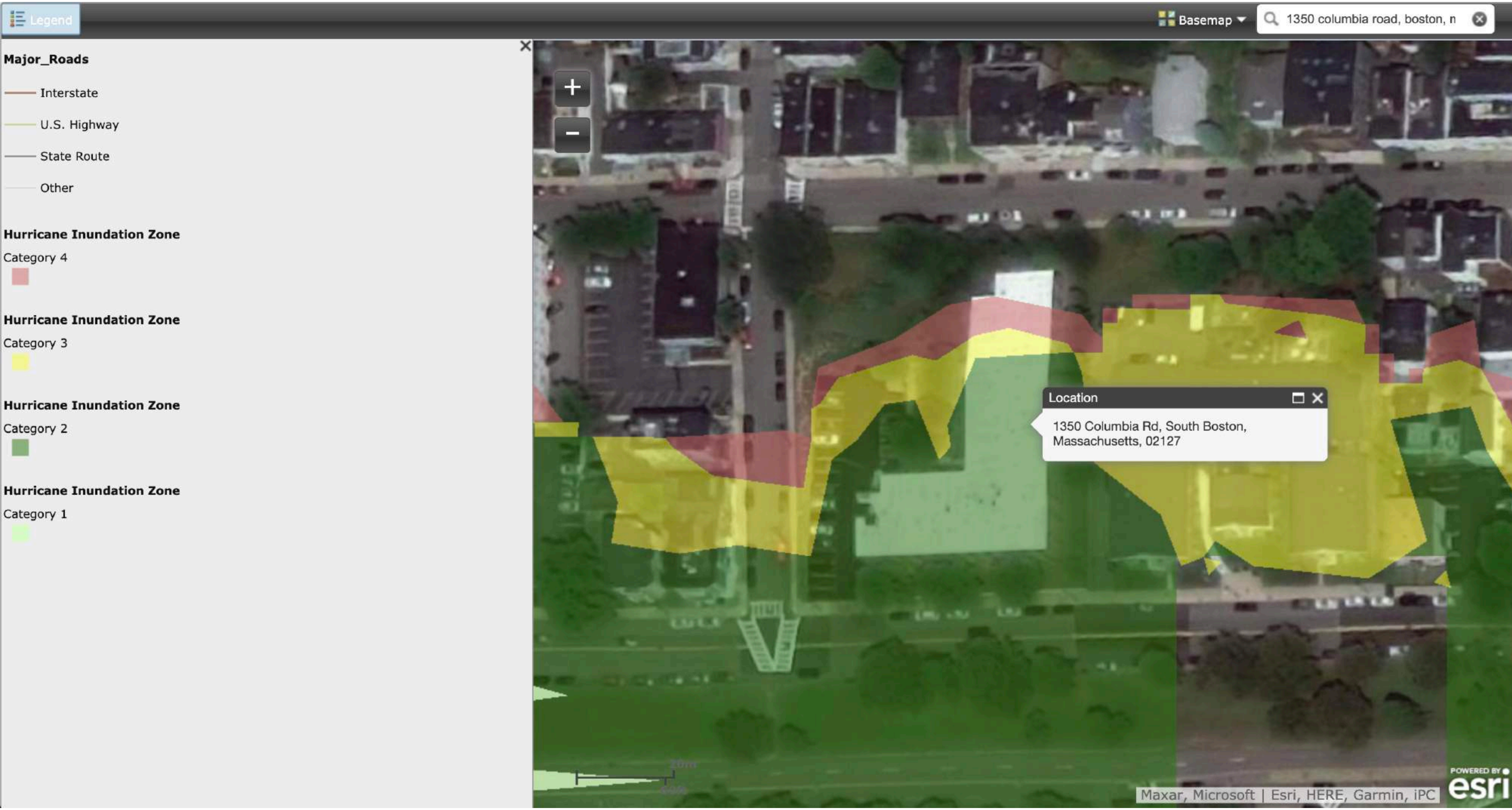
Resilience Assessments

LISC Resilience Assessment Example 1

Waterview Apartments

Year Built: 1975
Most Recent Year Rehabbed: 2015-2019 (minimal)
Total Square Feet: 41,739
Total # Apartments: 49
Total # Bedrooms: 63
Total # Stories: 3
Basement? Conditioned?: No, n/a


