

# Massachusetts Historic Preservation Conference 2017



## Session 2D

(1:00-2:30pm)

### Rising Water & Historic Resources

#### Lisa Craig

*Chief of Historic Preservation,  
City of Annapolis*

#### Julia Knisel

*Coastal Shoreline and Floodplain  
Manager, Massachusetts Office  
Coastal Zone Management*

#### Tom O'Shea

*Director of Stewardship & Natural  
Resources, The Trustees of  
Reservations*

#### Jon Rudzinski

*Principal, Rees-Larkin Development*

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AttendeeHub**

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**2017 MA Historic  
Preservation Conference**





# Rising Water & Historic Resources

## **Flood Risk & Adaptation Opportunities**



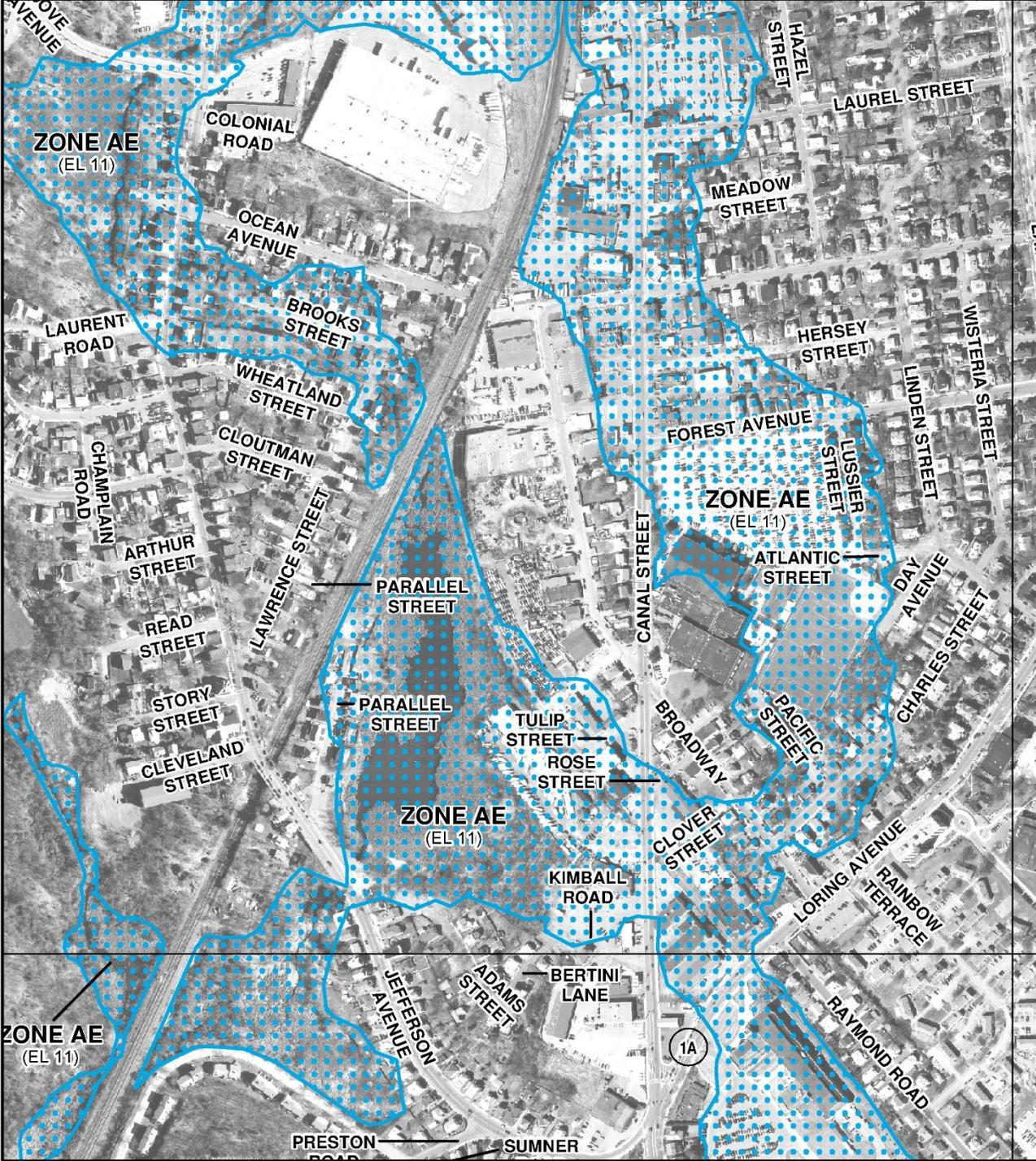
**Julia Knisel**  
Coastal Shoreline &  
Floodplain Manager

# Local Experience/Knowledge: Extent & magnitude of flooding (& erosion)



# MyCoast





MAP SCALE 1" = 500'



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0419G

**FIRM**  
**FLOOD INSURANCE RATE MAP**  
**ESSEX COUNTY,**  
**MASSACHUSETTS**  
**(ALL JURISDICTIONS)**

**PANEL 419 OF 600**  
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARBLEHEAD, TOWN OF	250091	0419	G
SALEM, CITY OF	250102	0419	G

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.



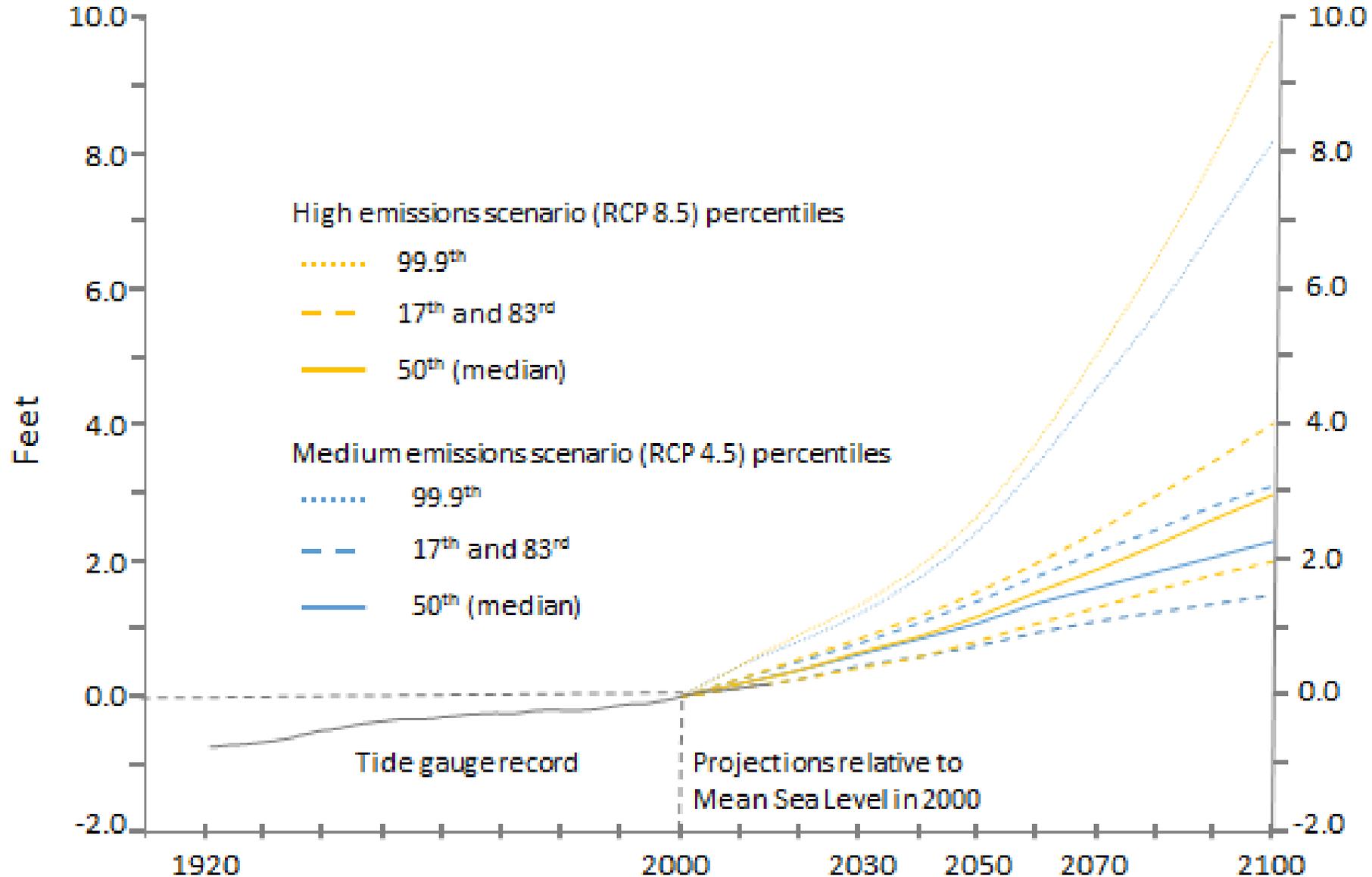
**MAP NUMBER**  
**25009C0419G**

**MAP REVISED**  
**JULY 16, 2014**

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](http://www.msc.fema.gov)

# Sea Level Rise Projections (Boston Tide Gauge)



# Massachusetts Sea Level Rise and Coastal Flooding Viewer

Interactive maps of coastal flooding areas and community facilities and infrastructure based on: sea level rise scenarios, Federal Emergency Management Agency flood zones, and hurricane surge models.

Intro

Sea Level Rise

FEMA Coastal Flood Zones

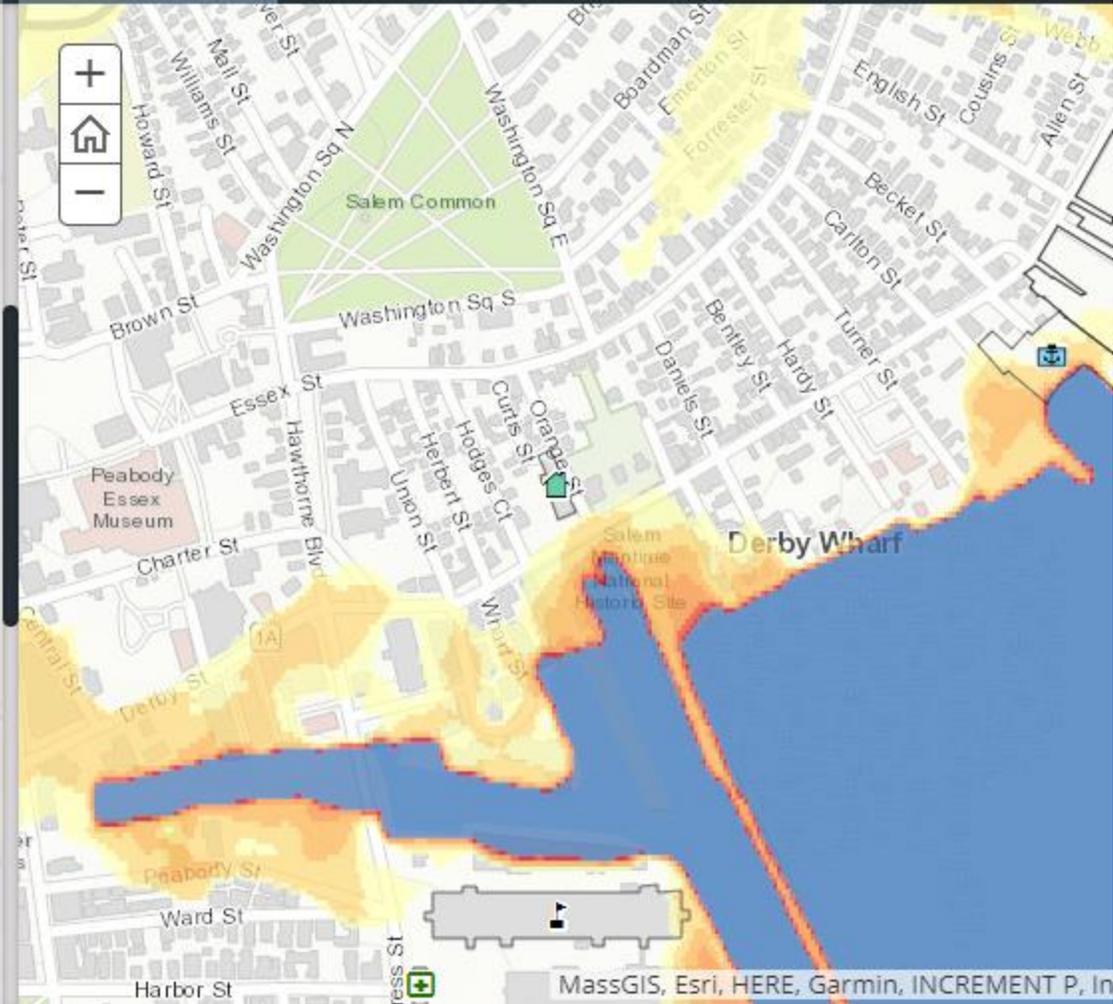
Hurricane Surge

## Potential Extent of Mean Higher High Water (MHHW) with Sea Level Rise

- MHHW
- MHHW + 1 ft Sea Level Rise
- MHHW + 2 ft Sea Level Rise
- MHHW + 3 ft Sea Level Rise
- MHHW + 4 ft Sea Level Rise
- MHHW + 5 ft Sea Level Rise
- MHHW + 6 ft Sea Level Rise

## Public Facilities and Infrastructure

- Airport
- Community Health Center
- Electrical Generation Facility
- Fire Station
- Harbormaster
- Hospital



# Massachusetts Sea Level Rise and Coastal Flooding Viewer

Interactive maps of coastal flooding areas and community facilities and infrastructure based on: sea level rise scenarios, Federal Emergency Management Agency (FEMA) flood zones, and hurricane surge models.

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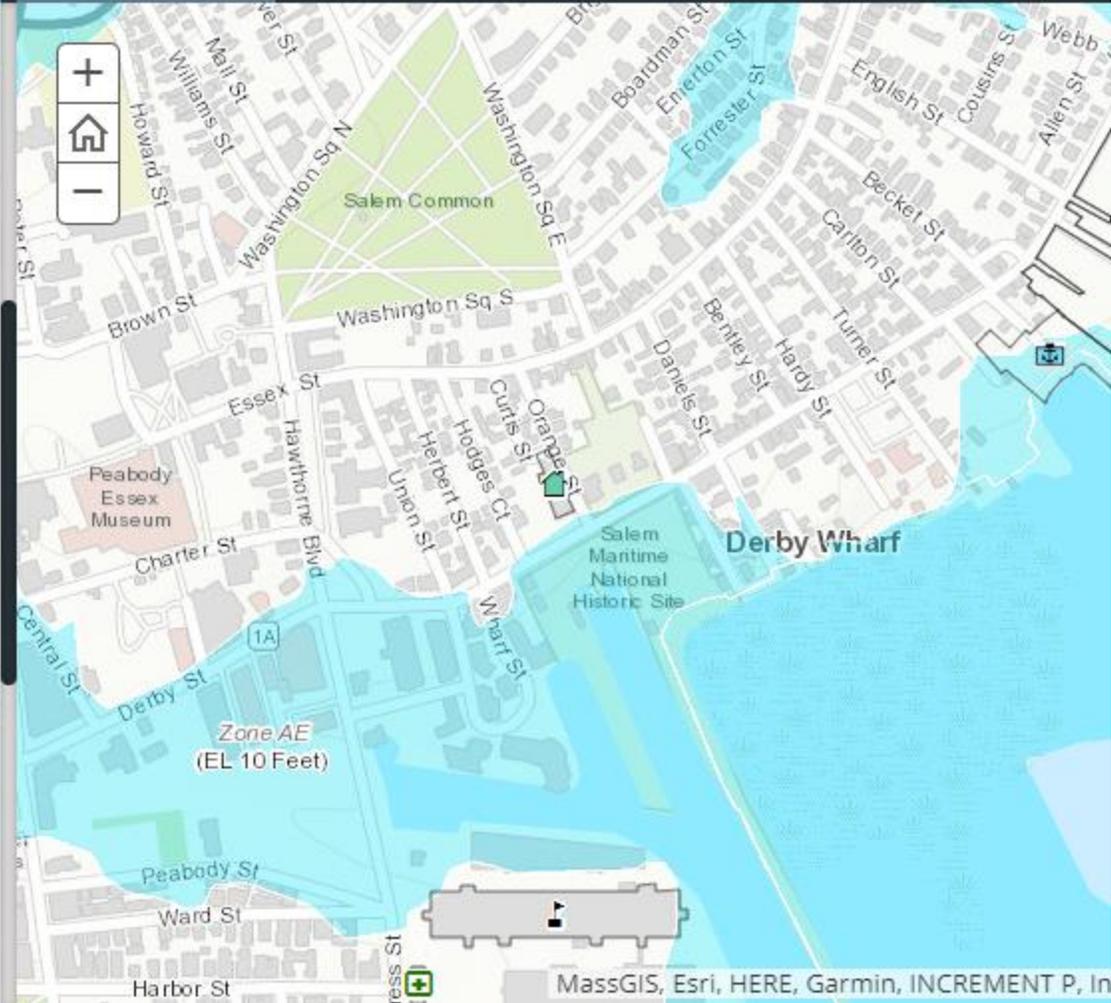
Hurricane Surge

## FEMA Coastal Flood Zones

 1% Annual Chance Flood Hazard (includes both A and V zones; zoom in to view zone labels)

## Public Facilities and Infrastructure

-  Airport
-  Community Health Center
-  Electrical Generation Facility
-  Fire Station
-  Harbormaster
-  Hospital
-  Landfill
-  Library
-  Long-Term Care Residence
-  MBTA Commuter Rail Station
-  MBTA Subway Station
-  Police Station
-  Port Facility



# Massachusetts Sea Level Rise and Coastal Flooding Viewer

Interactive maps of coastal flooding areas and community facilities and infrastructure based on: sea level rise scenarios, Federal Emergency Management Agency flood zones, and hurricane surge models.

