

Community Coastal Resiliency Plan

Town of Stonington, Connecticut
Public Meeting October 20, 2016

Social Media:
#StoningtonReady
@StoningtonCTGov
@ArupAmericas



ARUP



CivicMoxie™
experts in place



Agenda

Introduction

Project Approach

Sea Level Rise/Storm Surge Modeling

Vulnerability Assessment: Preliminary Results

Brief Break

Questions and Answers



Why we are here tonight...

- We want to be wise, plan ahead, and protect people, places, and investments:
 - protect public infrastructure from coastal flooding and sea level rise
 - minimize potential for loss of life and destruction to property
 - identify ways to enhance coastal resources
 - continue to *thrive* despite these shocks and stressors

By the time we all leave...

- You will understand why we are doing resiliency planning in Stonington
- Our project approach will be clear
- You will know the results of:
 - Sea level rise (SLR)/storm surge modeling
 - The vulnerability assessment
- You will have a break to do a quick planning exercise with the person next to you
- Everyone will have a chance to ask questions
- Next steps will be clear

We promise to get you out on time at 7:30 PM!

Project Approach

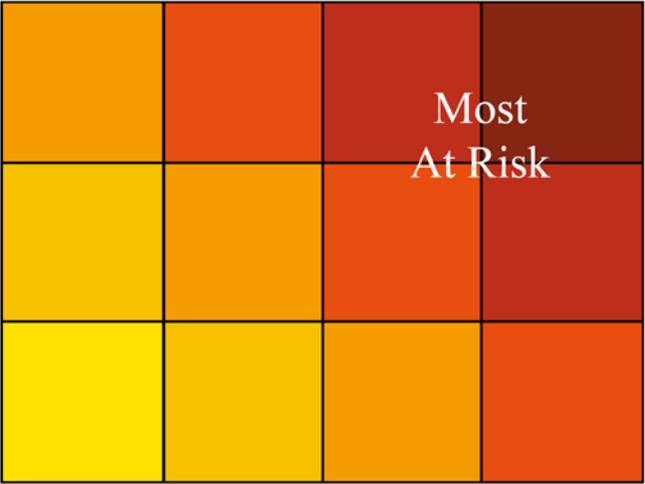
Overview of Approach

Step 1



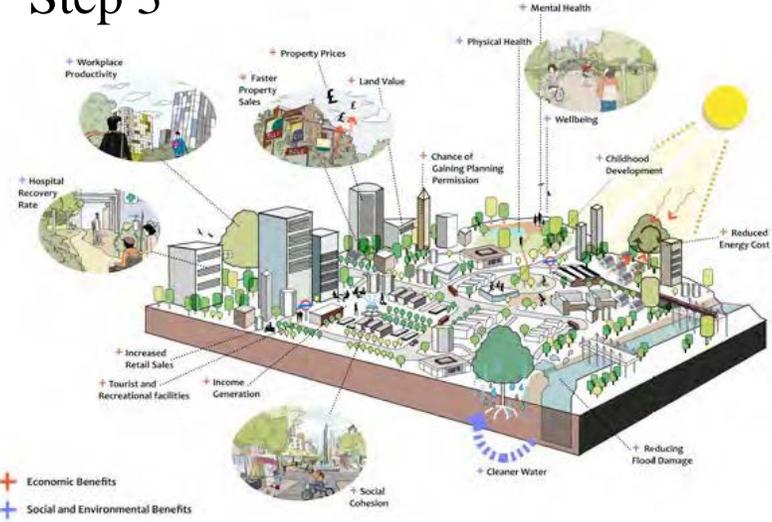
Establishing a climate baseline