Climate Ready Boston Map Explorer
Flooding, extreme heat, and social vulnerability
1350 columbia road, boston, ma
Layers
High Tide: 2030s (9-in SLR)
10% Annual Coastal Flood Risk: 2030s
1% Annual Coastal Flood Risk: 2030s
High Tide: 2050s (21-in SLR)
10% Annual Coastal Flood Risk: 2050s
1% Annual Coastal Flood Risk: 2050s
High Tide: 2070s (36-in SLR)
10% Annual Coastal Flood Risk: 2070s
1% Annual Coastal Flood Risk: 2070s
Stormwater Flooding: Near-term
E 8TH ST
Search result
1350 Columbia Rd, South Boston, Massachusetts, 02127
Zoom to
COLUMBIA RD
0
100
200ft
The City of Boston recognizes the value and benefit gained by sharing GIS data. Although the City has made…


Legend
Basemap
1350 columbia road, boston, n
Major_Roads
Interstate
U.S. Highway
State Route
Other
Hurricane Inundation Zone
Category 4
Hurricane Inundation Zone
Category 3
Hurricane Inundation Zone
Category 2
Hurricane Inundation Zone
Category 1
Location
1350 Columbia Rd, South Boston, Massachusetts, 02127
Maxar, Microsoft | Esri, HERE, Garmin, iPC
POWERED BY esri

LISC Resilience Assessment 1: Resilience Opportunities

Hazard	Resilience Opportunity	Estimated Cost	Timing
All	Emergency Preparedness Plan	Staff Time	Short Term
Flood	Purchase Flood Insurance	TBD pending quote	Short Term
Water Outage	Backup Potable Water	$600	Short Term
All	Resilience Hub	TBD	Medium Term
Flood	Backwater Valves	$18,000	Medium Term
Flood	Dry Floodproof Mechanical Room and Sump Pumps	$25,000	Medium Term
Flood	Site Floodproofing	$150,000	Long Term
Extreme Heat	Window Shading	$30,000	Long Term
Power Outage	Backup Power or Solar PV + Battery Storage	$200,000 (generator) or $290,000 (solar + storage)	Long Term
Extreme Heat	Insulated Cladding	TBD pending design	Long Term

LISC Resilience Assessment 1: Solar PV Feasibility

Solar System Capacity (kW AC)	64
Annual Solar Generation (kWh)	80,259

Net Investment without ITC or Additional Incentives	$	160,640
Net Present Value of 20 years of SMART Incentive Payments	$	153,912
Total Life Cycle Savings (NPV) with SMART Incentives	$	225,574
Annual Utility Saving Year 0	$	23,675

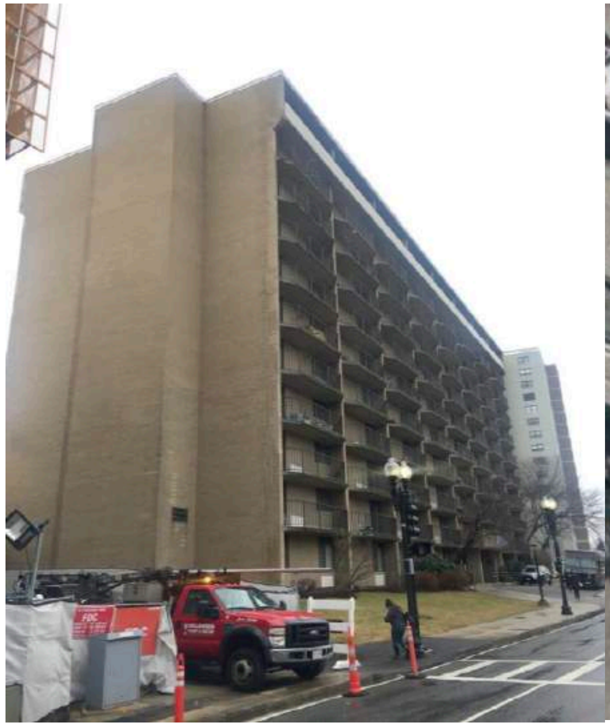
	With SMART Incentives
Savings-to-Investment Ratio (SIR)	2.40
Simple Payback	7