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FEMA Coastal Flood Zones

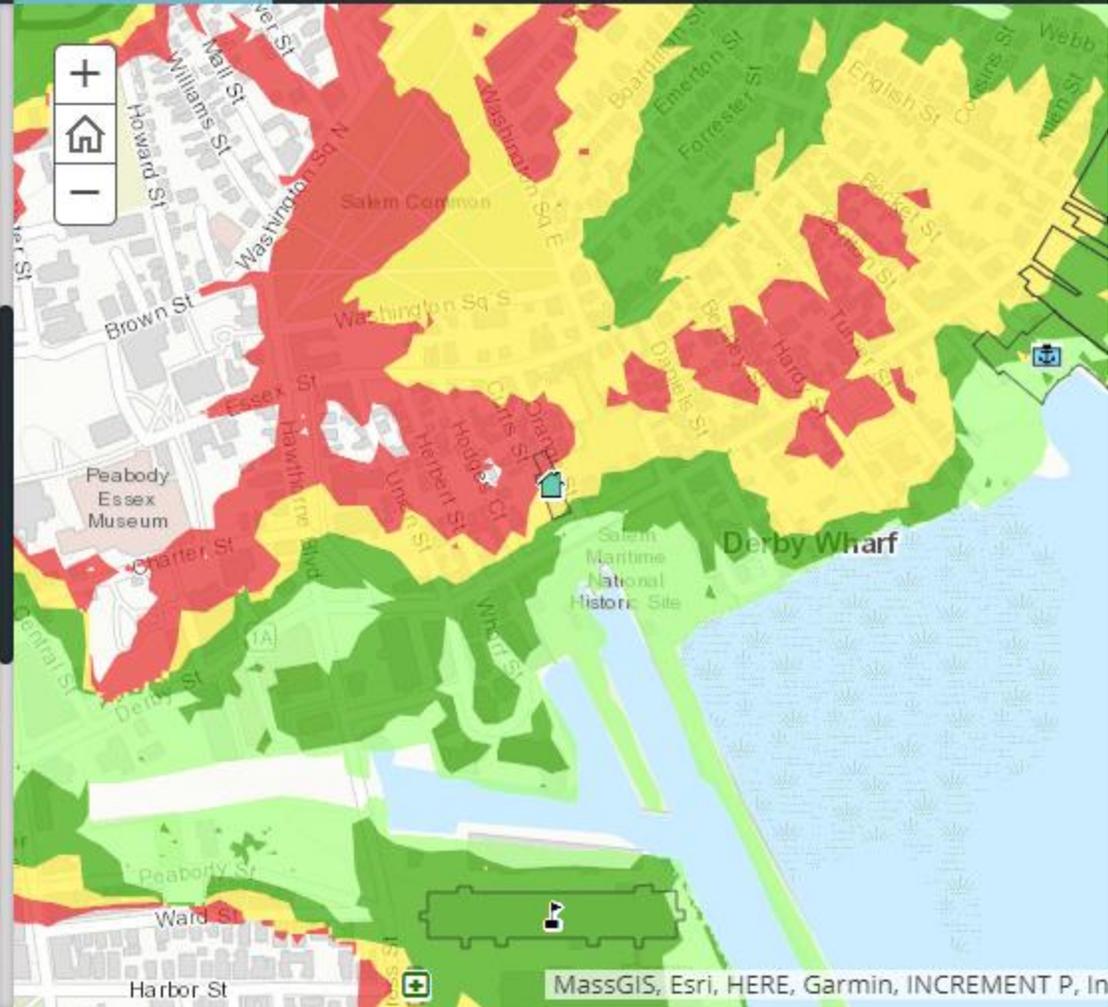
Hurricane Surge

## Hurricane Surge Scenarios

- Category 1
- Category 2
- Category 3
- Category 4

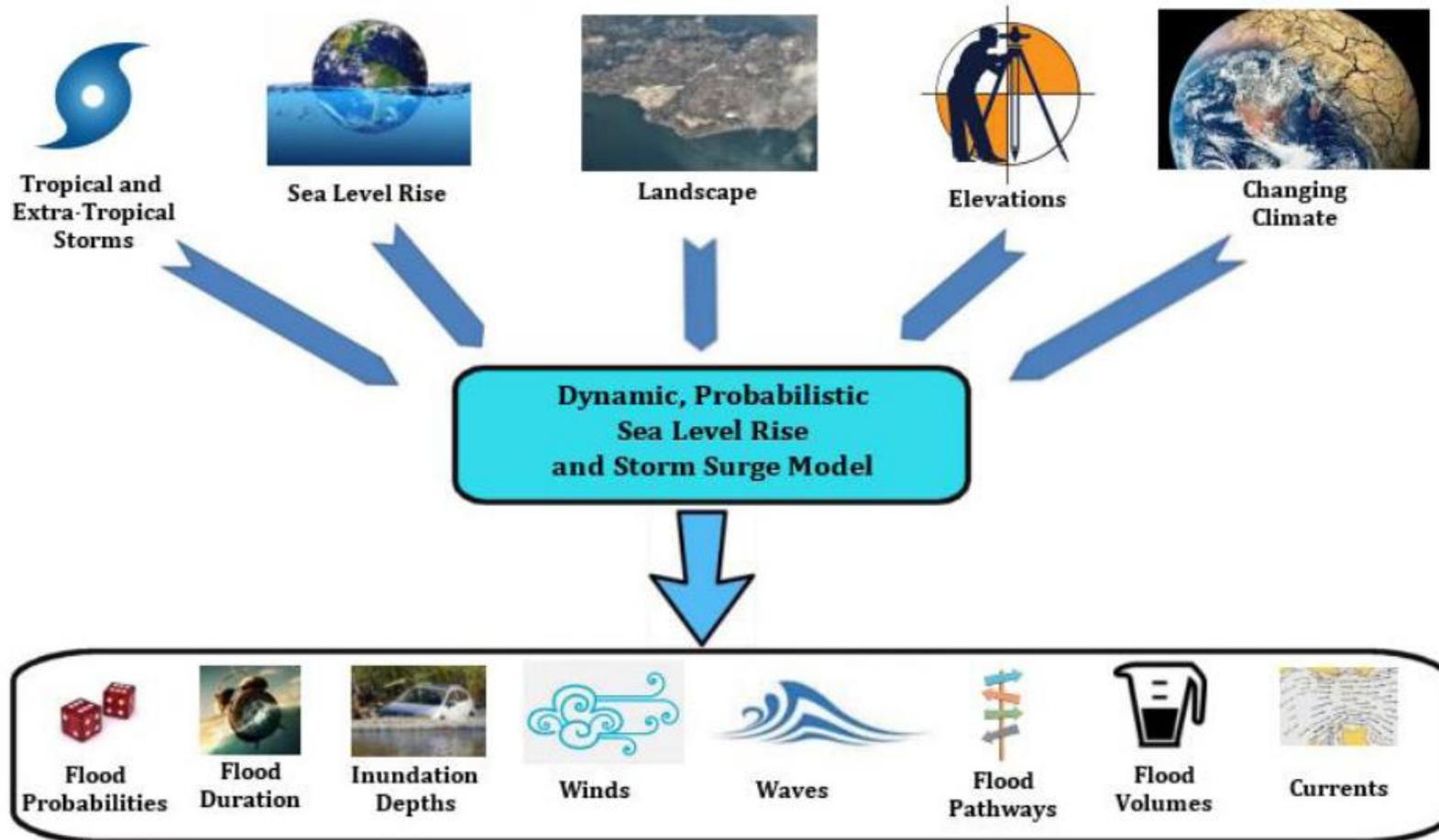
## Public Facilities and Infrastructure

- Airport
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- Hospital
- Landfill
- Library
- Long-Term Care Residence
- MBTA Commuter Rail Station
- MRTA Subway Station

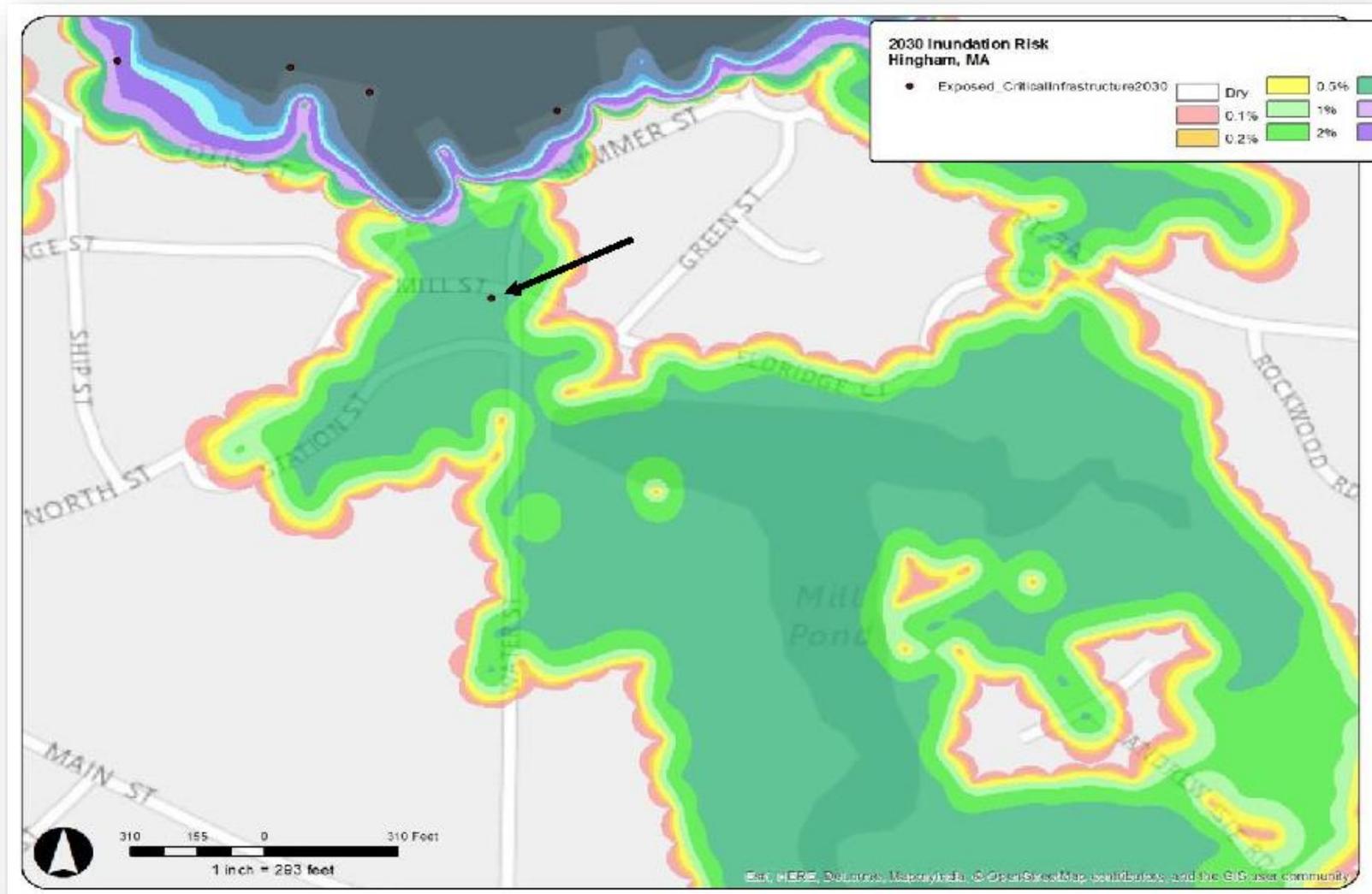


# Coast-wide Hydrodynamic Modeling (*coming in 2018*)

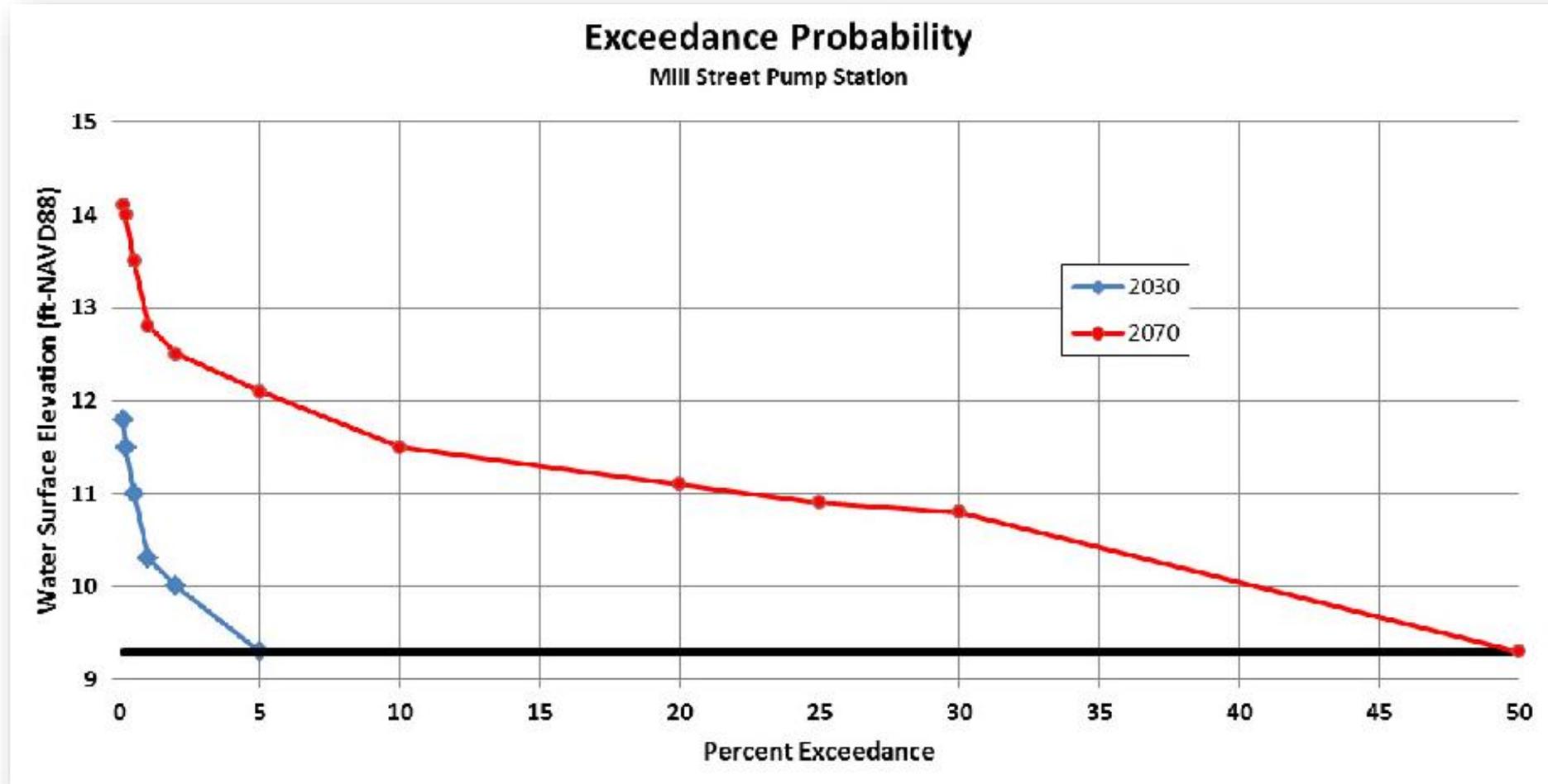
- Includes relevant physical processes (tides, storm surge, wind, waves, wave setup, river discharge, sea level rise, future climate scenarios)



# Local Assessment of Vulnerability



# Local Assessment of Vulnerability





# Future Precipitation Estimates (Statewide)

Variable	Baseline (1971-2000)	2030s (2020-2049)	2050s (2040-2069)	2070s (2060-2089)	2090s (2080-2099)
Total annual precipitation	47 in	+4.7 in	+6 in	+7.6 in	+7.3 in
# of days/year with precip. > 1 in	7 days	9 days	10 days	10 days	11 days

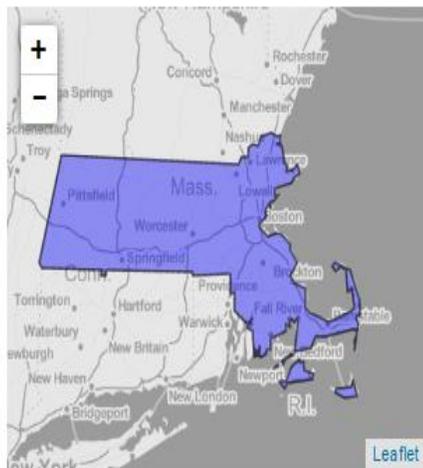
*\*Values are based on 90<sup>th</sup> percentiles across 28 projections, which represents the high end of the most likely scenario. These are estimates based on model scenarios and are not forecasts*

# MA Climate Clearinghouse (coming in October)

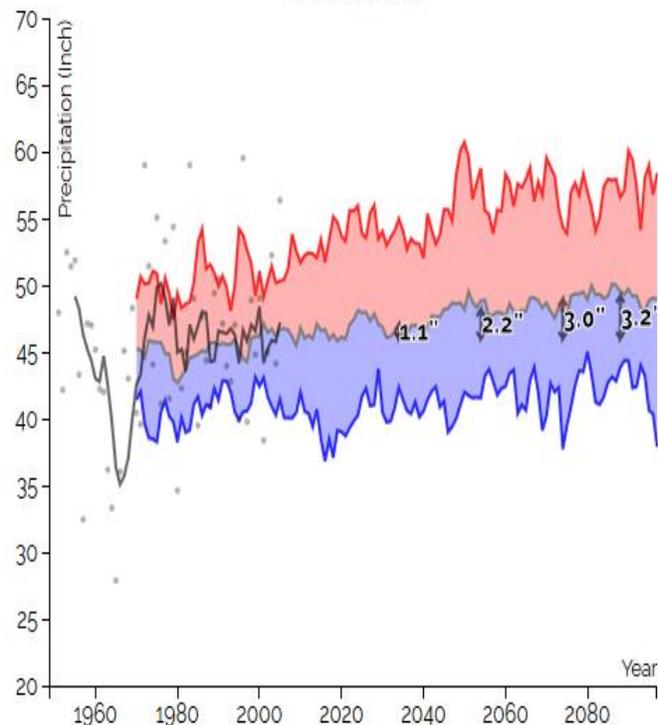
State:

Calculated Variable:

Season:



Annual Total Precipitation  
Massachusetts



Download Data

**Observed "**

5-yr Mean

**Modeled "**

Max

Median

Min

Changes from 1971-2000 for:

2020 - 2049	1.08"
2040 - 2069	2.19"
2060 - 2089	2.96"
2080 - 2097	3.20"

About the Source Data

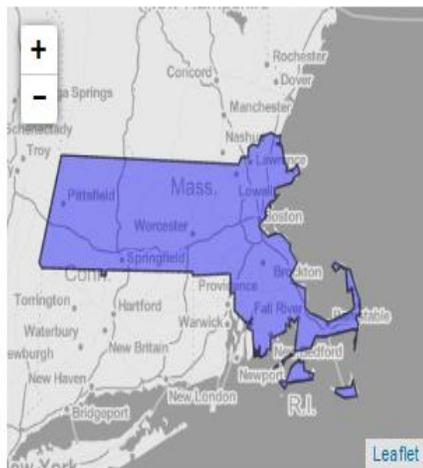
Add Chart



State:

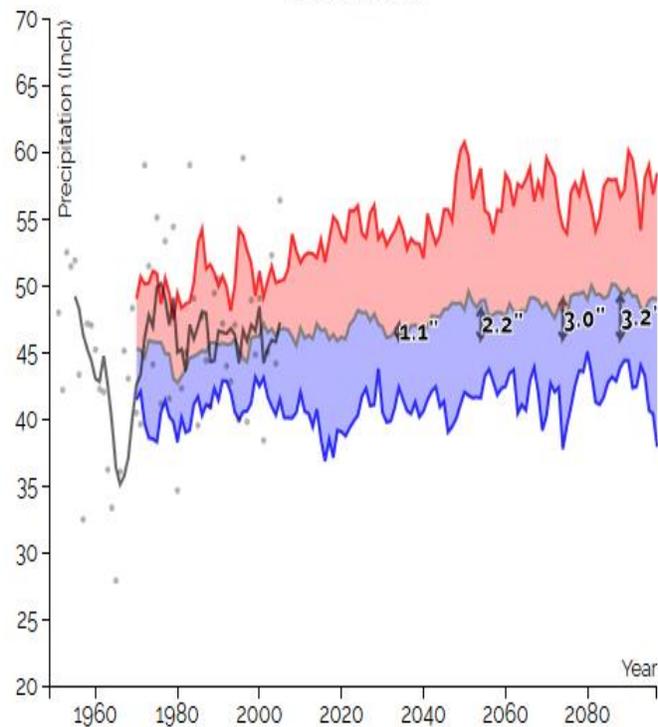
Calculated Variable:

Season:



Add Chart

## Annual Total Precipitation Massachusetts



Download Data

**Observed "**

5-yr Mean

**Modeled "**

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Changes from 1971-2000 for:

2020 - 2049	1.08"
2040 - 2069	2.19"
2060 - 2089	2.96"
2080 - 2097	3.20"

About the Source  
Data

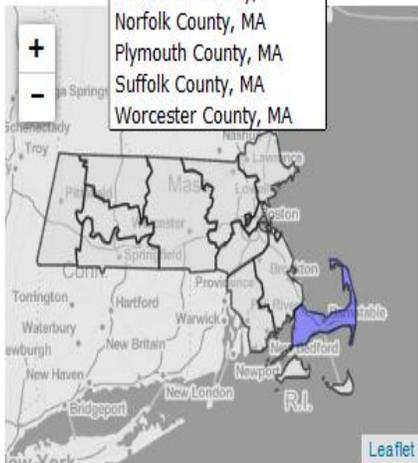




# MA CCC

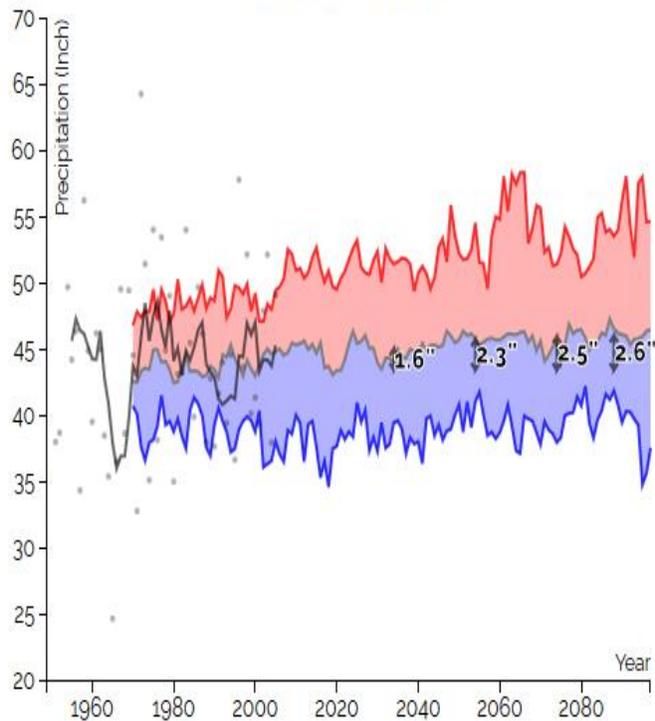
Massachusetts Climate Change Clearinghouse

County ▾ Barnstable County, MA ▾  
Barnstable County, MA  
Berkshire County, MA  
Bristol County, MA  
Calculate: Total Prec ▾  
Season: Franklin County, MA  
Hampden County, MA  
Hampshire County, MA  
Middlesex County, MA  
Nantucket County, MA  
Norfolk County, MA  
Plymouth County, MA  
Suffolk County, MA  
Worcester County, MA



## Annual Total Precipitation Barnstable County, MA

[Download Data](#)



**Observed "**

5-yr Mean

**Modeled "**

Max

Median

Min

Changes from  
1971-2000 for:

2020 - 2049 1.60'

2040 - 2069 2.30'

2060 - 2089 2.54'

2080 - 2097 2.59'

[About the Source  
Data](#)

[Add Chart](#)





State ▼ Massachusetts ▼

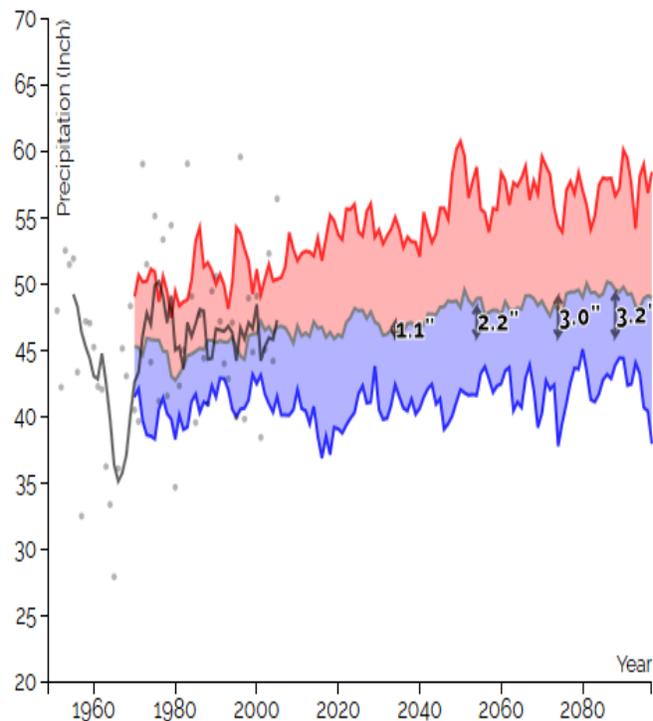
Calculated Variable:

- Total Precipitation ▼
- Maximum Temperature
- Minimum Temperature
- Average Temperature
- Growing Degree-Day Accumulation
- Heating Degree-Day Accumulation
- Cooling Degree-Day Accumulation
- Days with Maximum Temperature Above 90°F
- Days with Maximum Temperature Above 95°F
- Days with Maximum Temperature Above 100°F
- Days with Minimum Temperature Below 0°F
- Days with Minimum Temperature Below 32°F
- Total Precipitation**
- Days with Precipitation > 1"
- Days with Precipitation > 2"
- Days with Precipitation > 4"



Add Chart

## Annual Total Precipitation Massachusetts



Download Data

**Observed "**

5-yr Mean ↗

**Modeled "**

Max ↗

Median ↗

Min ↘

Changes from 1971-2000 for:

2020 - 2049	1.08"
2040 - 2069	2.19"
2060 - 2089	2.96"
2080 - 2097	3.20"

About the Source  
Data





# MA CCC

Massachusetts Climate Change Clearinghouse

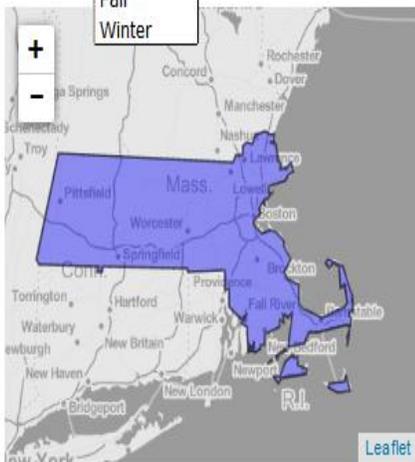
State

Calculated Variable:

Total Precipitation

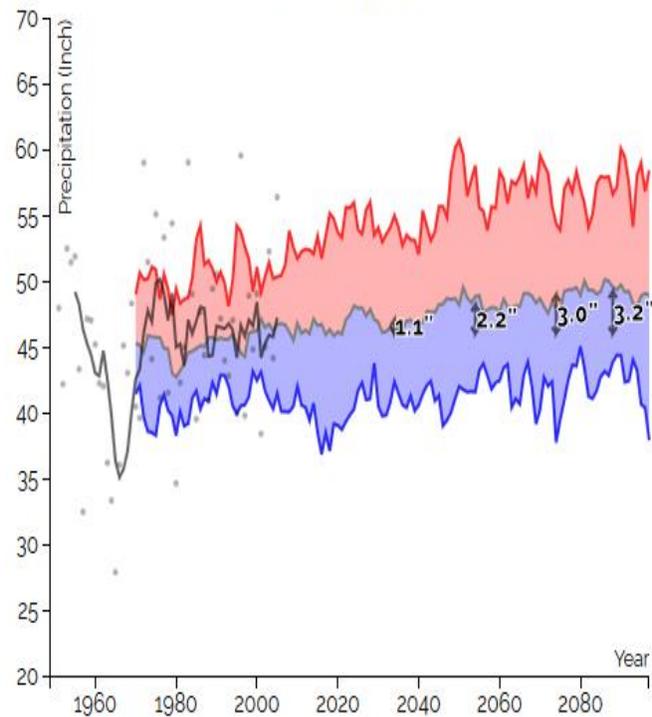
Season: Annual

- Annual
- Spring
- Summer
- Fall
- Winter



Add Chart

## Annual Total Precipitation Massachusetts



Download Data

Observed "

5-yr Mean

Modeled "

Max

Median

Min

Changes from  
1971-2000 for:

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2080 - 2097 3.20'

About the Source  
Data



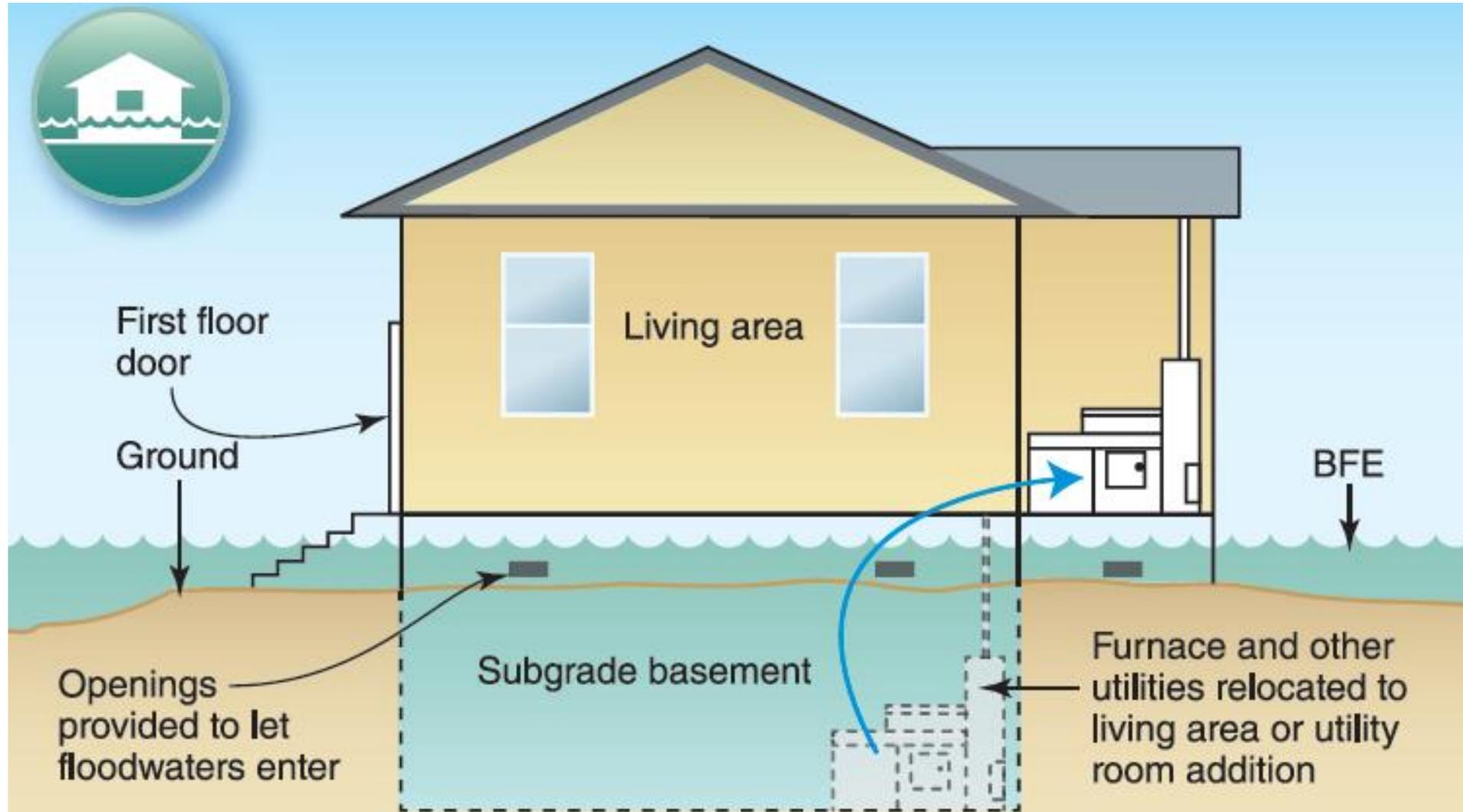
# Riverine Hydrology (*also coming soon*)

- Estimating future frequency & return periods for floods (& changes on low-flow statistics) for rivers & streams
- Projected streamflows based on hydrological model outputs for 2030s, 2050s, 2070s, & 2090s for medium (RCP 4.5) & high (RCP 8.5) emissions scenarios
- Return period of 1-yr, 10-yr, 20-yr, 50-yr & 100-year flood events

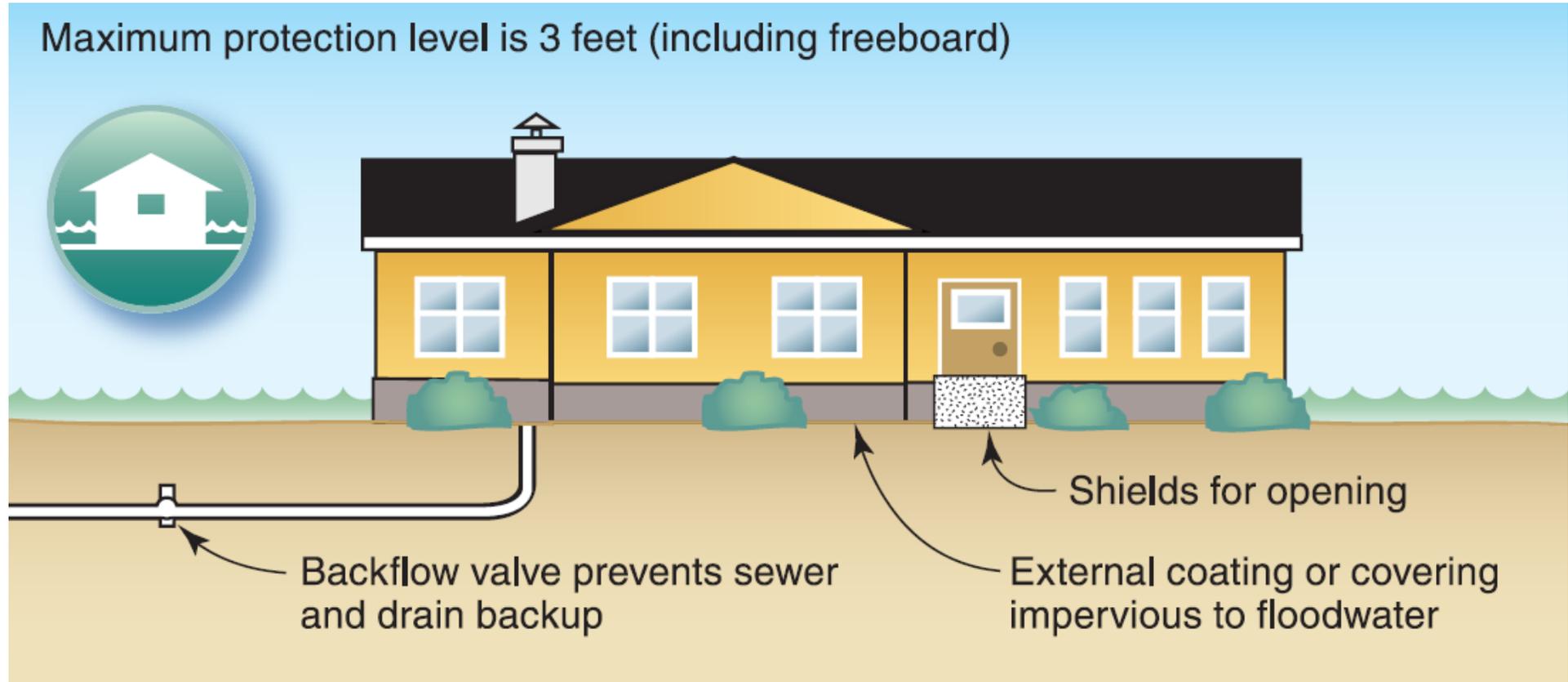
# Ways to Protect Buildings from Flooding

- Wet floodproofing: allowing water to enter during flooding
- Dry floodproofing: sealing to prevent floodwaters from entering
- Barrier system: building floodwall or levee/berm
- Elevation: raising so lowest floor or horizontal member is at or above regulated flood level (Base Flood Elevation)
- Relocation: moving to higher ground