Step 2



Ranking risk

Step 3



Developing solutions

Climate Baseline

SLR & storm surge



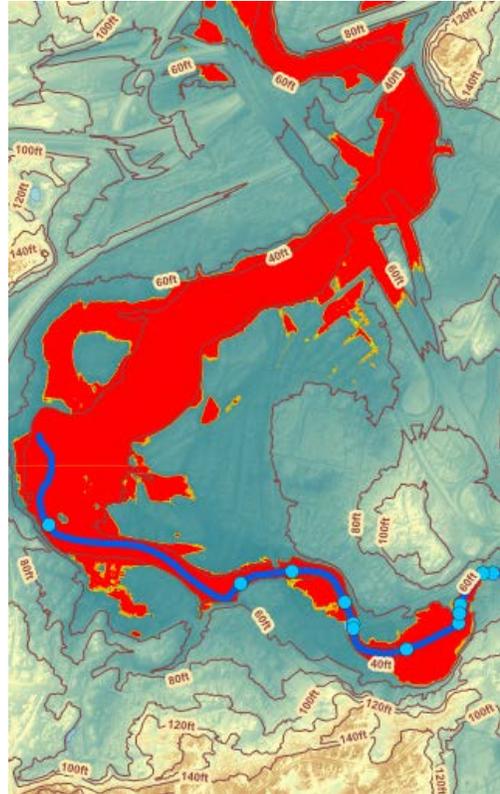
2015

2030

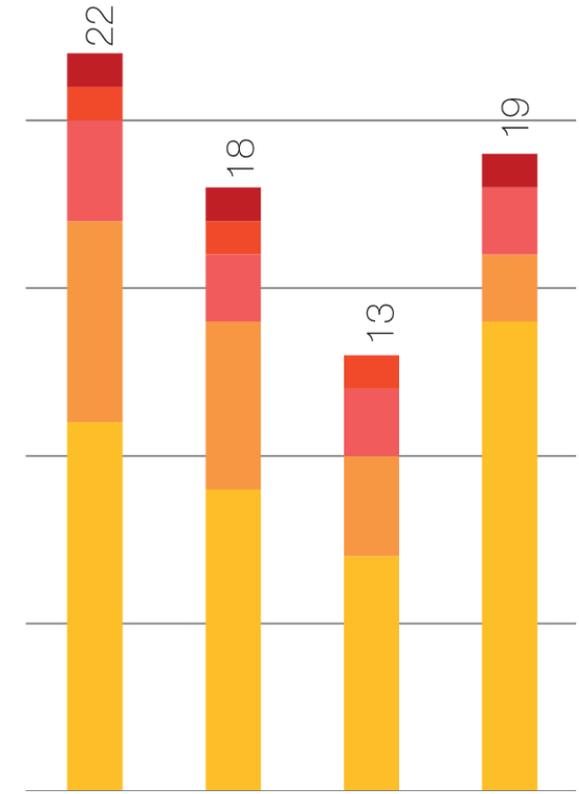
2050



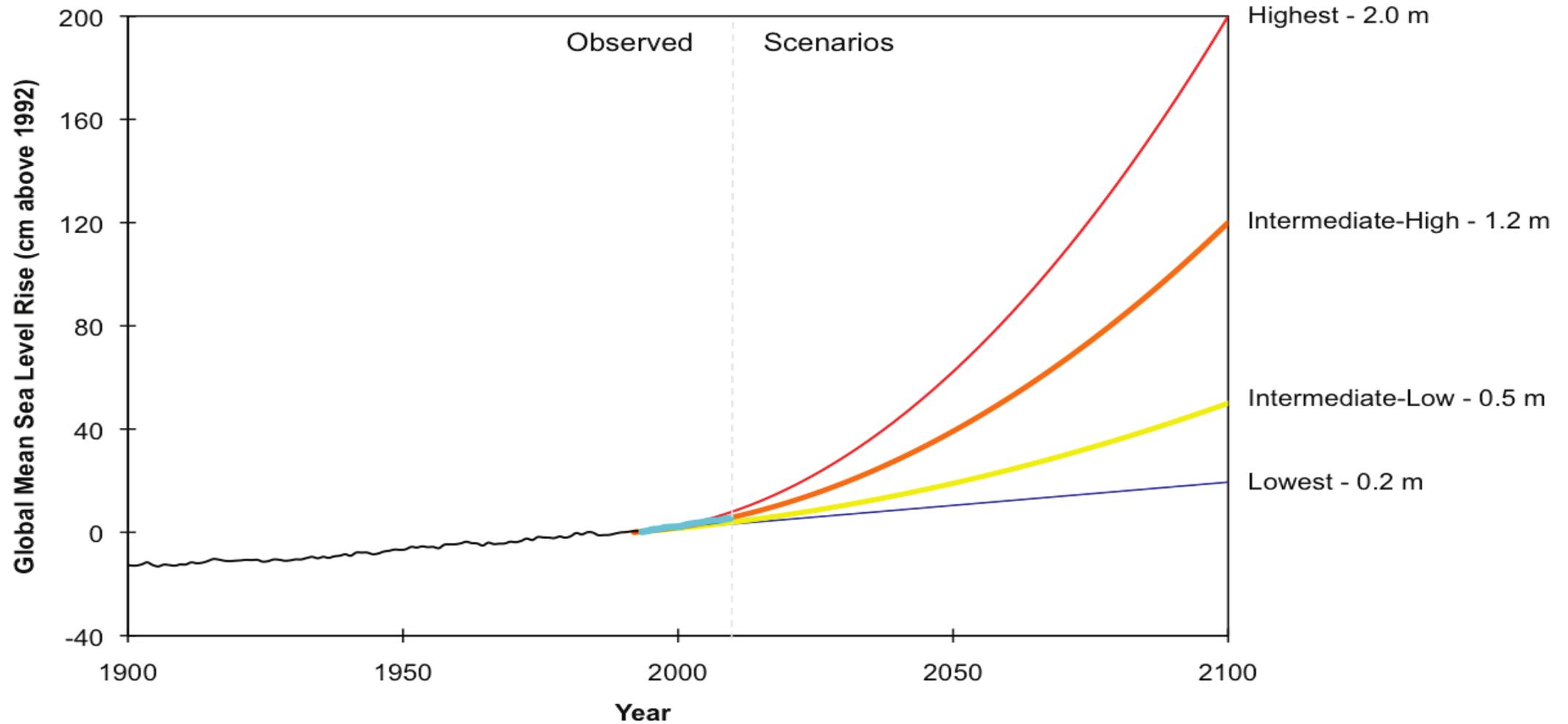
Precipitation



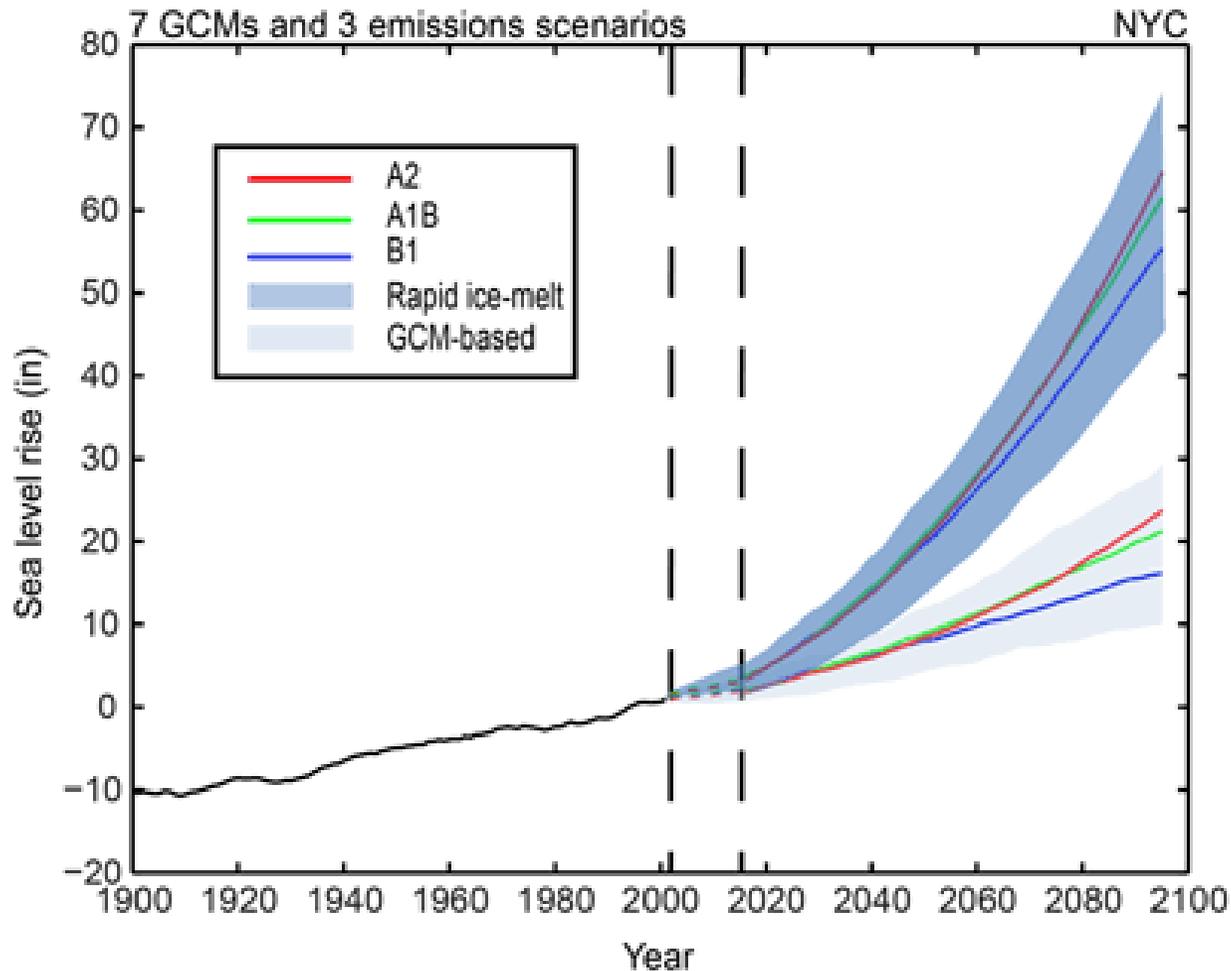
Temperature



Determining the Sea Level Rise elevations



GCM projections may underestimate accelerated ice sheet melting



Sea level rise is happening
3 x faster on the East Coast
than the global average

Nature Climate, 2012

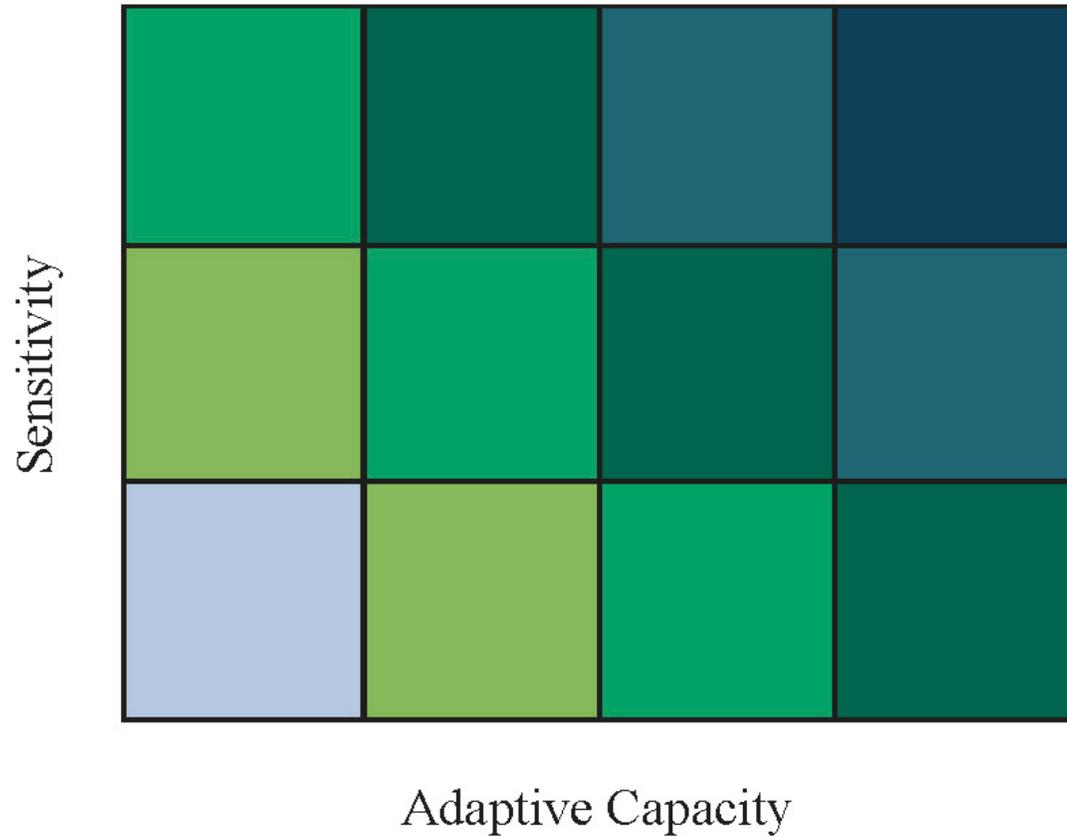
Sandy-like events may
become more like the
1 in 20 yr event vs. the
1 in 1000 yr event