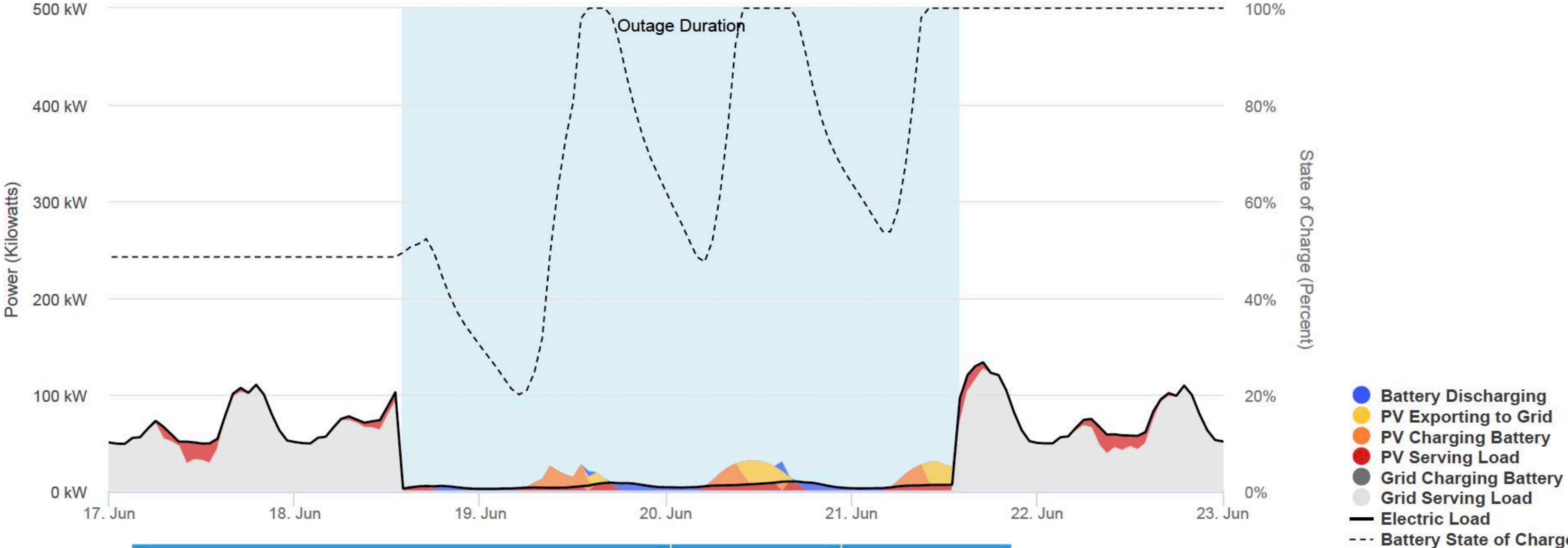
Life Cycle Term (Year)	25	
Inflation Rate	3%	
	Nominal	Real
Discount Rate	5%	2%
Escalation Rate	3%	0%