# Wet Floodproofed Home with Basement

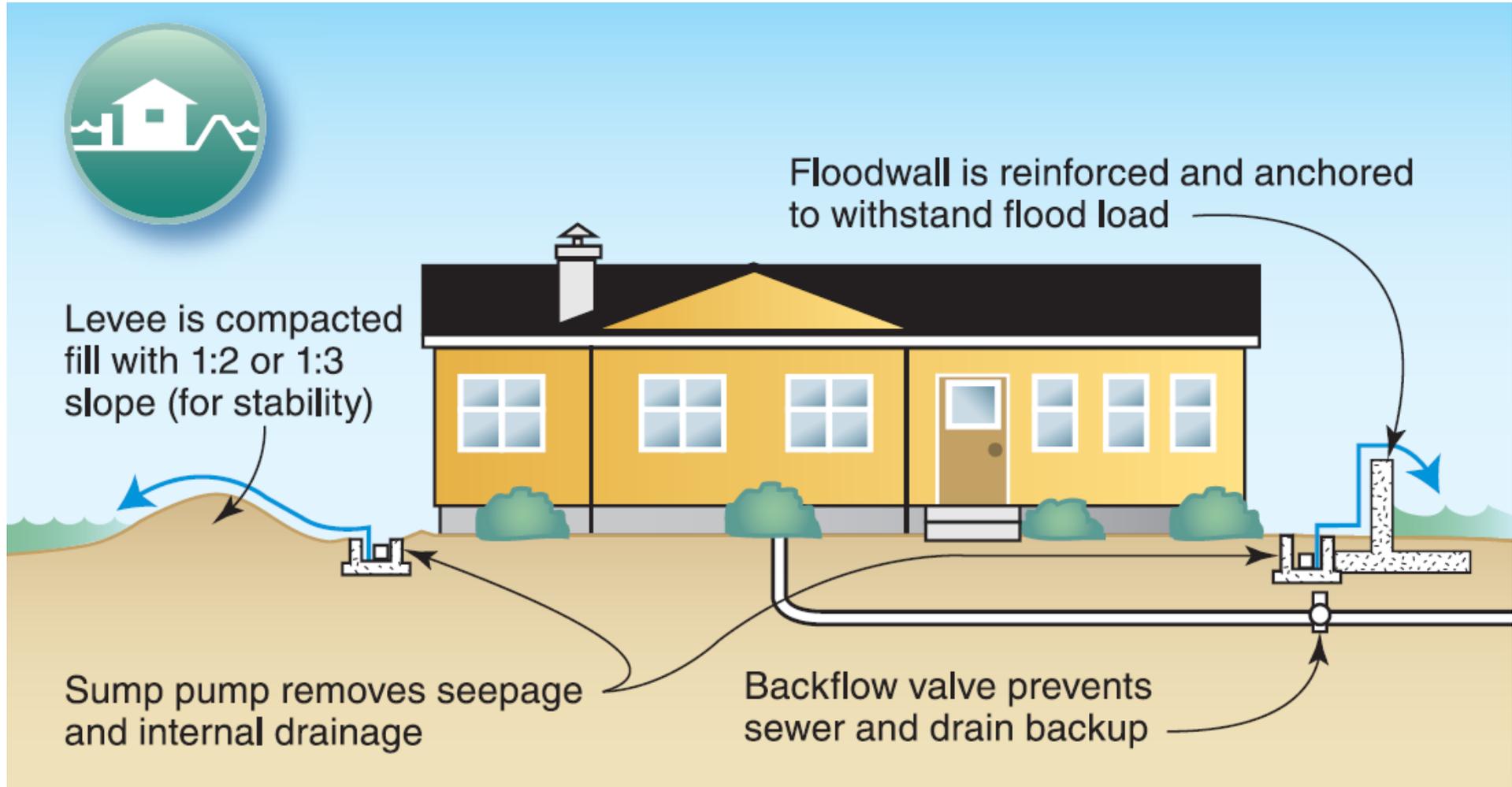


# Dry Floodproofed Home



**FEMA 2014**

# Home with Floodwall & Berm



FEMA 2014

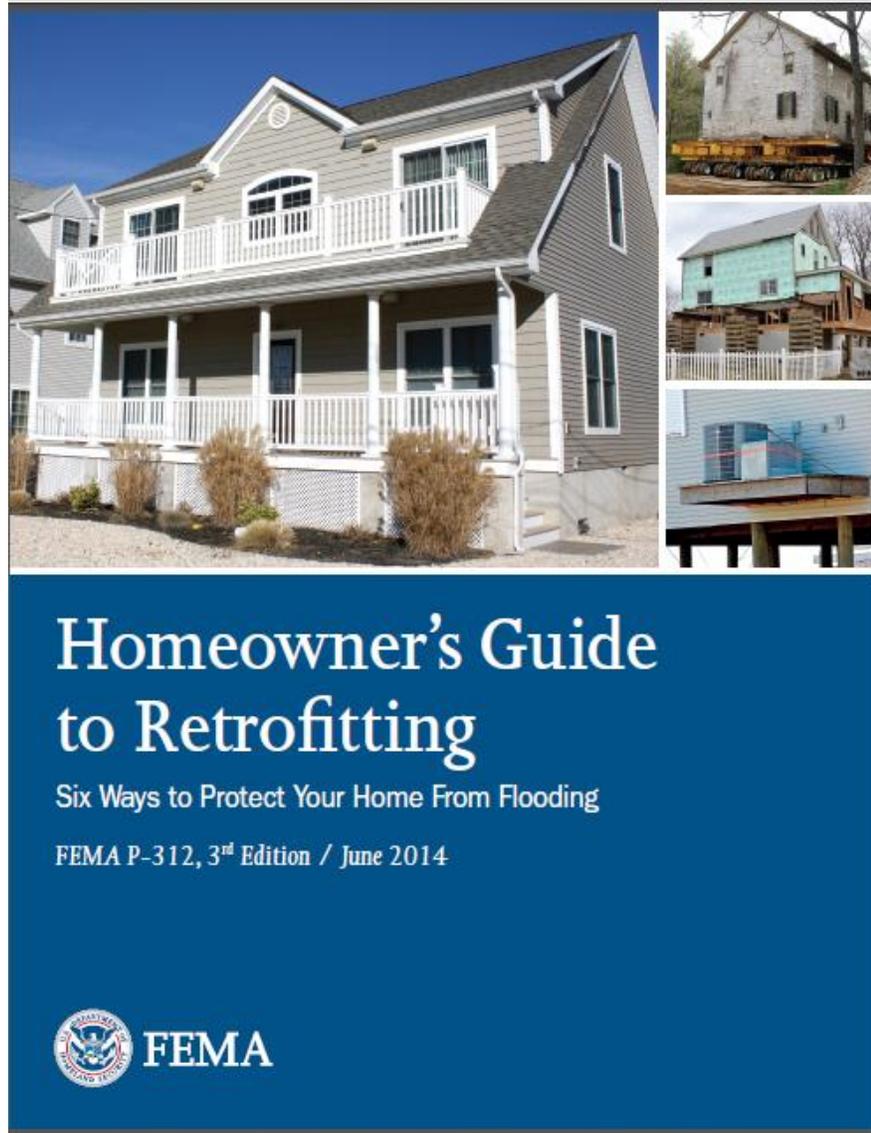
# Interior Retrofits to Lower Repair Costs

- Floors: remove carpeting
- Drains: install sewer backflow valve & sump pump
- Electrical systems: raise wiring, panel boxes, switches & outlets
- Appliances: elevate water heaters, furnaces & washers/dryers
- Interior Walls: cut drywall ~ 1 inch off floor to prevent mold

# Flood Mitigation Assistance

- FEMA Hazard Mitigation Assistance (**HMA**) grant programs
  - Hazard Mitigation Grant Program (**HMGPP**) following Presidential Declaration of Major Disaster
  - Flood Mitigation Assistance (**FMA**) program annually through National Flood Insurance Fund
- Property owners must apply through local government
- Hull, Quincy & Scituate have been successful with these programs

# Flood Hazard Management Resources



Dept. of Conservation &  
Recreation (DCR),  
Office of Water Resources  
Flood Hazard Management  
Program

Joy Duperault  
State NFIP Coordinator &  
State Hazard Mitigation  
Officer

[joy.duperault@state.ma.us](mailto:joy.duperault@state.ma.us)

Eric Carlson

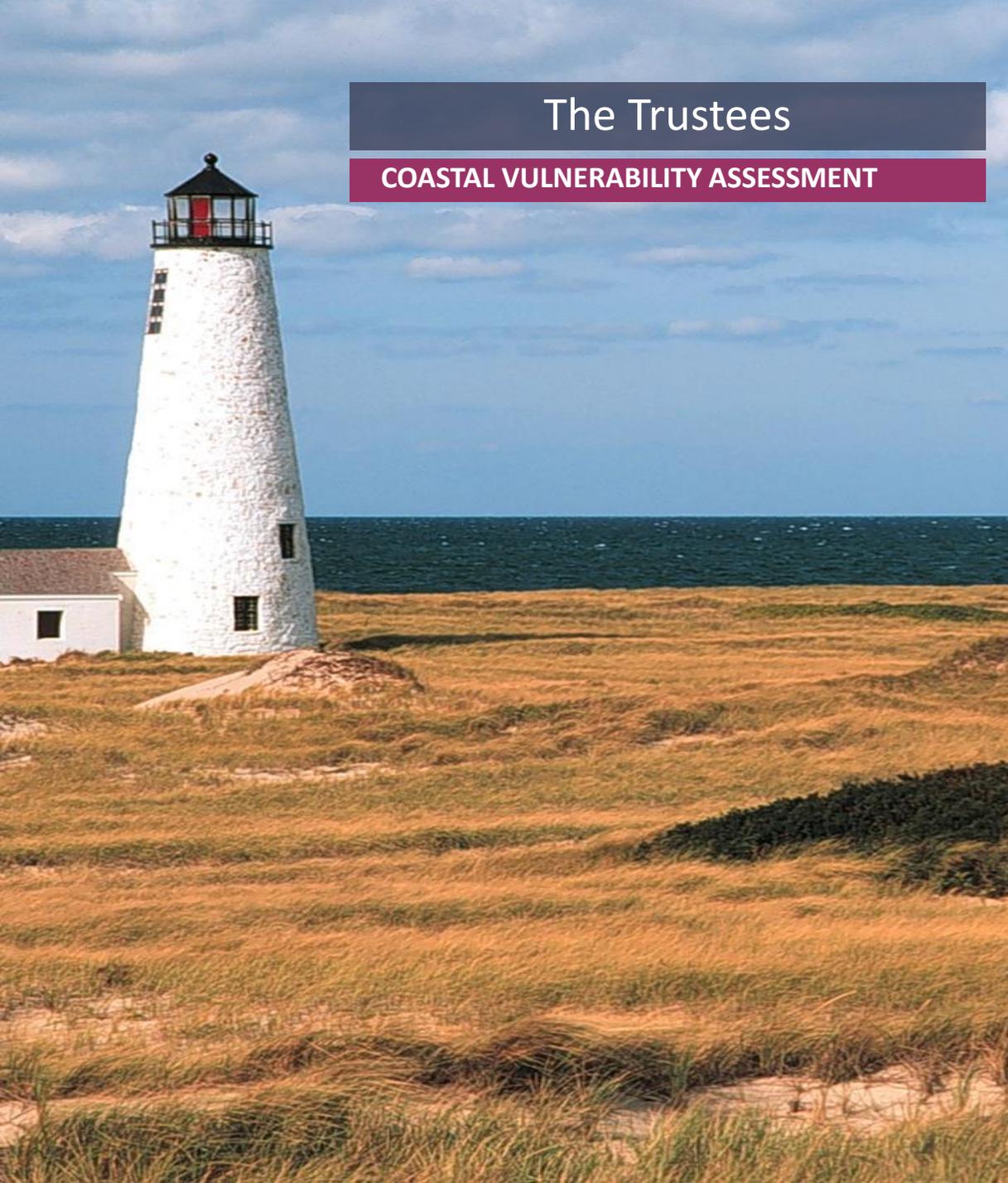
[Eric.Carlson@state.ma.us](mailto:Eric.Carlson@state.ma.us)

# StormSmart Communities & Properties

[www.mass.gov/czm/stormsmart](http://www.mass.gov/czm/stormsmart)

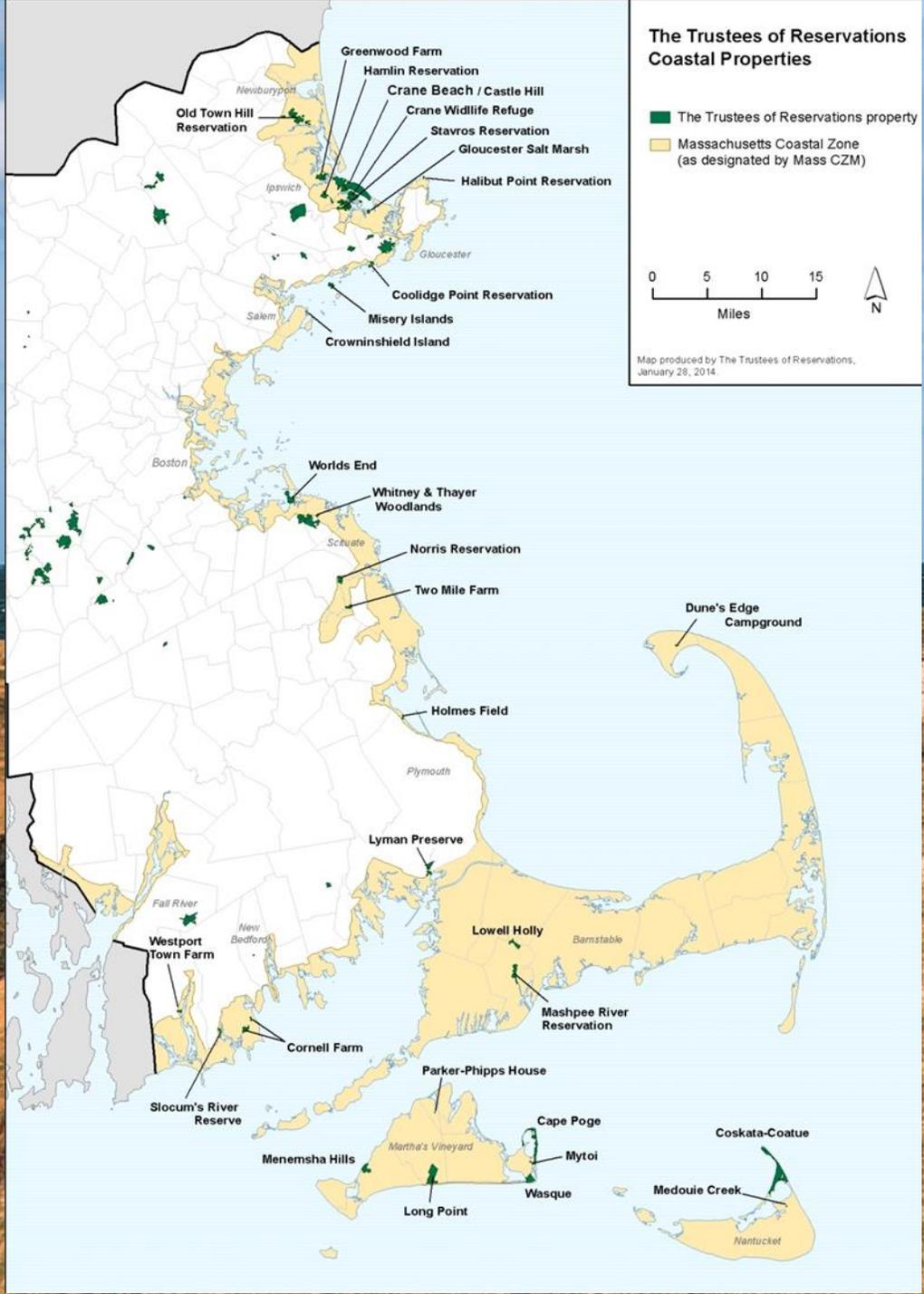
Technique	Relative Costs (per linear foot of shoreline)				
	<i>Design &amp; Permitting</i>	<i>Construction</i>	<i>Expected Maintenance Frequency</i>	<i>Avg. Annual Maintenance Costs<sup>2</sup></i>	<i>Avg. Annual Mitigation Costs</i>
<b>Artificial Dunes &amp; Dune Nourishment</b>	Low	Low	1-5 yrs.	Low	None
<b>Controlling Overland Runoff</b>	Low	Low	5-20 yrs.	Low	None
<b>Planting Vegetation</b>	Low	Low	1-3 yrs.	Low	None
<b>Bioengineering - Coir Rolls on Coastal Banks</b>	Low-Med.	Med.-High	1-3 yrs.	Low-Med.	Low
<b>Bioengineering - Natural Fiber Blankets on Coastal Banks</b>	Low	Low	1-3 yrs.	Low	None
<b>Sand Fencing</b>	Low	Low	3-5 yrs.	Low	None
<b>Beach Nourishment</b>	Med.	Low-Med.	5-10 yrs.	Low	Low
<b>Rock Revetments - Toe Protection</b>	High	High	10-20 yrs.	Low	Low- Med.
<b>Rock Revetments - Full Height</b>	Very High	Very High	20-25 yrs.	Low	Med.
<b>Seawall</b>	High-V. High	V. High	25-40 yrs.	Low	Med.-High

**Low:** < \$200, **Medium:** \$200-500, **High:** > \$500-1,000, **Very High:** > \$1,000



# The Trustees

## COASTAL VULNERABILITY ASSESSMENT



## Coastline Ownership

OWNER	Miles	% of Shoreline
Federal	191	8%
State	98	4%
Municipal/Local	252	10%
Trustees-held CRs	44	2%
Trustees Reservations	76	3%
Other Non-Profit/Land Trust	106	4%
Other Private (mostly CRs)	33	1%
<b>Total Miles of Shoreline</b>	<b>800</b>	<b>33%</b>
<b>Total Shoreline</b>	<b>2450</b>	<b>100%</b>



## Open Space Ownership

COASTLINE

<b>OWNER</b>	<b>% of Open Space</b>
Federal	24%
State	12%
Municipal/Local	32%
Trustees Reservations	10%
Trustees-held CRs	6%
Other Non-Profit/Land Trust	13%
Other Private (mostly CRs)	4%
<b>Total Open Space</b>	<b>100%</b>



# The Trustees of Reservations

## MISSION

- ▶ Founded in 1891, The Trustees of Reservations preserve, for public use and enjoyment, properties of exceptional scenic, historic, and ecological value in Massachusetts and work to protect special places across the state.
- ▶ 50,000 acres, including 25,000+ acres on 116 reservations
- ▶ Open to the public.
- ▶ Nonprofit conservation organization
- ▶ 1M+ visitors annually, 40,000+ member household



# The Trustees of Reservations

## COASTAL RESOURCES

- ▶ 32 Reservations (8,000 acres)
- ▶ 39 Parking Areas
- ▶ 103 Buildings
- ▶ 106 Other Structures
- ▶ 60 miles of trail (320 segments)
- ▶ 158 Cultural Resources points
- ▶ 48 State-listed Species
- ▶ Over 100 Vegetation Communities