Proceedings, National Academy of Sciences, 2016

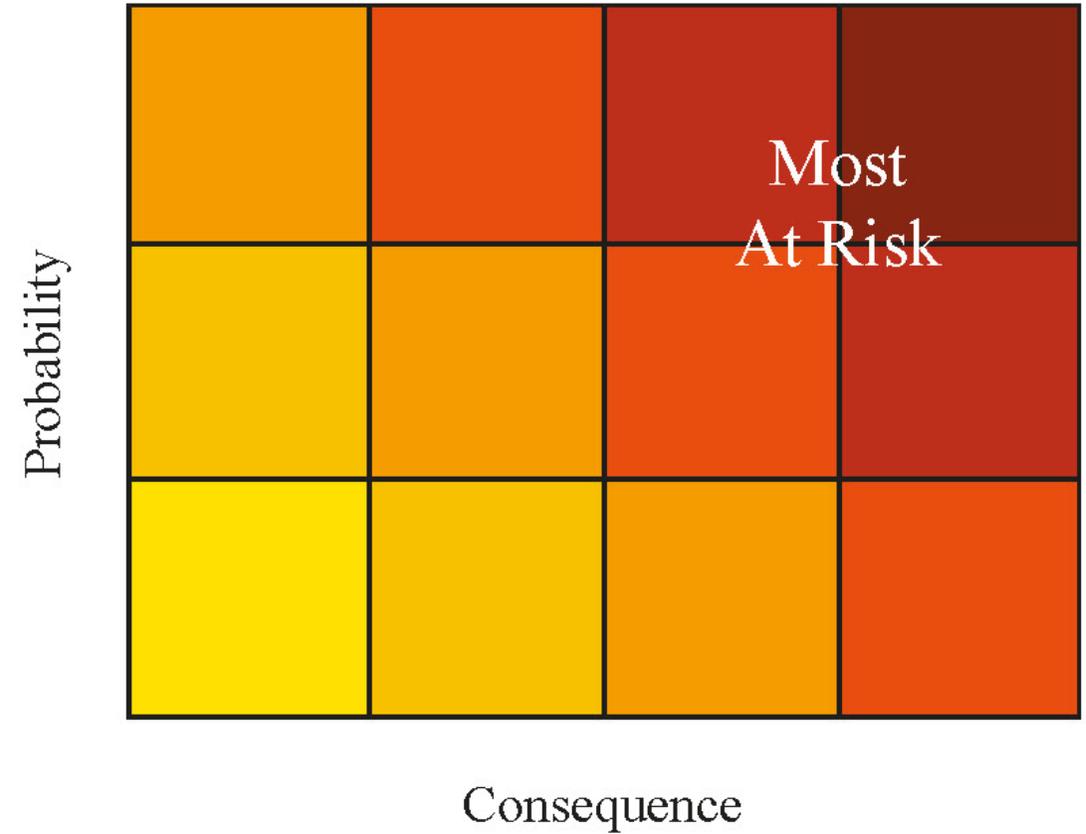
From: NASA: http://www.giss.nasa.gov/research/briefs/rosenzweig_03/

Prioritizing the Risk

Vulnerability



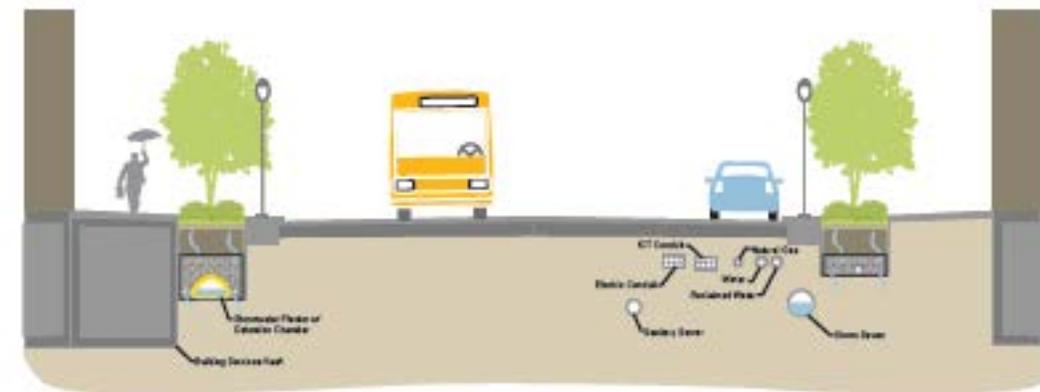
Risk



Translating Risk into Resilient Solutions



Illustration of buoyant architecture (source: Arup)