LISC Resilience Assessment: Solar+Storage

Amy Lowell House

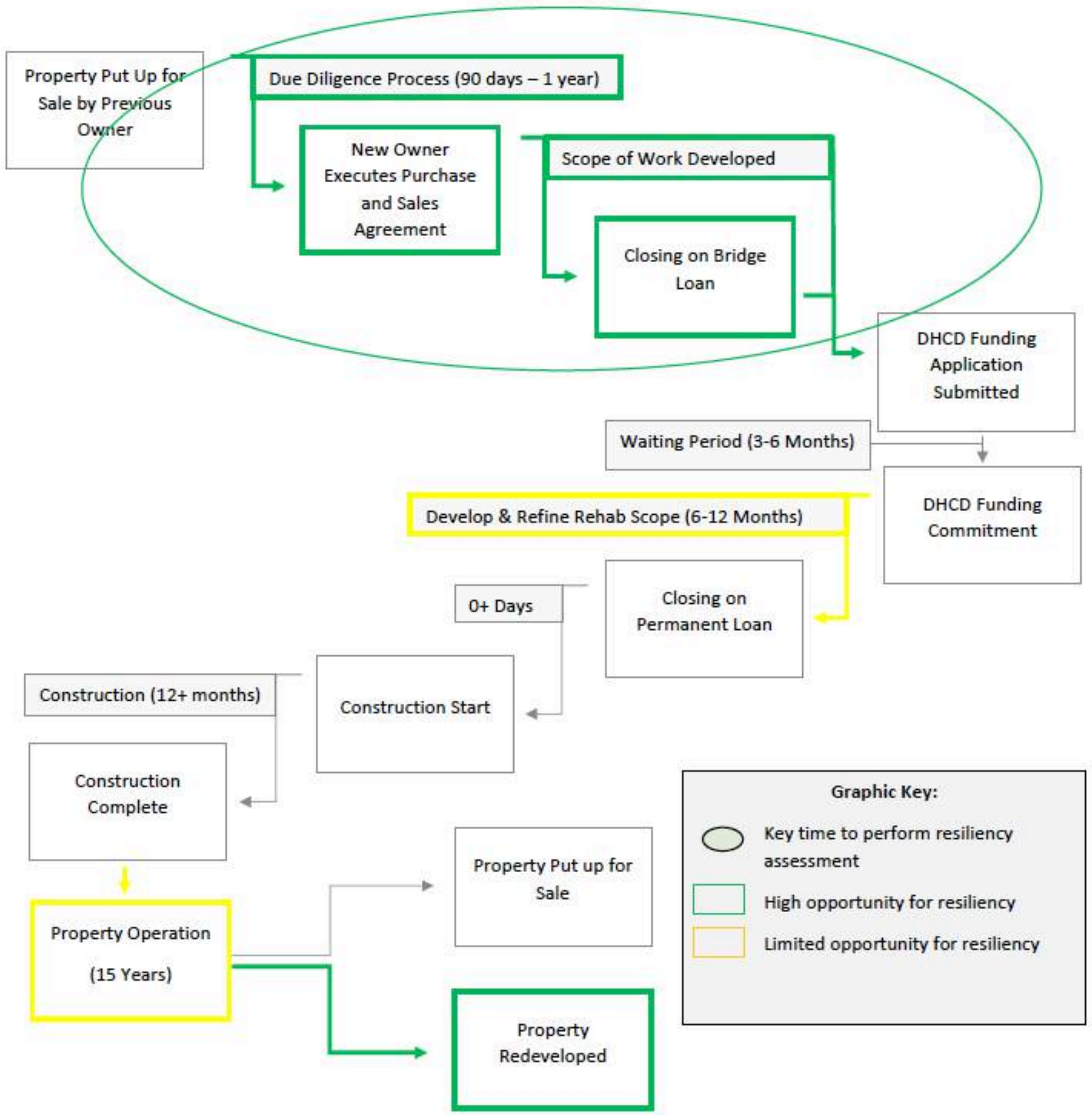
Year Built: 1975
Most Recent Year Rehabbed:
Total Square Feet: 115,000
Total # Apartments: 151
Total # Bedrooms: 151
Total # Stories: 11
Basement? Conditioned?: No, n/a