# Climate Change Predictions

OLD TOWN HILL, NEWBURY

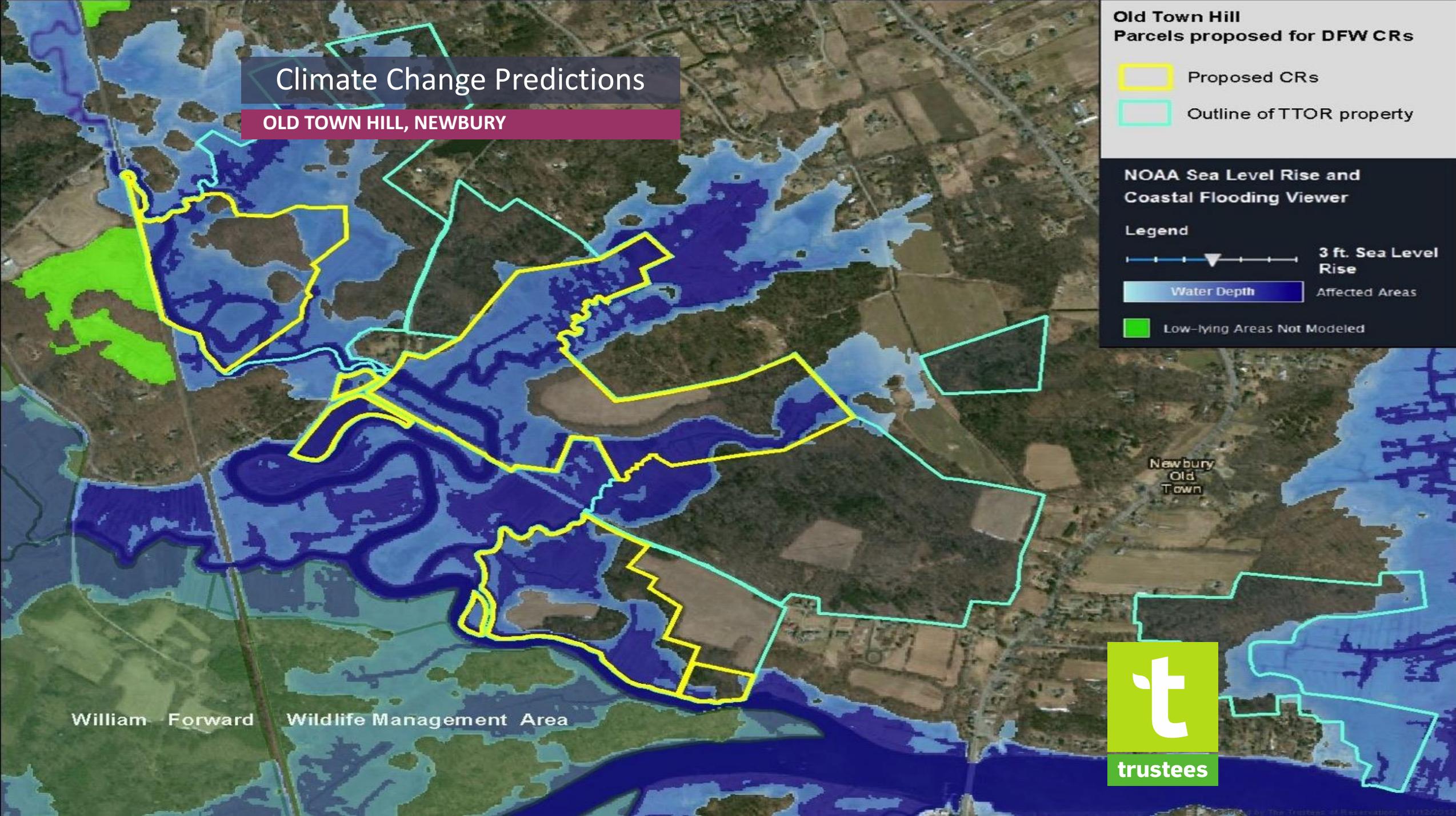
**Old Town Hill**  
Parcels proposed for DFW CRs

- Proposed CRs
- Outline of TTOR property

**NOAA Sea Level Rise and Coastal Flooding Viewer**

Legend

- 3 ft. Sea Level Rise
- Water Depth
- Affected Areas
- Low-lying Areas Not Modeled



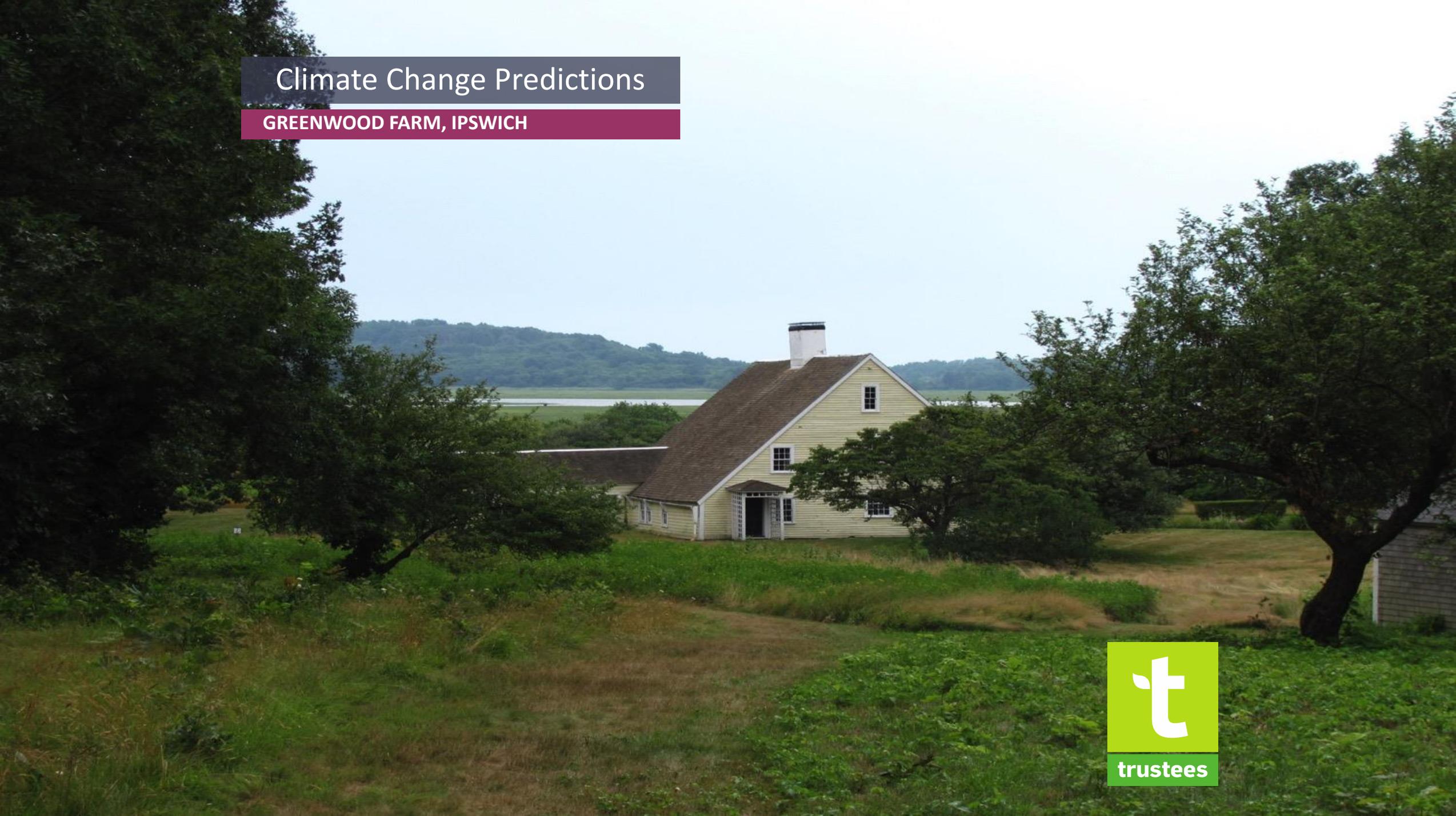
William Forward Wildlife Management Area

Newbury Old Town



# Climate Change Predictions

GREENWOOD FARM, IPSWICH



# Castle Neck

IPSWICH – SALT MARSH / ESTUARY



# Halibut Point

GLOUCESTER – ROCKY SHORELINE



# Coskata- Coatue

NANTUCKET – BARRIER BEACH



# Public Programs

WORLDS END, HINGHAM



# Financial

CRANE BEACH, IPSWICH



# Vulnerability Assessment

## OBJECTIVES

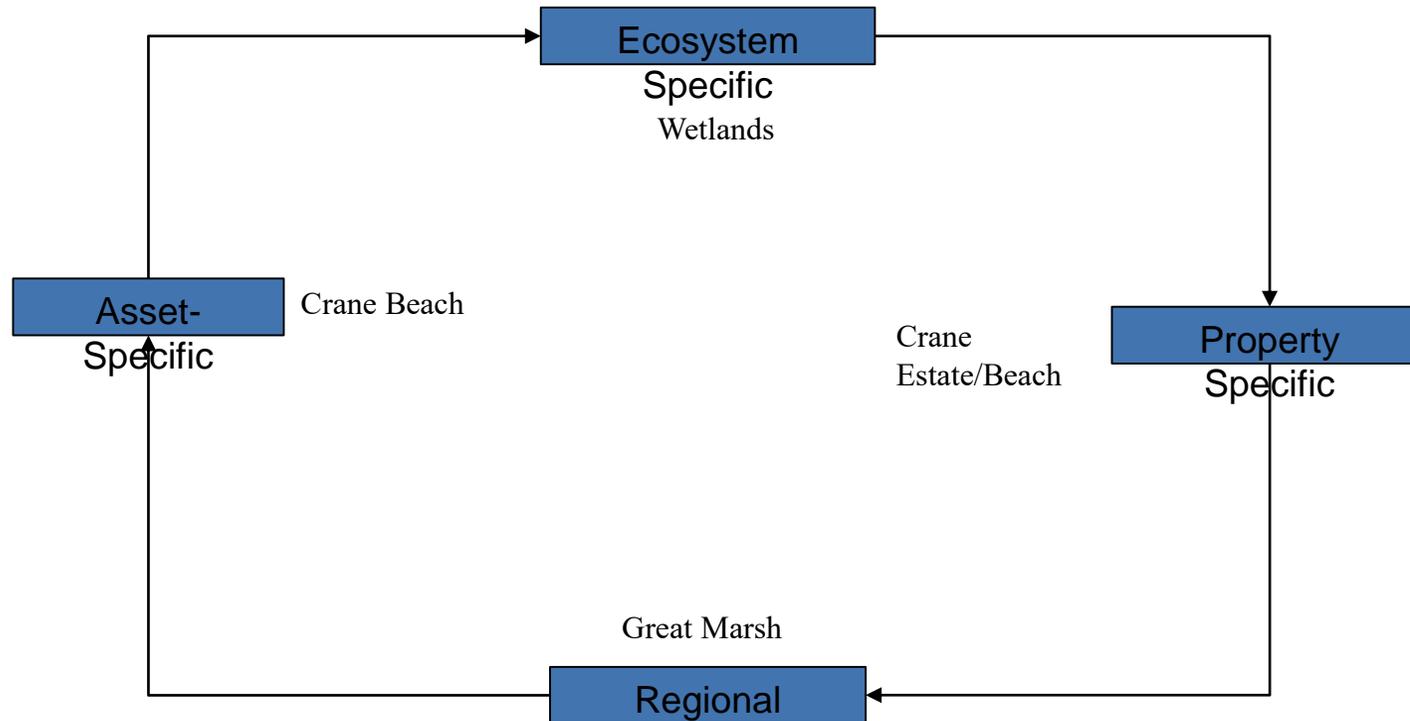
Modeling Vulnerability

Assigning Value and Calculating Risk

Identifying Top 5 Priorities and Strategies



What is vulnerable, what do we value and how are they connected at different spatial scales? What impact do vulnerabilities (and adaptations) on TOR properties have on neighboring properties and communities?



## Project Background

### OBJECTIVES

#### Modeling Vulnerability

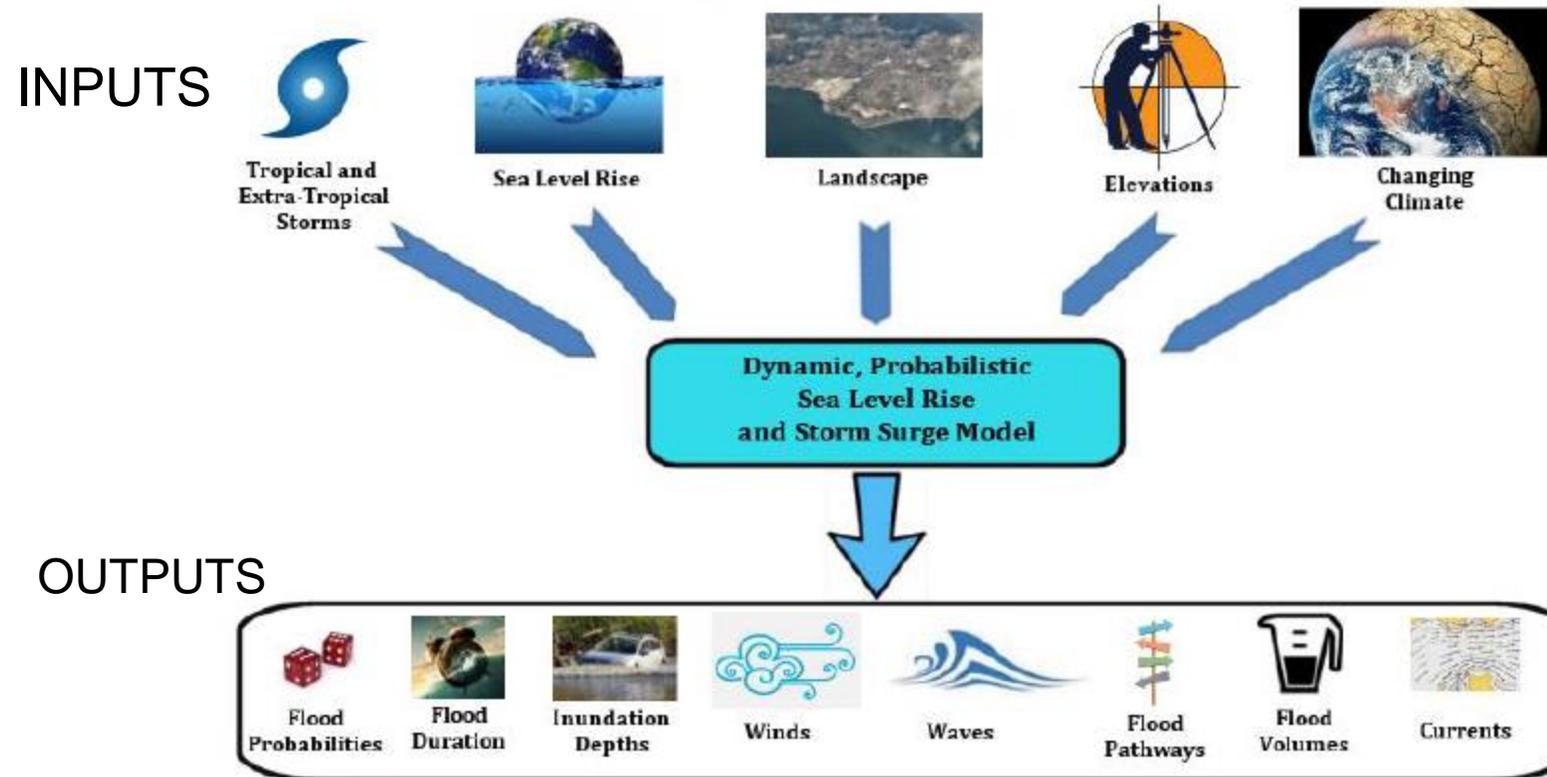
- ▶ GIS Data Development
- ▶ Vulnerabilities for years 2030 and 2070
- ▶ Probability-based approach for inundation

#### Primary Sources)

- MassDOT model results (Woods Hole Group)
- North Atlantic Coast Comprehensive Study (USACE)
- Sea Level Affecting Marshes Model (SLAMM) results (CZM – Woods Hole Group)

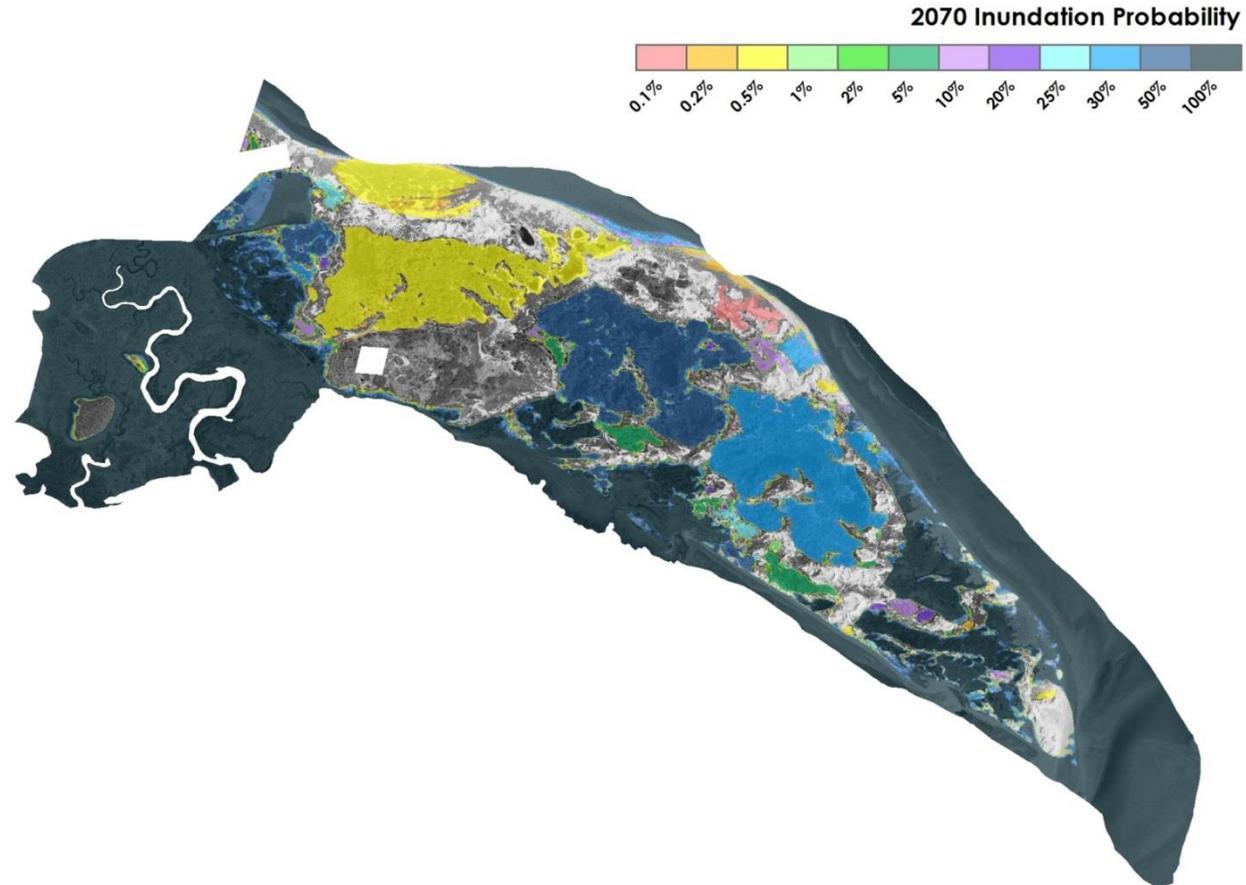


## Step 2: Vulnerability Assessment – Modeling Overview



# Inundation Probability

CRANE BEACH



2070 Inundation Probability

WOODS HOLE GROUP | YEARS



# The Trustees of Reservations

## OBJECTIVES

### Assigning Value and Calculating Risk

- ▶ Assign consequence scores (values) to each coastal resource
- ▶ Coastal Vulnerability Index (CVI)
  