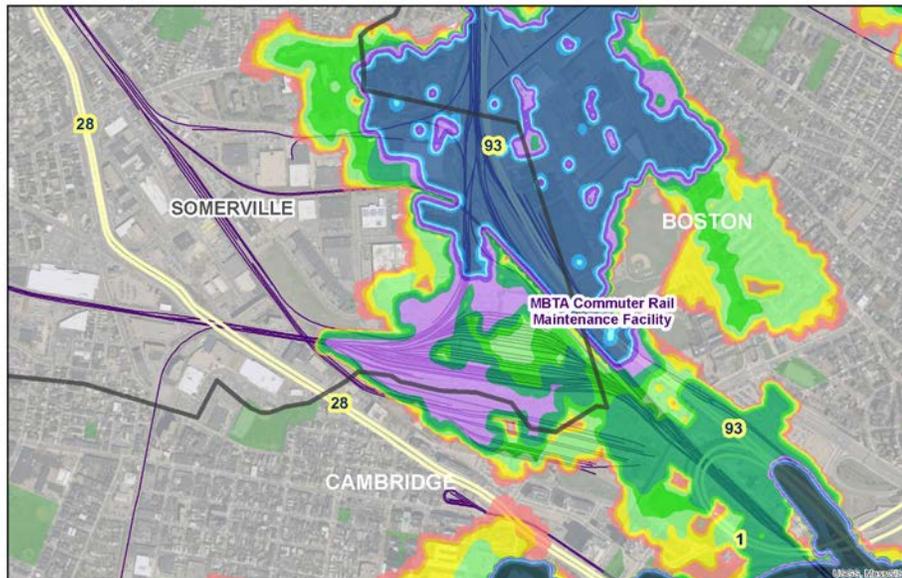


Task 1 – Data Gathering

Deliverables:

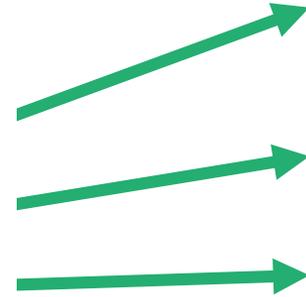
Draft and Final Technical Memo on resilience information.

GIS shape files of readily-available layers to form the basemap for subsequent analyses



Task 2 – Public Input

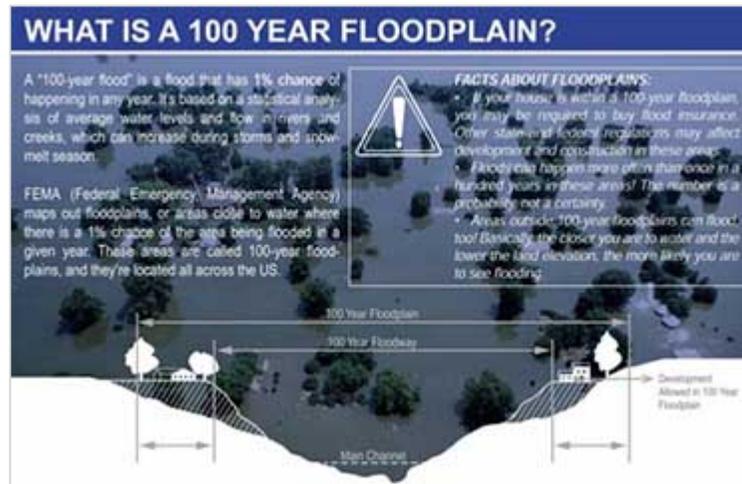
Six onsite meetings	Arup	Civic Moxie	WHG	TDA
1 kick off meeting	1	1	1	1
3 public meetings	3	3	1	
2 meetings with other boards	2	1	1	
Total meetings attended	6	5	3	1



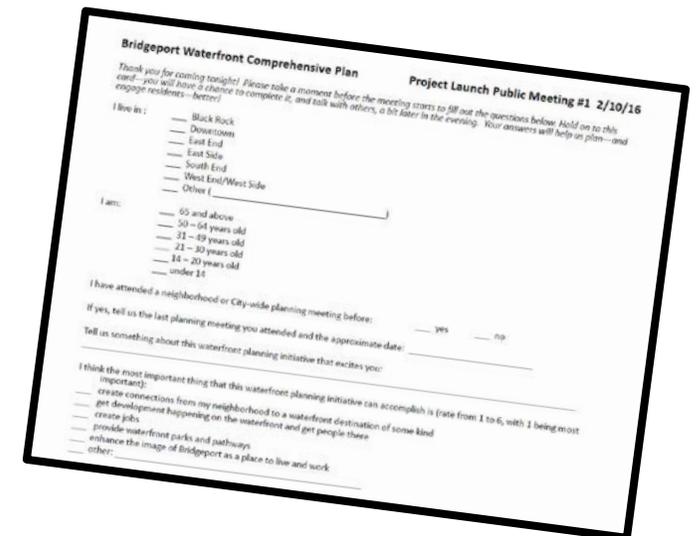
- Promotional Flyers
- Information sheets
- Presentations
- Summary of meetings and public feedback
- Participant data (demographics, interests, etc.)