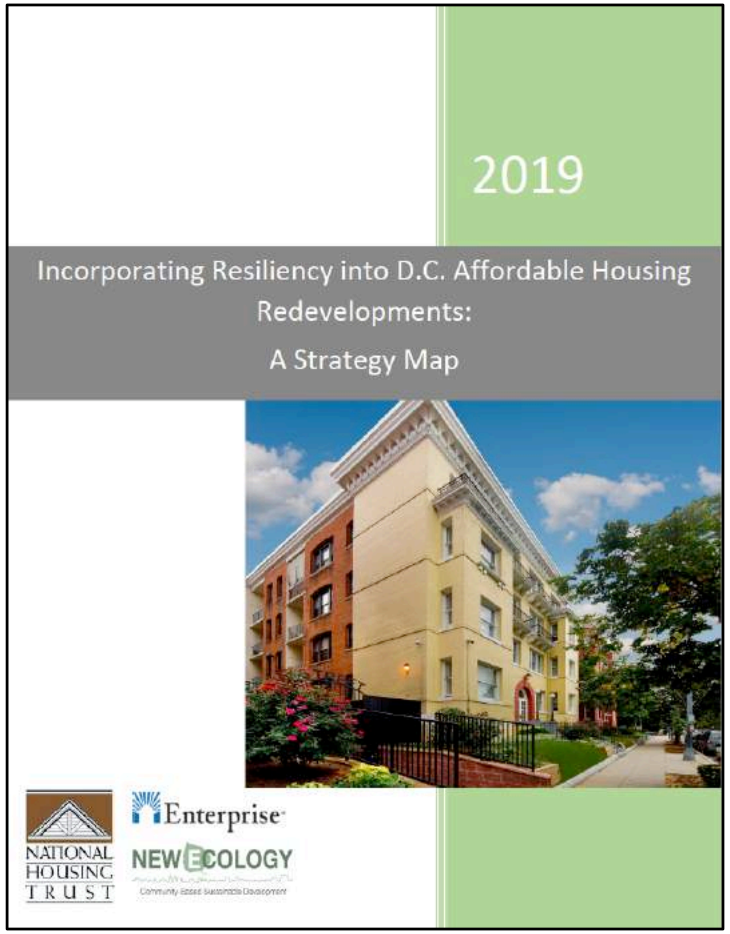




	Business As Usual	Resilience
Life Cycle Utility Cost — After Tax		
Utility Energy Cost	$307,249	$307,750
Utility Demand Cost	$581,470	$479,539
Utility Fixed Cost	$2,528	$2,528
Utility Minimum Cost Adder	$0	$0
Total System and Life Cycle Utility Cost — After Tax		
Total Life Cycle Costs	$851,058	$824,490
Net Present Value	$0	$26,568

When?


Property Put Up for Sale by Previous Owner
Due Diligence Process (90 days – 1 year)
New Owner Executes Purchase and Sales Agreement
Scope of Work Developed
Closing on Bridge Loan
DHCD Funding Application Submitted
Waiting Period (3-6 Months)
DHCD Funding Commitment
Develop & Refine Rehab Scope (6-12 Months)
Closing on Permanent Loan
0+ Days
Construction Start
Construction (12+ months)
Construction Complete
Property Operation (15 Years)
Property Put up for Sale
Property Redeveloped
Graphic Key:
Key time to perform resiliency assessment
High opportunity for resiliency
Limited opportunity for resiliency


2019
Incorporating Resiliency into D.C. Affordable Housing Redevelopments:
A Strategy Map
NATIONAL HOUSING TRUST
Enterprise
NEW ECOLOGY

Rapid Risk and Vulnerability Assessment Tool

Rapid RVA Tool

34 questions

Can be completed in 20-30 minutes

Provides 0-100 “Resilience Score”

Multiple uses

- Individual capital planning projects by local housing authority staff
- Educational tool
- Check on recommended resilience measures and associated design guidance by architects and engineers
- 5-year capital needs assessment as component of third-party assessment data forms, DHCD adapting as CPS data collection form

Rapid RVA Tool

Rapid Risk and Vulnerability Assessment | CHARM

Massachusetts Department of Housing and Community Development

RESILIENCE SCORE
Scores are out of 100 points, with 100 being most resilient
49

INSTRUCTIONS

This tool is intended to educate and guide LHA users in planning more resilient developments. Please use the following questions to gather information about a given development by walking the site and in conversation with site managers and staff. For "NO" answers, see applicable resilience strategies to consider in the column to the right. Refer to the Resilience Strategies page to identify and explore potential strategies. Related hazards are identified as follows: "EP" = emergency preparedness, "P/SLRSS" = precipitation/sea level rise and storm surge, "H" = extreme heat, "W" = wind. Each "YES" answer receives a score of 3, each "NO" answer receives a score of 0. Total scores for all questions to derive development Resilience Score.