- ▶ For each asset:
- ▶  $CVI = \text{probability of flooding} \times \text{consequence}$
- ▶ Rank all assets and prioritize adaptation projects



# The Trustees of Reservations

## OBJECTIVES

### Mission-based Criteria Used in Scoring Asset Values

- ▶ Natural Resource Integrity and Significance
- ▶ Cultural Resource Integrity and Significance
- ▶ Visitor Experience Integrity and Significance
- ▶ Public Programs
- ▶ Revenue Impact
- ▶ Operational Support



# The Trustees of Reservations

## OBJECTIVES

### 1,300+ Assets and Resources Scored for Consequence Values

- ▶ Roads, Trails, and Entrances
- ▶ Infrastructure
- ▶ Buildings
- ▶ Cultural Resource Features and Landscapes
- ▶ Vegetative / Natural Community
- ▶ Priority Habitat



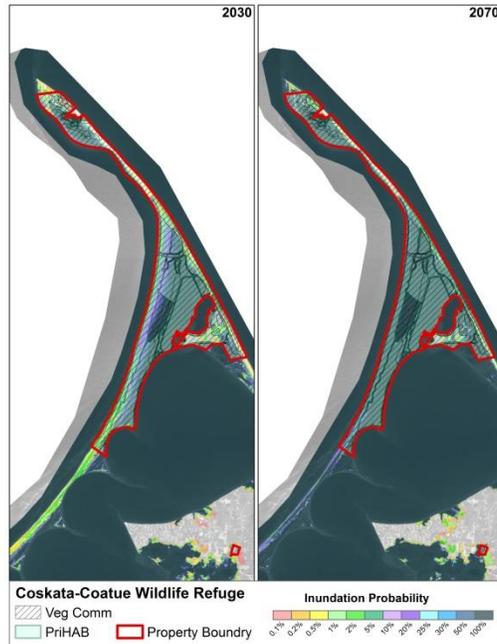
# Coastal Vulnerability Index

## EXAMPLE

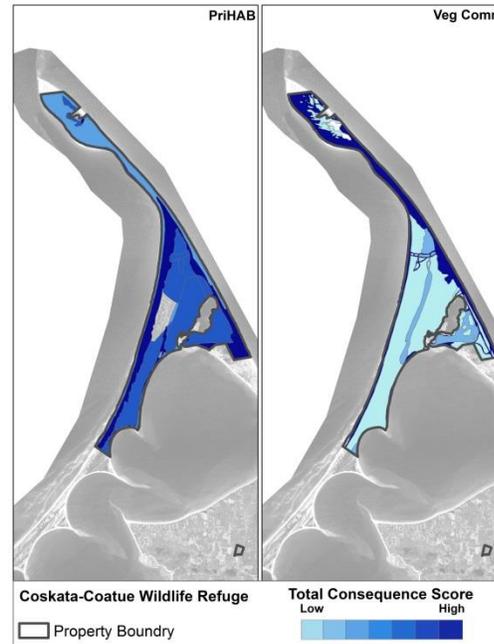
Asset	Property	Vulnerability (Probability of Inundation to Critical Depth)		Consequence	CVI (by Year)
		2030	2070		
Beach A	Property E	1%	5%	5	Prob x Consequence
Habitat B	Property F	2%	8%	2	Prob x Consequence
Habitat C	Property E	5%	15%	5	Prob x Consequence
Building D	Property G	6%	25%	3	Prob x Consequence



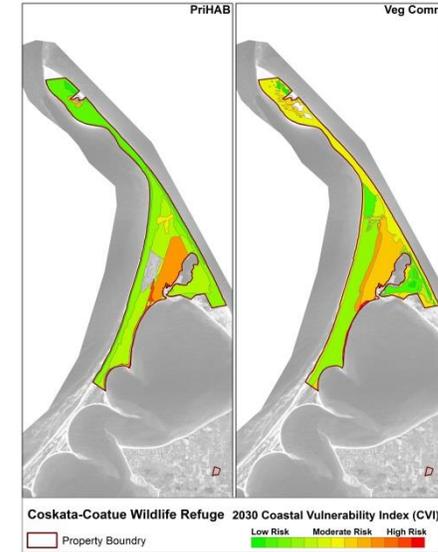
# Coskata-Coatue Wildlife Refuge



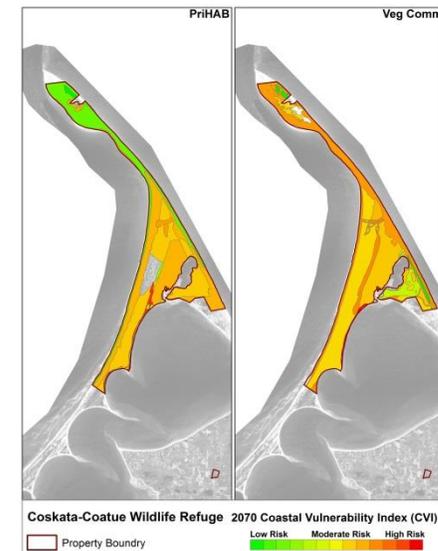
**X**



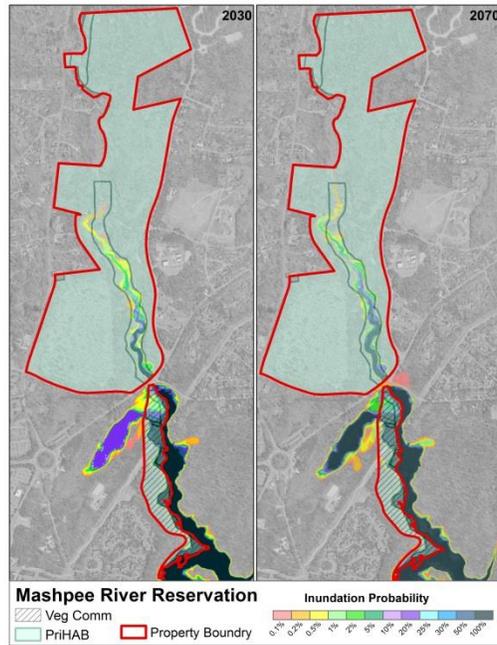
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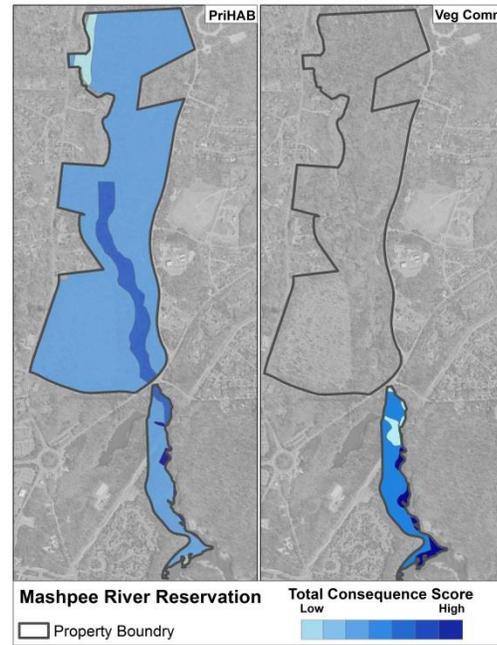
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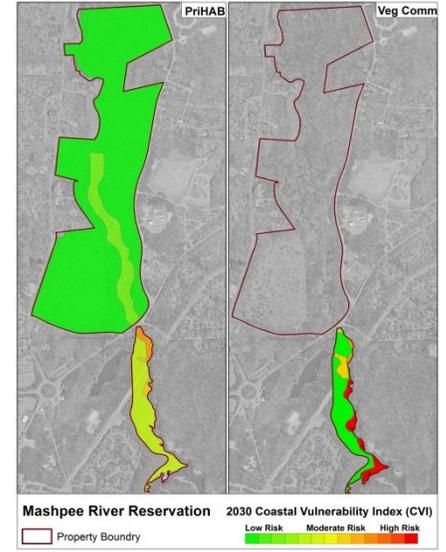
# Mashpee River Reservation



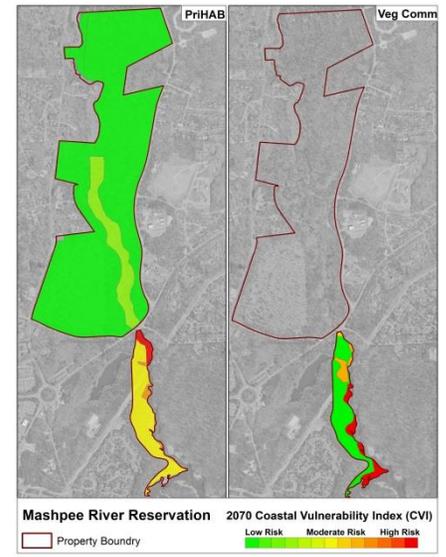
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# Results

# Top 25 Asset CVIs - Buildings

Assets			Consequence Scores								Probability (%)		Vulnerability					
FID	Dataset	Property	Name	_IN	_SIC	_IN	_SIC	_QUA	_SIC	_IC	_IMI	UP	TOTAL	_CON	2070AVG	2030AVG	CVI2070AVG	CVI2030AVG
1	Buildings	Cape Poge Wildlife Refuge	Gatehouse	0	0	0	0	3	4	2	4	1	31.1	100.0	100.0	3111	3111	
33	Buildings	Crane Wildlife Refuge	Longboat Barn	0	0	3	4	2	3	0	0	4	35.6	100.0	56.1	3556	1996	
71	Buildings	Norris Reservation	Boat House	0	0	0	0	4	4	0	0	0	17.8	100.0	100.0	1778	1778	
101	Buildings	World's End	Ranger Station	0	0	1	1	3	0	1	5	5	35.6	57.1	40.7	2032	1448	
32	Buildings	Crane Beach	Ranger Station - Gate	0	0	0	0	2	1	0	5	4	26.7	100.0	50.0	2667	1333	
31	Buildings	Crane Beach	Store	0	0	3	3	4	3	0	5	3	46.7	90.9	21.7	4242	1013	
61	Buildings	Lyman Reserve	Outhouse	0	0	3	3	1	1	0	0	0	17.8	96.8	16.5	1720	292	
29	Buildings	Crane Beach	Bathroom	0	0	0	0	5	5	5	5	5	55.6	39.0	3.4	2167	187	
30	Buildings	Crane Beach	Maintenance Shed	0	0	3	3	0	0	0	0	5	24.4	50.0	7.3	1222	178	
60	Buildings	Lyman Reserve	Lyman House	0	0	5	5	1	2	0	0	4	37.8	5.5	2.1	210	78	
27	Buildings	Coskata-Coatue Wildlife Refuge	Great Point Lighthouse	0	0	5	5	4	5	5	3	1	62.2	39.2	0.9	2441	59	
72	Buildings	Norton Point Beach	Ranger Station	0	0	0	0	5	5	0	5	3	40.0	10.0	1.0	400	40	
62	Buildings	Lyman Reserve	Barn	0	0	5	5	1	1	0	0	3	33.3	2.0	1.0	67	33	
57	Buildings	Long Point Wildlife Refuge	Scrubby Neck Schoolhouse	0	0	5	5	2	2	3	0	1	40.0	2.0	0.5	80	20	
59	Buildings	Long Point Wildlife Refuge	Gatehouse	0	0	0	0	4	4	1	5	2	35.6	1.0	0.2	36	7	
56	Buildings	Long Point Wildlife Refuge	Rental House	0	0	1	1	2	1	0	2	0	15.6	0.9	0.2	14	3	
40	Buildings	Crane Wildlife Refuge	Cottage Pumphouse	0	0	0	0	2	2	0	5	5	31.1	8.5	0.1	266	2	
0	Buildings	Cape Poge Wildlife Refuge	Lighthouse	0	0	5	5	4	5	5	4	1	64.4	0.0	0.0	0	0	
2	Buildings	Castle Hill	Milk House	0	0	5	5	2	3	1	0	2	40.0	0.0	0.0	0	0	
3	Buildings	Castle Hill	Cold House	0	0	5	5	2	3	1	0	4	44.4	0.0	0.0	0	0	
4	Buildings	Castle Hill	Greenhouse	0	0	5	5	3	1	1	2	4	46.7	0.0	0.0	0	0	
5	Buildings	Castle Hill	Barn Complex	0	0	5	5	5	5	5	5	4	75.6	0.0	0.0	0	0	
6	Buildings	Castle Hill	Steep Hill Beach Restrooms	0	0	0	0	3	2	2	3	0	22.2	0.0	0.0	0	0	
7	Buildings	Castle Hill	Power House	0	0	5	5	4	3	2	0	5	53.3	0.0	0.0	0	0	
8	Buildings	Castle Hill	Chauffeur's Garage	0	0	5	5	4	4	1	0	5	53.3	0.0	0.0	0	0	

## Top 25 Asset CVIs – Cultural Points

FID	Dataset	Property	Name	_IN'	_SIG	_IN'	_SIG	_QU'	_SIG	_IC	_IMI	UP	TOTAL_CON	2070AVG	2030AVG	CVI2070AVG	CVI2030AVG
154	Cultural_Pts	World's End	Back Dike and Causeway	0	0	2	2	4	4	0	0	4	35.6	100.0	100.0	3556	3556
113	Cultural_Pts	Misery Islands	Shipwreck	0	0	3	3	3	3	0	0	0	26.7	100.0	100.0	2667	2667
114	Cultural_Pts	Misery Islands	Saltwater Pool Ruins	0	0	3	3	3	3	0	0	0	26.7	100.0	100.0	2667	2667
67	Cultural_Pts	Crane Wildlife Refuge	Stone Pier	0	0	5	5	0	0	0	0	0	22.2	100.0	100.0	2222	2222
88	Cultural_Pts	Lyman Reserve	Packard Bog	4	4	1	1	0	0	0	0	0	22.2	100.0	99.8	2222	2218
153	Cultural_Pts	World's End	Front Dike Remains	0	0	1	1	3	4	0	0	0	20.0	100.0	100.0	2000	2000
81	Cultural_Pts	Lyman Reserve	Trout Pond	2	1	3	3	0	0	0	0	0	20.0	100.0	99.4	2000	1988
131	Cultural_Pts	Old Town Hill	Mill dam and associated features	0	0	3	3	1	1	0	0	0	17.8	100.0	99.4	1778	1768
45	Cultural_Pts	Crane Beach	Archeological Site	0	0	3	3	0	0	0	0	0	13.3	100.0	100.0	1333	1333
59	Cultural_Pts	Crane Beach	Archeological Site	0	0	3	3	0	0	0	0	0	13.3	100.0	100.0	1333	1333
61	Cultural_Pts	Crane Beach	Archeological Site	0	0	3	3	0	0	0	0	0	13.3	100.0	100.0	1333	1333
70	Cultural_Pts	Crane Wildlife Refuge	Old Path from Proctor Barn	0	0	3	3	0	0	0	0	0	13.3	100.0	100.0	1333	1333
72	Cultural_Pts	Crane Wildlife Refuge	Essex Causeway (end)	0	0	3	3	0	0	0	0	0	13.3	100.0	100.0	1333	1333
117	Cultural_Pts	Misery Islands	Ferry Site	0	0	3	3	0	0	0	0	0	13.3	100.0	100.0	1333	1333
118	Cultural_Pts	Misery Islands	Ferry Site	0	0	3	3	0	0	0	0	0	13.3	100.0	100.0	1333	1333
126	Cultural_Pts	Norris Reservation	Fishing Shack Site	0	0	3	3	0	0	0	0	0	13.3	100.0	99.5	1333	1327
82	Cultural_Pts	Lyman Reserve	The Meadow	1	1	2	2	0	0	0	0	0	13.3	100.0	99.4	1333	1325
96	Cultural_Pts	Lyman Reserve	Iron Ore Flats (Ministers Meadow)	0	0	2	3	0	0	0	0	0	11.1	100.0	100.0	1111	1111
37	Cultural_Pts	Crane Beach	Archeological Site	0	0	3	3	0	0	0	0	0	13.3	85.1	79.6	1135	1062
103	Cultural_Pts	Mashpee River Reservation	Great Bridge	0	0	2	2	2	1	0	0	0	15.6	100.0	66.8	1556	1039
148	Cultural_Pts	World's End	Camp House	0	0	2	1	1	2	0	0	0	13.3	87.5	68.4	1166	911
97	Cultural_Pts	Lyman Reserve	Harrys Preserve'	0	0	2	3	0	0	0	0	0	11.1	88.3	81.9	981	910
2	Cultural_Pts	Castle Hill	Floodgate	0	0	2	2	0	0	0	0	0	8.9	100.0	100.0	889	889
86	Cultural_Pts	Lyman Reserve	The Pond (was Tobey Field)	1	1	1	1	0	0	0	0	0	8.9	100.0	95.9	889	852
29	Cultural_Pts	Crane Beach	Historic Camp Site	0	0	3	3	0	0	0	0	0	13.3	81.4	59.6	1086	795