Clear summaries of outcomes and next steps – to keep the project moving

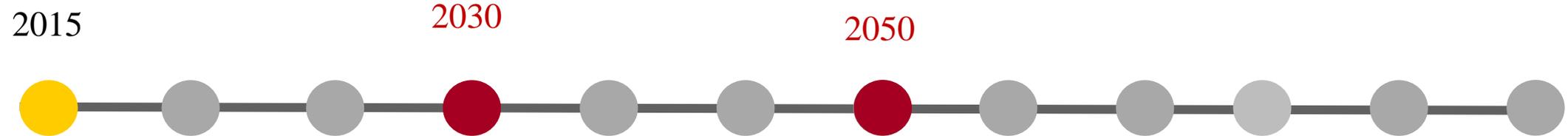


Information sheets to educate public -- to generate constructive discussions



Participant info and feedback surveys at every meeting – to provide data

Task 3 – Risk Assessment

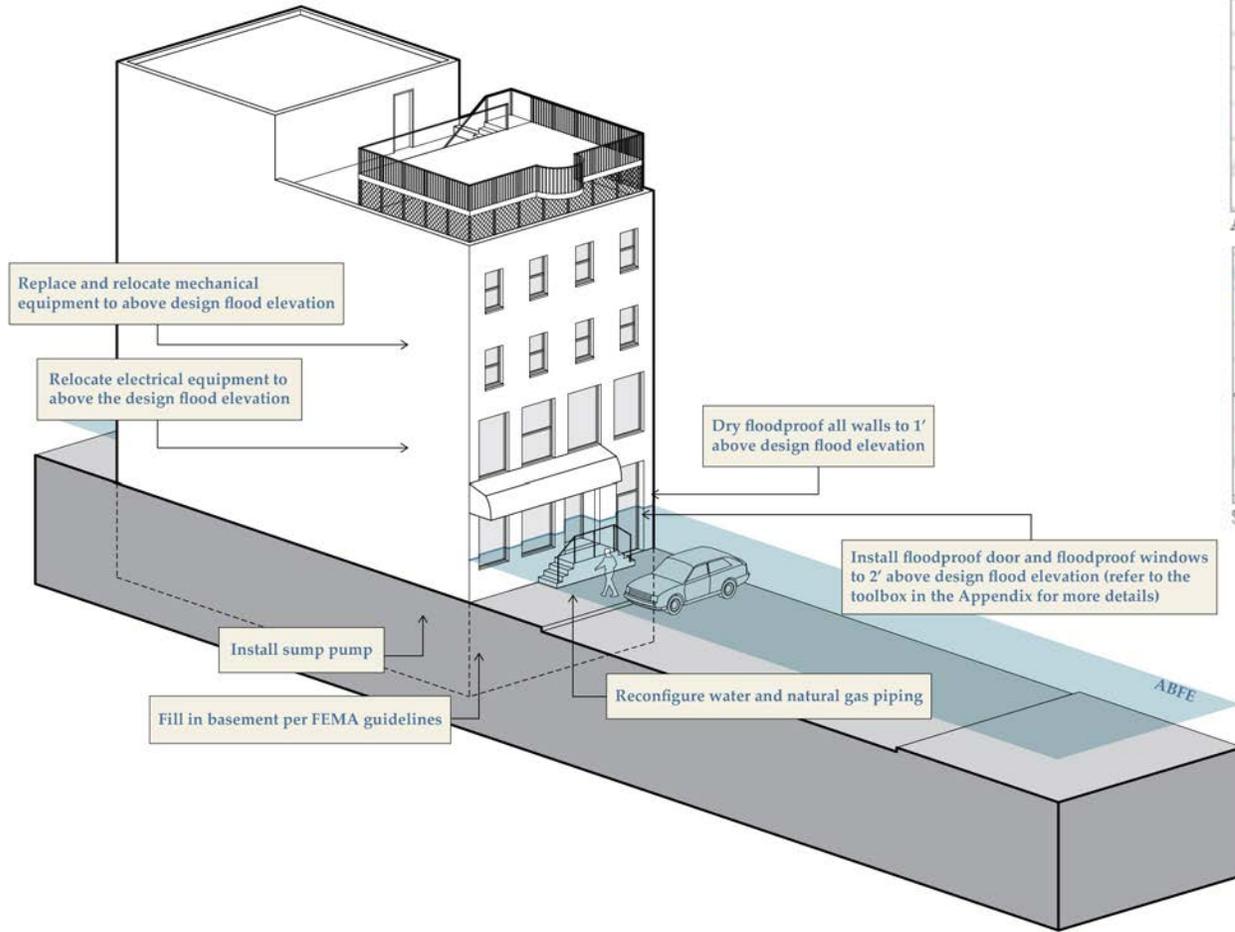


Deliverables

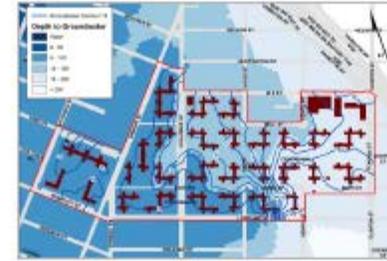
- Draft and Final Technical Memoranda
- Planning Horizon criteria
- Methodology and sources used to develop inundation
- GIS maps and shape files showing extent of flooding
- Levels of inundation at up to 25 assets for each scenario