Property Name	Prattville Apartments, Chelsea, MA
Assessment Completed By	Tom Chase
Date	5/28/20

ASSESSMENT QUESTIONS

PROPERTY MANAGEMENT	YES / NO	HAZARD(s)	COMMENTS	APPLICABLE RESILIENCE STRATEGIES	SCORE
Does the development have an emergency management plan covering staff, residents, and business operations continuity?	NO	EP	Some evacuation planning in place	22	0
Is the emeregency management plan referenced by the municipal emergency plan? Check with municipal officials to confirm.	NO	EP		22	0
Are staff familiar with the emergency preparedness plan and aware of their role in it, if identified?	NO	EP		22	0
Is there a nearby public facility where residents can go during power outages, storms or extreme heat or cold?	NO	EP		26	0
Are residents able to evacuate without mobility assistance?	YES	EP		22, 26, 27	3

Resilience Strategies Recommendations

Resilience Strategies | **CHARM**

Massachusetts Department of Housing and Community Development

INSTRUCTIONS

Use the strategy ID number below to match applicable strategies as identified during the Rapid Risk and Vulnerability Assessment.

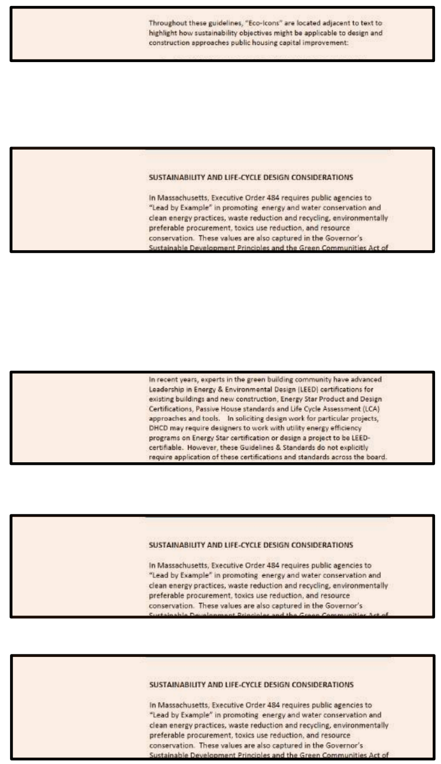
STRATEGY ID	STRATEGY NAME	HAZARD(s)	STRATEGY DETAILS	APPLICABLE DESIGN GUIDELINE SECTION
1	**Wet Floodproofing**	P/SLRSS	FEMA defines wet floodproofing as "Permanent or temporary measures applied to a structure or its contents that prevent or provide resistance to damage from flooding while allowing 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."	**06 10 00 ROUGH CARPENTRY** **06 20 00 FINISH CARPENTRY** **08 10 00 DOORS AND FRAMES** **09 20 00 GYPSUM** **09 30 00 TILE** **09 64 00 WOOD FLOORING** **09 65 00 RESILIENT FLOORING** **09 68 00 CARPET** **09 90 00 PAINTING** **14 20 00 ELEVATORS** **22 00 00 PLUMBING** **23 00 00 HVAC** **26 00 00 ELECTRICAL** **33 00 00 SITE UTILITIES**
2	**Dry Floodproofing (Building)**	P/SLRSS	Dry floodproofing of a building is installing measures applied to a structure to prevent damage from flooding by preventing floodwater from entering the structure. There are two types of dry floodproofing: active and permanent. Active measures require removable elements to be put into place before an anticipated flood. Permanent measures are fixtures and systems integrated into the structure itself, which do not need to be manually deployed in the event of an emergency. Dry floodproofing is prone to a high risk of failing in lightweight wood-framed buildings, however, and is not recommended for wood-framed building exteriors or openings per FEMA guidance.	**07 10 00 WATERPROOFING AND DAMPPROOFING** **07 90 00 SEALANTS** **08 10 00 DOORS AND FRAMES** **32 30 00 SITE IMPROVEMENTS** **33 00 00 SITE UTILITIES**