# Top 25 Asset CVIs – Infrastructure

FID	Dataset	Property	Name	_IN'	_SIC'	_IN'	_SIQU'	_SIC'	_IC'	_IMIUP'	TOTAL_CON	2070AVG	2030AVG	CVI2070AVG	CVI2030AVG		
37	Infrastruct	Crane Beach	Argilla Road Culvert	0	0	0	0	3	2	5	5	5	44.4	100.0	100.0	4444	4444
82	Infrastruct	Wasque	Wasque Pt. Beach Stairs	0	0	0	0	5	5	4	5	0	42.2	100.0	100.0	4222	4222
90	Infrastruct	World's End	Damde Meadows Bridge	0	0	0	0	4	3	4	3	5	42.2	100.0	100.0	4222	4222
30	Infrastruct	Crane Beach	Crane-side Ferry Dock	0	0	0	0	2	1	5	5	5	40.0	100.0	99.6	4000	3985
89	Infrastruct	World's End	Damde Meadows Education Shed	0	0	0	0	4	4	5	3	0	35.6	100.0	100.0	3556	3556
41	Infrastruct	Crane Wildlife Refuge	Choate-side Ferry Dock	0	0	0	0	3	3	4	2	4	35.6	100.0	93.0	3556	3305
0	Infrastruct	Cape Poge Wildlife Refuge	Dike Bridge	0	0	0	0	5	5	5	5	0	44.4	100.0	70.7	4444	3141
2	Infrastruct	Cape Poge Wildlife Refuge	Dike Bridge Causeway	0	0	0	0	5	5	5	5	0	44.4	100.0	61.4	4444	2730
38	Infrastruct	Crane Beach	Fox Creek Bridge	0	0	0	0	3	2	0	5	5	33.3	88.8	80.0	2959	2667
40	Infrastruct	Crane Wildlife Refuge	Choate House Culvert	0	0	0	0	0	0	3	2	3	17.8	100.0	100.0	1778	1778
73	Infrastruct	Old Town Hill	Adam's Field Causeway Culvert	0	0	0	0	2	2	0	0	3	15.6	100.0	100.0	1556	1556
74	Infrastruct	Old Town Hill	Newman Road Culvert	0	0	0	0	2	2	0	0	3	15.6	100.0	100.0	1556	1556
75	Infrastruct	Old Town Hill	Newman Road Bridge	0	0	0	0	2	2	0	0	3	15.6	100.0	100.0	1556	1556
76	Infrastruct	Old Town Hill	Hay Street Bridge	0	0	0	0	2	2	0	0	3	15.6	93.4	82.3	1453	1281
70	Infrastruct	Norris Reservation	Gordon Pond Dam	0	0	3	3	3	4	0	0	0	28.9	81.1	31.1	2342	900
77	Infrastruct	Old Town Hill	Boardwalk	0	0	0	0	2	2	0	0	0	8.9	100.0	100.0	889	889
27	Infrastruct	Coskata-Coatue Wildlife Refuge	Coskata Life Saving Cottage	0	0	5	5	1	3	2	0	0	35.6	100.0	16.0	3556	570
54	Infrastruct	Long Point Wildlife Refuge	Off-season Road Culvert	0	0	0	0	3	5	1	2	0	24.4	100.0	20.0	2444	489
34	Infrastruct	Crane Beach	Store Septic Tank	0	0	0	0	0	0	0	4	4	17.8	100.0	25.0	1778	444
61	Infrastruct	Lyman Reserve	Red Brook Aluminum Bridge	0	0	0	0	0	2	0	0	0	4.4	100.0	91.2	444	405
25	Infrastruct	Coolidge Reservation	Coolidge Point Jetty	0	0	0	0	1	1	0	0	0	4.4	100.0	73.4	444	326
91	Infrastruct	World's End	Culvert	0	0	0	0	2	1	0	0	3	13.3	10.0	20.0	133	267
1	Infrastruct	Cape Poge Wildlife Refuge	Cape Poge Sand Planks	0	0	0	0	3	2	2	3	0	22.2	46.0	11.8	1021	262
72	Infrastruct	Norton Point Beach	Norton Pt. Air Station	0	0	0	0	5	5	2	5	2	42.2	100.0	5.0	4222	211
97	Infrastruct	World's End	Culvert	0	0	0	0	2	1	0	0	3	13.3	22.5	15.0	300	200

# Top 25 Asset CVIs – Parking

FID	Dataset	Property	Name	_IN	_SIG	_IN	_SIG	_QUA	_SIG	_IC	_IMI	UP	TOTAL_CON	2070AVG	2030AVG	CVI2070AVG	CVI2030AVG
0	Parking	Cape Poge Wildlife Refuge	Town Parking Lot at Dike Road	0	0	0	0	4	4	0	3	0	24.4	100.0	96.3	2444	2355
7	Parking	Crane Beach	Crane Beach Main Parking Area	0	0	0	0	5	5	5	5	5	55.6	87.1	20.6	4839	1143
15	Parking	Long Point Wildlife Refuge	Long Point Summer Parking Area	0	0	0	0	5	5	5	5	0	44.4	4.8	0.6	215	25
33	Parking	Wasque	Wasque Western Parking Area	0	0	0	0	5	5	3	5	0	40.0	4.5	0.5	180	20
23	Parking	Norton Point Beach	Norton Point Beach Parking Area	0	0	0	0	0	0	0	5	0	11.1	6.8	0.8	76	9
17	Parking	Lyman Preserve	Lyman Parking Area	0	0	0	0	2	2	0	0	2	13.3	1.0	0.3	13	4
6	Parking	Crane Beach	Town of Ipswich Parking Area	0	0	0	0	0	0	0	4	1	11.1	16.7	0.2	185	2
10	Parking	Hales Brook and Sippican River	Hales Brook Parking Area	0	0	0	0	1	1	0	0	1	6.7	0.5	0.1	3	1
1	Parking	Castle Hill	Castle Hill Cedar Point Parking Area	0	0	0	0	3	3	4	5	1	35.6	0.0	0.0	0	0
2	Parking	Castle Hill	Inn at Castle Hill Parking Area	0	0	0	0	3	3	2	5	1	31.1	0.0	0.0	0	0
3	Parking	Castle Hill	Castle Hill Great House Parking Area	0	0	0	0	5	5	5	5	4	53.3	0.0	0.0	0	0
4	Parking	Coolidge Reservation	Coolidge Parking Area	0	0	0	0	5	3	0	0	3	24.4	0.0	0.0	0	0
5	Parking	Cornell Fam	Cornell Fam Parking Area	0	0	0	0	2	1	0	0	4	15.6	0.0	0.0	0	0
8	Parking	Gov. Hutchinson's Field	Gov. Hutchinson's Field Parking Area	0	0	0	0	1	1	0	0	0	4.4	0.0	0.0	0	0
9	Parking	Greenwood Farm	Greenwood Farm Parking Area	0	0	0	0	2	2	1	0	0	11.1	0.0	0.0	0	0
11	Parking	Hales Brook and Sippican River	Sippican River Parking Area	0	0	0	0	0	0	0	0	0	0.0	1.5	0.5	0	0
12	Parking	Hamlin Reservation	Hamlin Parking Area	0	0	0	0	2	2	0	0	2	13.3	0.0	0.0	0	0
13	Parking	Long Point Wildlife Refuge	Long Point Off-Season Parking Area	0	0	0	0	5	5	3	3	0	35.6	0.1	0.0	5	0
14	Parking	Long Point Wildlife Refuge	Long Point Parking Area	0	0	0	0	5	5	5	5	0	44.4	0.2	0.0	9	0
16	Parking	Lowell Holly	S Sandwich Rd Parking Area	0	0	0	0	1	1	0	0	0	4.4	0.0	0.0	0	0
18	Parking	Mashpee River	Mashpee New Parking Area	0	0	0	0	1	2	0	0	3	13.3	0.0	0.0	0	0
19	Parking	Mashpee River	Mashpee Town Parking Area	0	0	0	0	3	2	0	0	2	15.6	0.0	0.0	0	0
20	Parking	Menemsha Hills	Menemsha Hills Parking Area	0	0	0	0	3	5	5	2	0	33.3	0.0	0.0	0	0
21	Parking	Mytoi	Mytoi Parking Area	0	0	0	0	3	5	5	2	0	33.3	0.3	0.0	9	0
22	Parking	Norris Reservation	Norris Parking Area	0	0	0	0	4	3	0	0	3	22.2	0.0	0.0	0	0

## Top 25 Asset CVIs – Roads

FID	Dataset	Property	Name	_IN	_SIG	_IN	_SIG	_QU	_SIG	_IC	_IMI	UP	TOTAL_CON	2070AVG	2030AVG	CVI2070AVG	CVI2030AVG
9	Roads	Crane Beach	ARGILLA ROAD	0	0	0	0	5	5	5	5	5	55.6	81.5	65.5	4530	3638
18	Roads	Crane Beach	Dirt Road to Ferry	0	0	0	0	3	4	4	4	5	44.4	98.8	69.7	4390	3097
17	Roads	Crane Beach	Parkin Area Turn-around	0	0	0	0	5	5	5	5	5	55.6	77.0	23.5	4280	1304
12	Roads	Castle Hill	Gatehouse Driveway	0	0	0	0	5	5	5	5	5	55.6	51.5	23.3	2859	1295
3	Roads	Old Town Hill	NEWMAN ROAD	0	0	0	0	5	3	0	0	5	28.9	41.1	39.5	1186	1142
100	Roads	Coskata-Coatue Wildlife Refuge	Great Point Road	0	0	0	0	5	5	5	5	5	55.6	80.7	16.7	4482	928
80	Roads	Cape Poge Wildlife Refuge	THE DYKE ROAD	0	0	0	0	5	5	5	5	5	55.6	37.8	14.6	2102	810
4	Roads	Old Town Hill	BOSTON ROAD	0	0	0	0	3	2	0	0	3	17.8	56.9	43.1	1011	766
88	Roads	Norton Point Beach	KATAMA ROAD END	0	0	0	0	5	5	5	5	5	55.6	81.7	5.4	4537	302
1	Roads	Old Town Hill	HAY STREET	0	0	0	0	3	2	0	0	3	17.8	29.0	15.3	515	272
25	Roads	World's End	MARTINS LANE	0	0	3	3	5	3	5	5	5	64.4	4.1	3.0	265	193
5	Roads	Old Town Hill	COTTAGE ROAD	0	0	0	0	3	2	0	0	3	17.8	19.0	8.0	337	143
8	Roads	Crane Beach	ARGILLA ROAD	0	0	0	0	5	5	5	5	5	55.6	8.6	2.0	478	113
0	Roads	Old Town Hill	HAY STREET	0	0	0	0	3	2	0	0	3	17.8	8.0	5.2	142	93
31	Roads	World's End	Entrance/Parking Driveway	0	0	0	0	5	5	5	5	5	55.6	4.2	1.2	233	65
82	Roads	Wasque	West Side Driveway	0	0	0	0	5	5	5	5	5	55.6	12.2	1.0	677	55
105	Roads	Long Point Wildlife Refuge	East Side Turn-around	0	0	0	0	5	5	5	5	5	55.6	9.5	0.6	526	34
10	Roads	Hamlin Reservation	ARGILLA ROAD	0	0	0	0	3	3	3	4	3	35.6	4.6	0.9	162	33
102	Roads	Long Point Wildlife Refuge	West Side Driveway	0	0	0	0	5	5	5	3	5	51.1	8.3	0.6	424	31
97	Roads	Coskata-Coatue Wildlife Refuge	WAUWINET ROAD	0	0	0	0	5	5	5	5	5	55.6	10.8	0.5	603	26
95	Roads	Coskata-Coatue Wildlife Refuge	WAUWINET ROAD	0	0	0	0	5	5	5	5	5	55.6	13.4	0.4	744	20
86	Roads	Norton Point Beach	KATAMA ROAD	0	0	0	0	5	5	5	5	5	55.6	5.5	0.3	307	18
106	Roads	Long Point Wildlife Refuge	Schoolhouse Driveway	0	0	0	0	5	5	5	5	5	55.6	1.9	0.3	106	14
7	Roads	Greenwood Farm	Trustees Driveway	0	0	0	0	3	3	1	1	3	24.4	11.7	0.5	286	13
14	Roads	Castle Hill	Exit Driveway	0	0	0	0	5	5	5	5	5	55.6	14.0	0.2	776	13

## Top 25 Asset CVIs – Trails

FID	Dataset	Property	Name	_IN	_SIC	_IN	_SIC	QUAS	SIC	_IC	_IMI	UP	TOTAL_CON	2070AVG	2030AVG	CVI2070AVG	CVI2030AVG
372	Trails	Leland Beach	Leland Inner Track	0	0	0	0	5	5	5	5	3	51.1	100.0	87.4	5111	4465
91	Trails	Menemsha Hills	Beach Loop (on Beach)	0	0	0	0	5	5	5	4	0	42.2	99.7	98.1	4208	4141
143	Trails	World's End	Bridge Carriage Road	0	0	3	3	5	5	3	5	5	64.4	71.9	63.3	4633	4079
275	Trails	World's End	Viewing Blind Trail	0	0	0	0	5	5	4	3	3	44.4	82.0	79.8	3643	3547
239	Trails	Coskata-Coatue Wildlife Refuge	Entrance Track	0	0	0	0	5	5	5	5	5	55.6	99.9	56.4	5552	3131
298	Trails	Crane Beach	Red Trail Back	0	0	0	0	5	5	4	3	4	46.7	99.3	66.4	4636	3097
214	Trails	Cape Poge Wildlife Refuge	Main Track	0	0	0	0	5	5	5	5	5	55.6	91.6	48.7	5088	2706
303	Trails	Crane Wildlife Refuge	Lower Dock Raod	0	0	0	0	5	5	5	2	5	48.9	87.5	52.6	4280	2572
8	Trails	Coskata-Coatue Wildlife Refuge	Outer Beach Track	0	0	0	0	5	5	4	5	4	51.1	61.4	43.0	3140	2196
218	Trails	Cape Poge Wildlife Refuge	Simons Point Track	0	0	0	0	2	2	3	0	3	22.2	100.0	98.2	2222	2182
238	Trails	Coskata-Coatue Wildlife Refuge	Lighthouse Loop	0	0	0	0	4	5	5	3	3	44.4	92.8	48.6	4122	2159
110	Trails	Old Town Hill	Adams Pasture Trail Causeway	0	0	0	0	3	2	0	0	5	22.2	93.1	89.5	2068	1989
10	Trails	Coskata-Coatue Wildlife Refuge	Outer Coaskata Track	0	0	0	0	3	3	4	2	4	35.6	97.7	55.6	3473	1978
11	Trails	Coskata-Coatue Wildlife Refuge	Glades Trail	0	0	0	0	1	2	4	1	2	22.2	100.0	85.1	2222	1891
132	Trails	Wasque	Wasque Point Spur to Beach	0	0	0	0	5	5	5	5	0	44.4	43.2	41.1	1920	1827
221	Trails	Leland Beach	Leland Cutover Track	0	0	0	0	5	5	4	5	5	53.3	70.9	32.0	3782	1705
376	Trails	Cape Poge Wildlife Refuge	Middle-west Track	0	0	0	0	2	2	3	0	3	22.2	99.2	74.0	2205	1644
212	Trails	Cape Poge Wildlife Refuge	Elbow Track	0	0	0	0	2	2	0	0	3	15.6	100.0	95.8	1555	1490
216	Trails	Cape Poge Wildlife Refuge	Outer Track	0	0	0	0	2	2	3	0	3	22.2	99.9	64.0	2220	1423
217	Trails	Cape Poge Wildlife Refuge	Inner Track	0	0	0	0	2	2	0	0	3	15.6	99.0	85.8	1541	1335
138	Trails	World's End	The Neck Carriage Road	0	0	0	0	4	3	1	3	4	33.3	49.4	39.6	1648	1319
337	Trails	Norton Point Beach	Track	0	0	0	0	5	5	5	5	5	55.6	72.5	23.5	4026	1304
315	Trails	Castle Hill	Lower Cedar Point Road	0	0	0	0	4	4	2	0	4	31.1	68.0	40.9	2117	1271
5	Trails	Coskata-Coatue Wildlife Refuge	Coskata Woods Track	0	0	0	0	1	2	3	1	0	15.6	98.5	81.5	1532	1268
302	Trails	Crane Wildlife Refuge	Choate Is. Main Road	0	0	0	0	5	5	5	2	5	48.9	32.8	24.9	1603	1215

# Top 25 Asset CVIs – Priority Habitat

FID	Dataset	Property	Name	_IN	_SIC	_IN	_SIC	_QU	_SIC	_IC	_IMI	UP	TOTAL_CON	2070AVG	2030AVG	CVI2070AVG	CVI2030AVG
23	PriHab_Sp	Cape Poge Wildlife Refuge	Piping Plover	5	5	0	0	3	3	3	0	0	42.2	100.0	100.0	4222	4222
24	PriHab_Sp	Cape Poge Wildlife Refuge	Piping Plover	5	5	0	0	3	3	3	0	0	42.2	100.0	100.0	4222	4222
26	PriHab_Sp	Cape Poge Wildlife Refuge	Piping Plover	5	5	0	0	3	3	3	0	0	42.2	100.0	98.2	4222	4145
28	PriHab_Sp	Cape Poge Wildlife Refuge	Piping Plover	5	5	0	0	3	3	3	0	0	42.2	99.6	95.7	4206	4040
25	PriHab_Sp	Cape Poge Wildlife Refuge	Piping Plover	5	5	0	0	3	3	3	0	0	42.2	99.8	95.3	4214	4024
16	PriHab_Sp	Cape Poge Wildlife Refuge	Northern Harrier	5	3	0	0	3	3	3	0	0	37.8	100.0	100.0	3778	3778
31	PriHab_Sp	Cape Poge Wildlife Refuge	Roseate Tern	2	5	0	0	3	4	3	0	0	37.8	100.0	100.0	3778	3778
363	PriHab_Sp	Wasque	Piping Plover	3	5	0	0	3	3	3	0	0	37.8	100.0	100.0	3778	3778
364	PriHab_Sp	Wasque	Piping Plover	3	5	0	0	3	3	3	0	0	37.8	100.0	100.0	3778	3778
362	PriHab_Sp	Wasque	Piping Plover	3	5	0	0	3	3	3	0	0	37.8	100.0	99.3	3778	3750
361	PriHab_Sp	Wasque	Piping Plover	3	5	0	0	3	3	3	0	0	37.8	99.3	97.5	3751	3682
370	PriHab_Sp	Wasque	Roseate Tern	2	5	0	0	3	3	3	0	0	35.6	100.0	100.0	3556	3556
21	PriHab_Sp	Cape Poge Wildlife Refuge	Piping Plover	5	5	0	0	3	3	3	0	0	42.2	99.8	79.8	4213	3370
4	PriHab_Sp	Cape Poge Wildlife Refuge	Least Tern	5	2	0	0	2	3	3	0	0	33.3	100.0	100.0	3333	3333
12	PriHab_Sp	Cape Poge Wildlife Refuge	Least Tern	5	2	0	0	2	3	3	0	0	33.3	100.0	100.0	3333	3333
32	PriHab_Sp	Cape Poge Wildlife Refuge	Roseate Tern	2	5	0	0	3	4	3	0	0	37.8	100.0	88.2	3778	3331
369	PriHab_Sp	Wasque	Roseate Tern	2	5	0	0	3	3	3	0	0	35.6	99.5	93.5	3539	3325
11	PriHab_Sp	Cape Poge Wildlife Refuge	Least Tern	5	2	0	0	2	3	3	0	0	33.3	100.0	96.1	3333	3204
9	PriHab_Sp	Cape Poge Wildlife Refuge	Least Tern	5	2	0	0	2	3	3	0	0	33.3	100.0	95.0	3333	3166
81	PriHab_Sp	Coskata-Coatue Wildlife Refuge	Piping Plover	5	5	0	0	1	2	1	0	0	31.1	100.0	100.0	3111	3111
27	PriHab_Sp	Cape Poge Wildlife Refuge	Piping Plover	5	5	0	0	3	3	3	0	0	42.2	96.7	71.0	4084	2996
82	PriHab_Sp	Coskata-Coatue Wildlife Refuge	Piping Plover	5	5	0	0	1	2	1	0	0	31.1	99.6	96.1	3099	2991
344	PriHab_Sp	Wasque	Common Tern	2	2	0	0	2	3	3	0	0	26.7	100.0	100.0	2667	2667
345	PriHab_Sp	Wasque	Common Tern	2	2	0	0	2	3	3	0	0	26.7	100.0	100.0	2667	2667
353	PriHab_Sp	Wasque	Least Tern	2	2	0	0	2	3	3	0	0	26.7	100.0	100.0	2667	2667