Exceedence Probability %	Design Year (yr)	2013	2030		2070	
		Water Depth (ft)	Water depth per ground elevation (ft)	Water depth per lobby elevation (ft)	Water depth per ground elevation (ft)	Water depth per lobby elevation (ft)
0.1	1000	dry	dry	dry	dry	dry
0.2	500	dry	dry	dry	dry	dry
0.5	250	dry	dry	dry	dry	dry
1	100	dry	dry	dry	dry	dry
2	50	dry	dry	dry	dry	dry
5	20	dry	dry	dry	dry	dry
10	10	dry	dry	dry	dry	dry
20	5	dry	dry	dry	dry	dry
25	4	dry	dry	dry	dry	dry
30	3	dry	dry	dry	dry	dry
50	2	dry	dry	dry	dry	dry
100	1	dry	dry	dry	dry	dry

Task 4 - Recommended Resilience Solutions



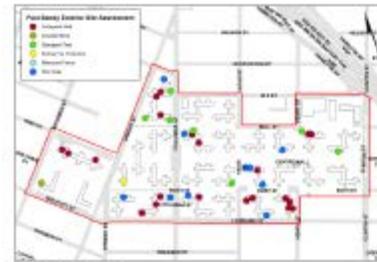
Aerial



Ground Water



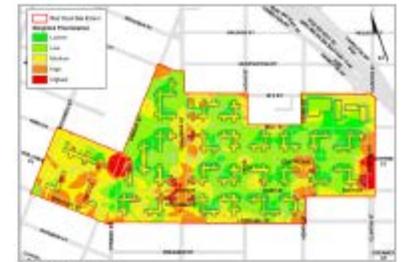
FEMA FIRM



Sandy Impacts



Heat Island



Prioritization

UMASS BOSTON - Coastal Climate Change Adaptation Planning				Vulnerable Flood Risk Areas										
				Morrissey Blvd. Entrance			Bayside Expo Center			Mt. Vernon Street				
General Description				The Morrissey Blvd. Entrance is currently the primary entrance to the UMASS-Boston campus. A significant portion of this street, especially south of the campus entrance, is low-lying and is prone to flooding even under present day conditions (storm surge or heavy rainfall events). Once the water surface elevation overtops higher elevations along the coastline, most of Morrissey Blvd. will become flooded. At the campus entrance specifically, as shown in the aerial view, storm surge flooding initially may occur from the Patten's Cove side and subsequently the Savin Hill Cove side when water surface elevations reach between approximately 9.5-10.0 feet NAVD88.			The Bayside Expo center region, recently purchased by UMASS-Boston, is slated to undergo redevelopment. Currently, the area is prone to potential flooding, especially the low-lying parking lot regions (one of the lowest elevations in the region). It is likely that there is potential for poor drainage and flooding of this area (approximately 30 acres) even during contemporary rainfall storm events. As sea level increases, there are also lower areas along the Dorchester Bay shoreline that will become susceptible to the higher water surface elevations during storm events, resulting in significant overtopping and widespread flooding of the area. Specifically, areas along the Harbor walk area shown in the aerial view.			The southeastern end of Mt. Vernon Street is under consideration as a potential location for a secondary entrance to the UMASS-BOSTON campus. This area currently experiences storm water drainage delays and issues. The current storm water drain lines from this area discharge into Dorchester Bay with an invert elevation at approximately Mean Higher High Water. As sea level rises, this will further impede storm water drainage ability from this region. There is also some susceptible low lying areas to the east of the Mt. Vernon Street terminus, as shown in the aerial below. Potential upland flooding may occur along some lower elevation access points in this region.				
Mean Higher High Water (MHHW) Timelapse	Annual (1-year) Storm Surge Timelapse	300-year Storm Surge Timelapse	Approximate Maximum Water Surface Elevation (ft. NAVD88)	Morrissey Blvd. Entrance			Bayside Expo Center			Mt. Vernon Street				
				Upland Flooding Potential	Recommended Engineering Adaptations	Estimated Adaptation Cost*	Upland Flooding Potential	Recommended Engineering Adaptations	Estimated Adaptation Cost*	Upland Flooding Potential	Recommended Engineering Adaptations	Estimated Adaptation Cost*		
			4.0	No Flooding Expected	No Action Required	N/A	Poor Drainage of Bayside Expo Parking areas during heavy rainfall events.	Minor flood proofing of structures Installation of a pump house and pumped based-drainage system for parking area*	Capital Cost: \$ 2.0 Million Annual Maintenance Costs: \$ 10,000	No Flooding Expected	No Action Required	N/A		
			5.0											
			6.0											
			7.0	Flooding of Morrissey Blvd. approximately 1/4 mile south of campus entrance.	No flooding of campus entrance or campus facilities	No Flooding of areas from Dorchester Bay waters.	Modular seawall installation at critical locations along Harbor walk	Capital Cost: \$ 1.0-1.5 million (1,000 foot length)	Area has experienced poor storm water drainage. Storm water outfall at 2010 MHHW elevation may not adequately drain in future	Improve storm water removal and drainage lines. Modify storm water outfall or add pump house.	Capital Cost: \$ 250,000 Annual Maintenance Costs: \$ 2,000			
			8.0											
			9.0	Flooding of campus entrance. Initially from Patten's Cove (tidal pond to the west of entrance), and subsequently from Savin Hill Cove.	Tidal control structure installation at entrance to Patten's Cove. Soft solution (beach nourishment and vegetation enhancement) along Savin Hill Cove.	Capital Cost: \$500-750,000 Annual Maintenance Costs: \$10,000	Flooding of Bayside Expo areas from Dorchester Bay. Water overtops harbor walk in places.	Seawall extension along Harbor walk as needed	Capital Cost: \$15,000	Flooding from Dorchester Bay via low-lying pathways to the east of Mt. Vernon Street	Provide clean fill in low lying areas or increase storm damage protection through targeted soft coastal engineering solutions	Capital: \$300-500,000 Annual Maintenance: \$5,000		
			10.0											
			11.0											
			12.0											
			13.0											
14.0				Widespread flooding of UMASS Boston Campus, Morrissey Blvd. and surrounding areas	In addition to adaptations above, additional flood proofing and elevation of critical infrastructure.	Capital Cost: \$20 per square foot of building for wet flood proofing	Widespread flooding of UMASS Boston Campus, Morrissey Blvd. and surrounding areas	In addition to adaptations above, additional flood proofing and elevation of critical infrastructure.	Capital Cost: \$20 per square foot of building for wet flood proofing	Widespread flooding of UMASS Boston Campus, Morrissey Blvd. and surrounding areas	In addition to adaptations above, additional flood proofing and elevation of critical infrastructure.	Capital Cost: \$20 per square foot of building for wet flood proofing		
15.0														
16.0														