Building and Site Guidelines

DHCD Design Guidelines Revisions

Existing
DHCD Design Guidelines by CSI Section

New Resilience
Design Guidelines by CSI Section



Revised
DHCD Design Guidelines by CSI Section

Resilience Best Practices

Building Strategies

<u>Resilient Structure and Enclosure</u> **The most effective wall assemblies are well insulated, air and water tight to keep flooding out and maintain comfortable indoor temperature.**	Climate Hazard			Guideline Section
	PRECIPITATION	STORM SURGE	EXTREME HEAT	
Repairing or improving the thermal performance of **masonry** at all properties should always be done with attention to managing moisture and permeability as well as thermal performance.			◆	04 20 00 Unit Masonry
Use **wood** building materials which are considered flood damage resistant, meaning they can withstand direct contact with water for at least 72 hours without being significantly damaged.	◆	◆		06 10 00 Rough Carpentry 06 20 00 Finish Carpentry
For some residential buildings, the Massachusetts Energy Code requires a **continuous air barrier** assembly for new construction buildings or additions at opaque exterior walls or soffits, including joints and junctions to abutting constructions to control air movement through the wall. The air barrier also serves as a liquid-water drainage plane when flashed to discharge water to the exterior.	◆	◆		07 10 00 Waterproofing and Dampproofing
The most **effective wall assemblies** have a primary **water barrier** (the exterior cladding: brick, clapboards, shingles, etc.) and a secondary, vapor-open, bulk water barrier (house wrap with all joints taped, peel-and-stick membrane, liquid-applied air and water barrier, or other product).			◆	07 20 00 Building Insulation & Moisture Protection
Making improvements to **roof drainage** will help buildings address water penetration and structural failures. Improving roof insulation at the eaves of sloped roofs will reduce the freeze-thaw cycling of ice and snow on the roof that leads to ice dams.	◆		◆	07 30 00 Asphalt Roof Shingles

SMALL/MEDIUM DEVELOPMENT STRATEGIES

The graphic below demonstrates a suite of potential strategies for wood frame, wood enclosure and wood frame, masonry enclosure buildings, the most common small/medium construction types in the DHCD portfolio. For wood frame, wood enclosure buildings in flood zones, elevating the building may also be possible.

Emergency Generator
Raise electrical equipment, conduit, panels, and wiring above the Design Flood Elevation (DFE) Consider the backup power needs of residents, especially if they are expected to shelter in place during power outages. Size backup generators to the critical loads identified.

Solar Panels
A roof replacement offers an ideal time to evaluate the orientation of the roof for future installation of solar photovoltaic (PV) or solar thermal domestic hot water heating systems.

Roof Overhang
When designing new 1-2 story buildings, architects should design ample roof overhangs, durable perimeter foundation and siding materials to minimize the need for gutters.

Cool Roof
Avoid dark brown and black shingles because they tend to build up and retain heat, and have a shorter lifespan.

Retaining/Perimeter Wall
Retaining walls can be used to manage flood and landslide risk. Retaining walls must be designed to withstand earth load and hydrostatic pressure to insure a long-lasting installation. Temporary flood barriers may be installed at entrances and deployed in advance of an anticipated flood events.

Design Flood Elevation
Build walls, waterproof materials, and building systems protection to the design flood elevation as defined by FEMA or municipal guidelines when available.

Window Well
Protect window wells by building up the walls at least six inches to protect from flash flooding.

Permeable Pavement
Permeable pavement and open grid pavement can reduce surface runoff and increase water infiltration rates into soils which may be useful in managing stormwater.

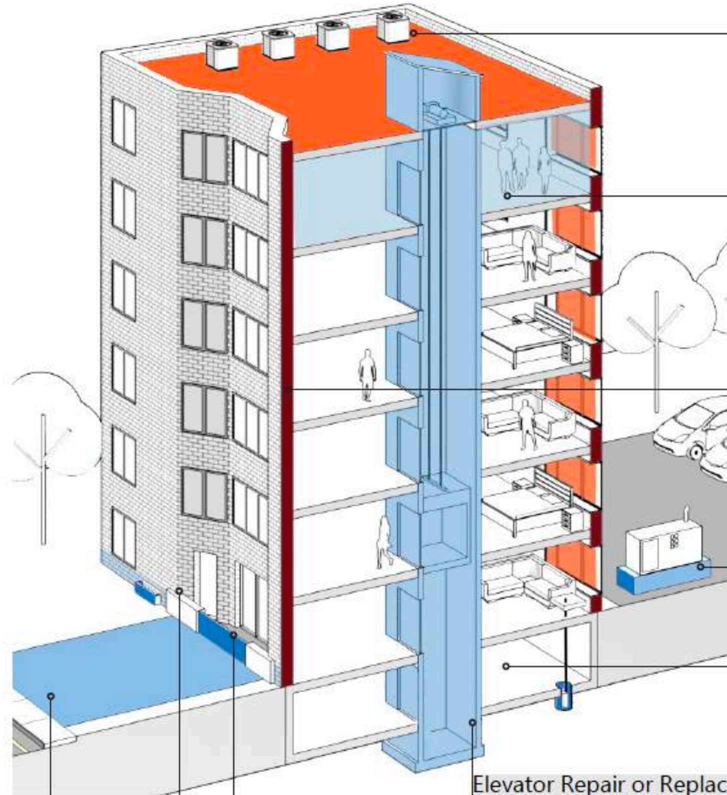
Elevate Mechanical Equipment
Elevating mechanical equipment off the ground in basements minimizes risk from flooding.