# Top 25 Asset CVIs – Vegetation Communities

FID	Dataset	Property	Name	_IN'_SIC'_IN'_SI@QU@SIC_IC'_IMIUP	TOTAL_CON	2070AVG	2030AVG	CVI2070AVG	CVI2030AVG
951	Veg_Comm	World's End	OPEN WATER - TIDAL	3 2 4 4 5 5 3 4 0	66.7	100.0	100.0	6667	6667
941	Veg_Comm	World's End	MARITIME JUNIPER SHRUB/WOODS	4 5 4 4 3 5 2 2 0	64.4	100.0	100.0	6444	6444
912	Veg_Comm	World's End	EMERGENT WETLAND	3 3 4 4 4 4 4 3 0	64.4	99.8	99.8	6432	6432
540	Veg_Comm	Menemsha Hills	COASTAL BEACH	5 3 0 0 5 5 5 5 0	62.2	100.0	100.0	6222	6222
975	Veg_Comm	Cape Poge Wildlife Refuge	MARITIME BEACH	5 3 0 0 5 5 5 5 0	62.2	100.0	100.0	6222	6222
539	Veg_Comm	Menemsha Hills	COASTAL BEACH	5 3 0 0 5 5 5 5 0	62.2	100.0	99.9	6222	6214
972	Veg_Comm	Cape Poge Wildlife Refuge	MARITIME BEACH	5 3 0 0 5 5 5 5 0	62.2	100.0	99.2	6222	6170
970	Veg_Comm	Cape Poge Wildlife Refuge	MARITIME BEACH	5 3 0 0 5 5 5 5 0	62.2	100.0	98.7	6220	6144
973	Veg_Comm	Cape Poge Wildlife Refuge	MARITIME BEACH	5 3 0 0 5 5 5 5 0	62.2	99.8	98.3	6210	6116
923	Veg_Comm	World's End	GRASSLAND	4 3 4 4 5 5 3 5 0	73.3	91.2	82.0	6686	6015
862	Veg_Comm	Wasque	BARRIER BEACH-COASTAL BEACH	5 3 0 0 5 5 5 5 0	62.2	97.8	93.9	6086	5843
67	Veg_Comm	Coskata-Coatue Wildlife Refuge	MARITIME BEACH	3 5 0 0 5 5 5 3 0	57.8	100.0	100.0	5778	5778
69	Veg_Comm	Coskata-Coatue Wildlife Refuge	MARITIME BEACH	3 5 0 0 5 5 5 3 0	57.8	100.0	100.0	5778	5778
72	Veg_Comm	Coskata-Coatue Wildlife Refuge	MARITIME BEACH	3 5 0 0 5 5 5 3 0	57.8	100.0	100.0	5778	5778
231	Veg_Comm	Crane Beach	SAND BEACH	5 3 0 0 5 5 3 5 0	57.8	99.9	99.5	5775	5751
68	Veg_Comm	Coskata-Coatue Wildlife Refuge	MARITIME BEACH	3 5 0 0 5 5 5 3 0	57.8	100.0	97.6	5778	5639
969	Veg_Comm	Cape Poge Wildlife Refuge	MARITIME BEACH	5 3 0 0 5 5 5 5 0	62.2	100.0	88.9	6222	5532
54	Veg_Comm	Castle Hill	SALT MARSH	5 3 5 5 3 3 0 0 0	53.3	100.0	99.8	5333	5323
28	Veg_Comm	Castle Hill	MARITIME SHRUB THICKET	5 3 5 5 2 2 1 1 0	53.3	100.0	99.1	5333	5285
956	Veg_Comm	World's End	SUCCESSIONAL GRASSLAND	3 3 5 5 5 5 3 5 0	75.6	78.4	68.0	5927	5139
474	Veg_Comm	Long Point Wildlife Refuge	SHALLOW MARSH MEADOW OR FEN	5 4 5 5 3 3 1 0 0	57.8	100.0	85.4	5778	4934
863	Veg_Comm	Wasque	MARITIME BEACH	5 3 3 3 5 5 5 5 0	75.6	88.1	64.7	6659	4892
52	Veg_Comm	Castle Hill	SALT MARSH	3 3 5 5 3 3 0 0 0	48.9	100.0	100.0	4889	4889
53	Veg_Comm	Castle Hill	SALT MARSH	3 3 5 5 3 3 0 0 0	48.9	100.0	100.0	4889	4889
55	Veg_Comm	Castle Hill	SAND BEACH	5 3 0 0 5 5 3 5 0	57.8	93.3	83.1	5388	4804

# SLAMM Modeling- Example Results



## SLAMM Wetland Categories



# Top 5 Properties

LARGEST CONCENTRATION OF HIGH RISK



## Summary of Results

### TRENDS AND ADAPTATIONS

Coastal wetlands (salt marsh) and beaches have the highest CVIs

Irregularly flooded marshes are shifting to regularly flood marshes

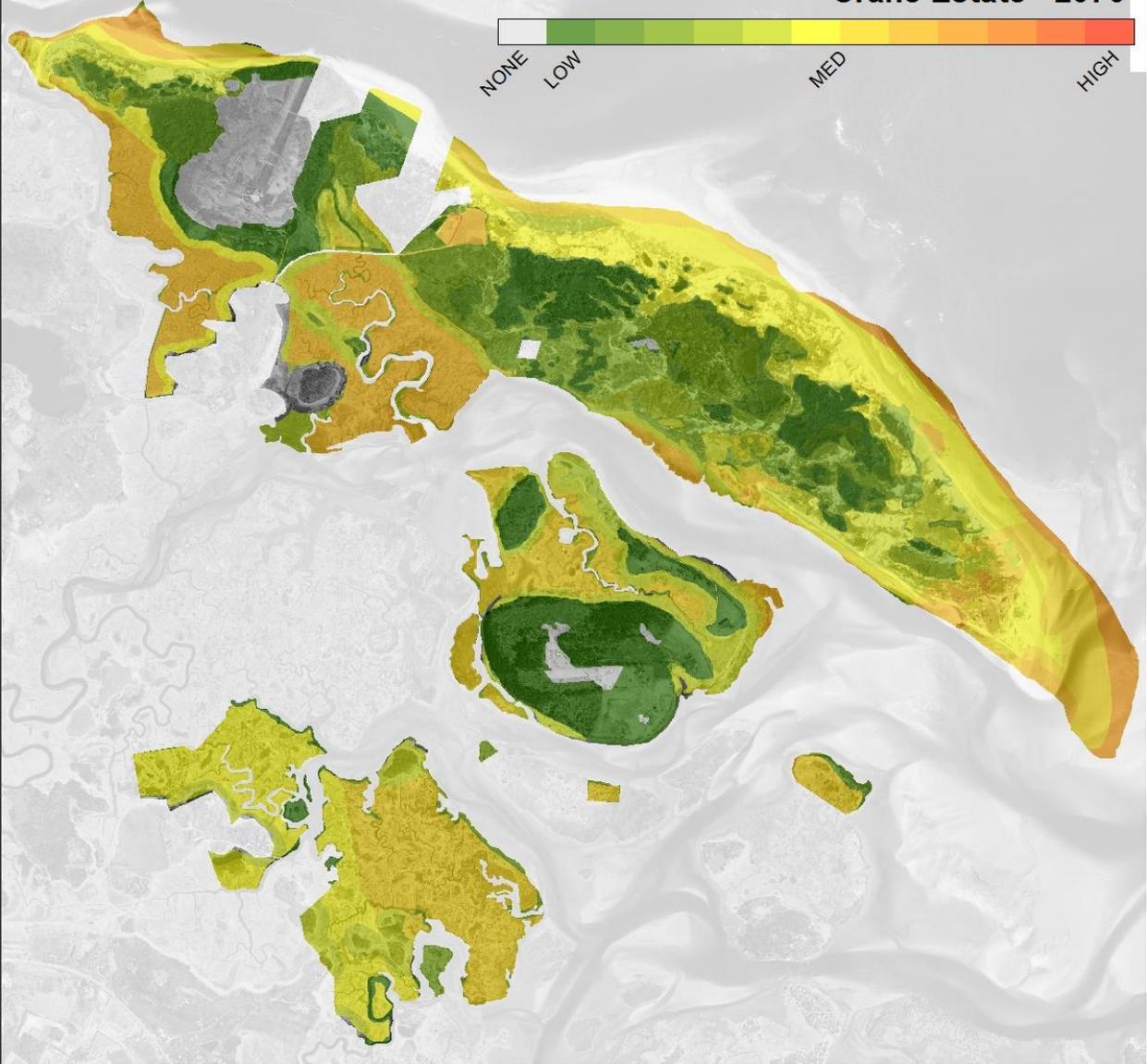
Impacts to priority habitats

5-7 Properties with higher density of elevated CVIs

Buildings, cultural resources and parking lots tend to have lower CVIs, but there are some with high probability of inundation, but lower consequence score



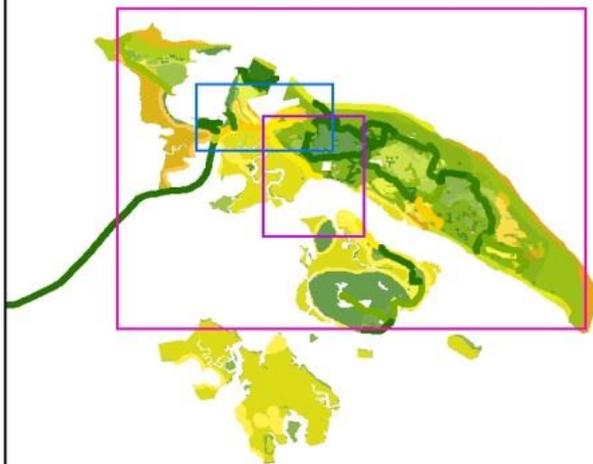
**Coastal Vulnerability Index  
Crane Estate - 2070**



2030 MHHW (+1.51m)  
2070 MHHW (+2.34m)



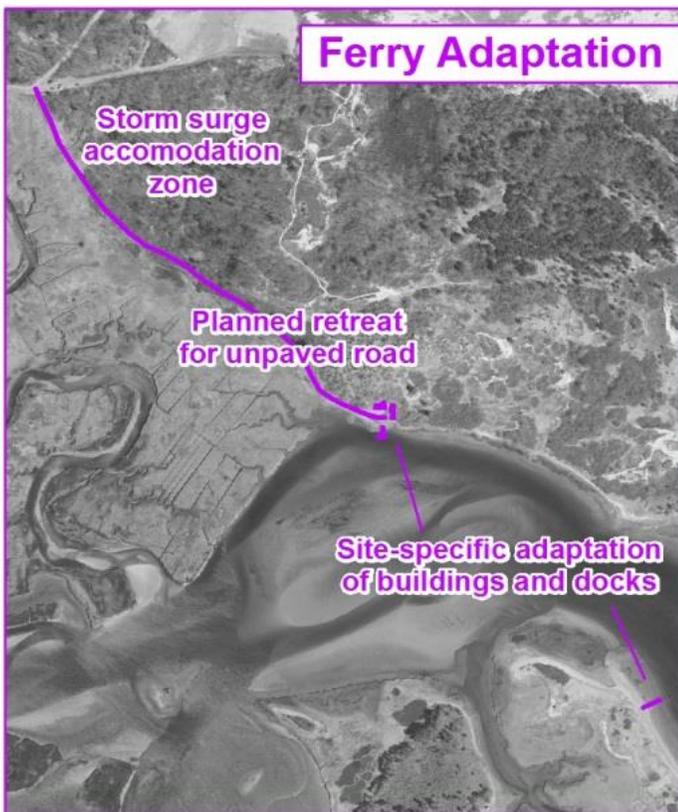
### Crane Estate CVI



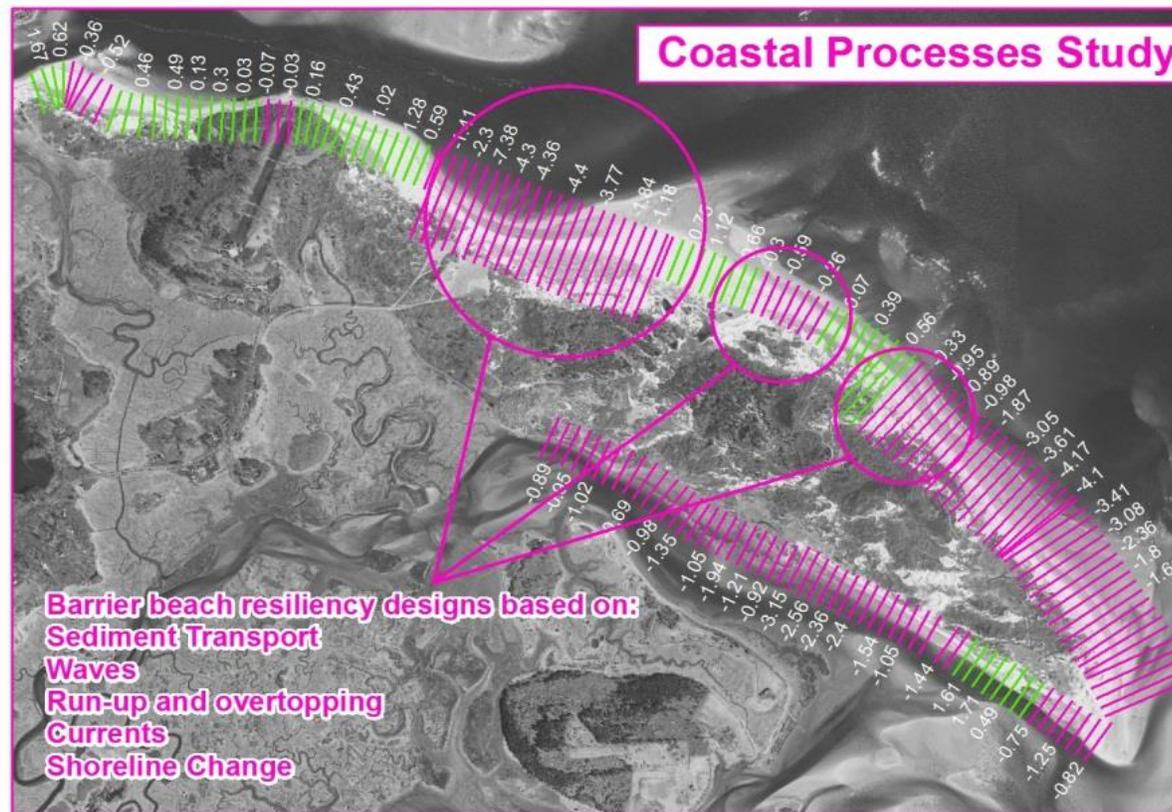
### Argilla Road Adaptation



### Ferry Adaptation



### Coastal Processes Study



- Barrier beach resiliency designs based on:
- Sediment Transport
- Waves
- Run-up and overtopping
- Currents
- Shoreline Change

## The Trustees of Reservations

### NEXT STEPS

- ▶ Use CVI to prioritize adaptation alternatives
- ▶ Adaptation planning and project implementation
- ▶ Public release of final report
- ▶ Media and community outreach
- ▶ Inform broader coastal strategy





# Rising Waters & Historic Resources: a Developer's Perspective

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Jon Rudzinski

Principal

**Rees-Larkin Development**

*jon@rees-larkindevelopment.com*



## **Rising Water & Historic Resources: a Developer's Perspective**

### **Case Study: Boott Cotton Mills I (2004 – 2006)**

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- Apartments at Boott Mills: Adaptive Re-use of historic mill
- 154-unit mixed-income development completed by WinnDevelopment in 2005
- Architect: The Architectural Team, Inc.

# Rising Water & Historic Resources: a Developer's Perspective

## Boott Cotton Mills I: Turbine Room / Riverwalk

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22 September 2017

Rees-Larkin Development

## Rising Water & Historic Resources: a Developer's Perspective

### Boott Cotton Mills I: Flood Levels & Design

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- Building Located in FEMA Flood Zone AE
- Initial Design: F.F.E. of first floor raised to level of 100-year flood plain
- City Engineer pushed for higher F.F.E.
- Despite extra cost, developer complied w/ City request; re-designed F.F.E. was set further above 100-year flood level

# Rising Water & Historic Resources: a Developer's Perspective

## Boott Cotton Mills I: Mother's Day Flood, May '06

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## Rising Water & Historic Resources: a Developer's Perspective

### Boott Cotton Mills I: Outcomes

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- May 2006: Building evacuated as pre-caution
- Flood waters crested inches below building threshold; minimal damage



## Rising Water & Historic Resources: a Developer's Perspective

### Case Study: Boott Cotton Mills II (2012-2013)

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- Boott Mills West: Adaptive Re-use of historic mill
- 78 apartments & 39 condos & commercial space completed by Winn / Rees-Larkin
- Architect: The Architectural Team, Inc.
- Civil Engineer: Nobis Engineering

## Rising Water & Historic Resources: a Developer's Perspective

### Case Study: Boott Cotton Mills II

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- Building Located in FEMA Flood Zone AE
- Previous build-out left some common areas & commercial space in 100-year flood zone
- High insurance costs vs. high cost of retro-fitting portable flood barriers (windows / doors)
- Outcome: limited areas exposed



## Rising Water & Historic Resources: a Developer's Perspective

### Case Study: Massachusetts Mills III (2014-2017)

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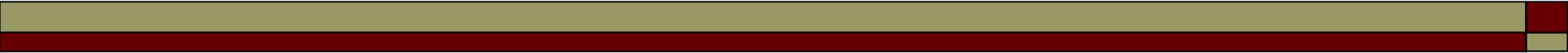
- Mass Mills III: Adaptive Re-use of historic mill (Picker Building)
- 70-unit mixed-income development completed by Mullins / Rees-Larkin in 2016
- Architect: Russell Scott Steedle & Capone
- Civil Engineer: HW Moore Associates, Inc.

# Rising Water & Historic Resources: a Developer's Perspective

## Mass Mills III: Relationship to Merrimack River

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## Rising Water & Historic Resources: a Developer's Perspective

### Mass Mills III: Flood Levels and Design

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- Building Located in FEMA Flood Zone AE
- Initial Design: F.F.E. of first floor raised slightly above level of 100-year flood plain
- Developer/ Design Team: Reconsideration of design
- Despite extra cost, F.F.E. set 15 inches above 100-year flood level

# Rising Water & Historic Resources: a Developer's Perspective

## Mass Mills III: After Redevelopment

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## Rising Water & Historic Resources: a Developer's Perspective

### **Lessons: Limits to Resilient Design in Priv. Dev.**

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- The “system” usually works
- Common sense decisions based on project-based cost-benefit analysis (i.e. individual buildings)
- Resilient Design more prevalent for Standard Environmental factors rather than Extreme factors (esp. “Rising Waters”)



## Rising Water & Historic Resources: a Developer's Perspective

# Lessons: Impediments to Resilient Design

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- Cost
- Insurance Standards
- Lack of knowledge / Inertia / Path of Least Resistance



# Rising Water & Historic Resources: a Developer's Perspective

## Lessons: Opportunities

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- Regulatory
- Role of Federal / State Subsidy