Insulation
Well insulated, airtight buildings with appropriate vapor control keep heat inside in winter and can be cooled more efficiently in summer.

Windows
Shading windows reduces the amount of solar heat gain in the interior of the building, thereby reducing cooling loads during the summer months and leading to lower indoor temperatures during power outages when the cooling system is not operational.

LARGE DEVELOPMENT STRATEGIES

The graphic below demonstrates a suite of potential strategies for a concrete frame, masonry enclosure building, the most common large construction type in the DHCD portfolio.



Cool Roof
Standard built up asphalt, rubber, black EPDM, or other dark roofs can reach temperatures of 150°F or more in the summer sun. A light-colored "cool roof" under the same conditions could stay more than 50°F cooler.

Community Room
Back-up the community room to an emergency generator and cooling system to shelter in place during power outages.

Dry Floodproofing
Creating a waterproof barrier in a section of wall to make it impermeable may require the use of sealants which are applied directly to the exterior surface of the building to seal exterior walls and floors. This is desirable below the DFE.

Elevate Mechanical Equipment
Elevating mechanical equipment off the ground in basements minimizes risk from flooding.

Resilient Materials
Flood damage resistant materials should be continuous from the lowest point in the building up to the Design Flood Elevation (DFE), if known.

Elevator Repair or Replacement
Where flooding is a concern, raise elevator components that can be elevated out of sump pits and above the design flood elevation (DFE), and take steps to mitigate flooding in elevator pits by waterproofing the interior of the pit and installing sump pumps tied to a backup power source.

Temporary Barriers
Temporary barriers can be quickly deployed, generally in less than 24 hours depending operational availability and size of deployment. Consult an engineer to see if this is a viable strategy as flood barriers may put stresses on the building structure and may conflict with the building code

Design Flood Elevation
Build walls, waterproof materials, and building systems protection to the design flood elevation as defined by FEMA or municipal guidelines when available.

Permeable Pavement
Permeable pavement and open grid pavement can reduce surface runoff and increase water infiltration rates into soils which may be useful in managing stormwater.

Emergency Preparedness

Emergency Preparedness Guidelines

Three step emergency planning process, with document template:

1. Identify Staff Contact Info and Roles
2. Organize Critical Information (securely stored and backed up)
3. Develop Protocols

Protocols include:

- Building & Systems Preparedness Protocols
- Resident/Apartment Preparedness Protocol
- Evacuation Protocol
- Sheltering Protocol

Example Protocol Form

Resident Engagement Tasks for Building Team (BT) and/or Resident Engagement (RE) Teams	Team Lead BT/RE	Initial When Complete	Time Shutdown	Time Re-Open
Designate Team to keep backup copies of all keys during emergency.				
Alert residents not to deposit trash in compactors during power outage				
Communicate to residents not to flush toilets if a building backwater valve is engaged. Install ball valves in place of standard gate valves and turn off water to toilets when backwater valves are engaged.				
Assist residents in securing outdoor furniture, trash storage, and any items on balconies if high winds expected				
Help residents remove or unplug window air conditioners				
If intercom unavailable, ensure other communications systems are in place to contact residents.				
Distribute "GoBag Checklist" to residents if evacuation is possible				
Note: Prepare standard email and text messages to send to residents for the notifications above, in order to save time during an emergency event.				

Thank You!

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