* - Initial Capital Costs and Operational and Maintenance costs provided are estimates based on costs from similar types of projects. More detailed and accurate costs would be required for actual engineering and construction. Estimated costs are based on 2010 dollar value.

- Depends on length of seawall installed.

+ - Based on a 30 acre area with a peak intensity rainfall of 5 in/hr (average of 0.3 inches/hr over a 24 hour period)

High-level,
Engineering
solutions

Task 5 - Draft and Final Coastal Resilience Plan



- Draft plan presented to public
- Input captured in the subsequent rewrite
- High-level summary of comments
- Public session will be held to present the final Coastal Resilience Plan

Project Team



Lisa Dickson
Arup

Project Manager



Kirk Bosma
Woods Hole Group

Coastal Engineer



Susan Silberberg
Civic Moxie

Stakeholder Engagement



Madeline Fraser Cook
TDA

CDBG Compliance

Sea Level Rise and Storm Surge Modeling

Climate Change Flooding

FEMA Maps

- **FEMA is only backward looking**
- **Only considers “100-year” storm**
- **Transect based analysis**

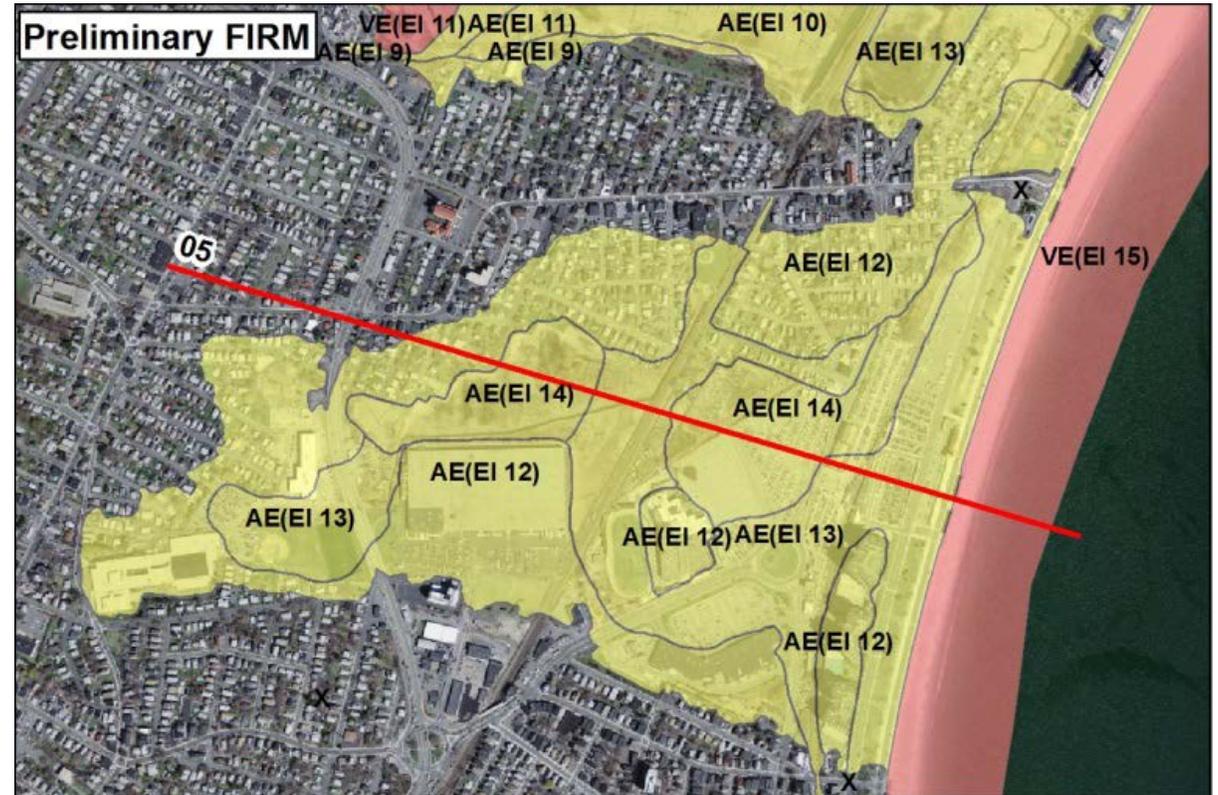
Bathtub Approach

- **Inundation maps do not reflect dynamic nature of coastal flooding**
- **Does not account for joint flooding conditions**
- **Does not account for tides**

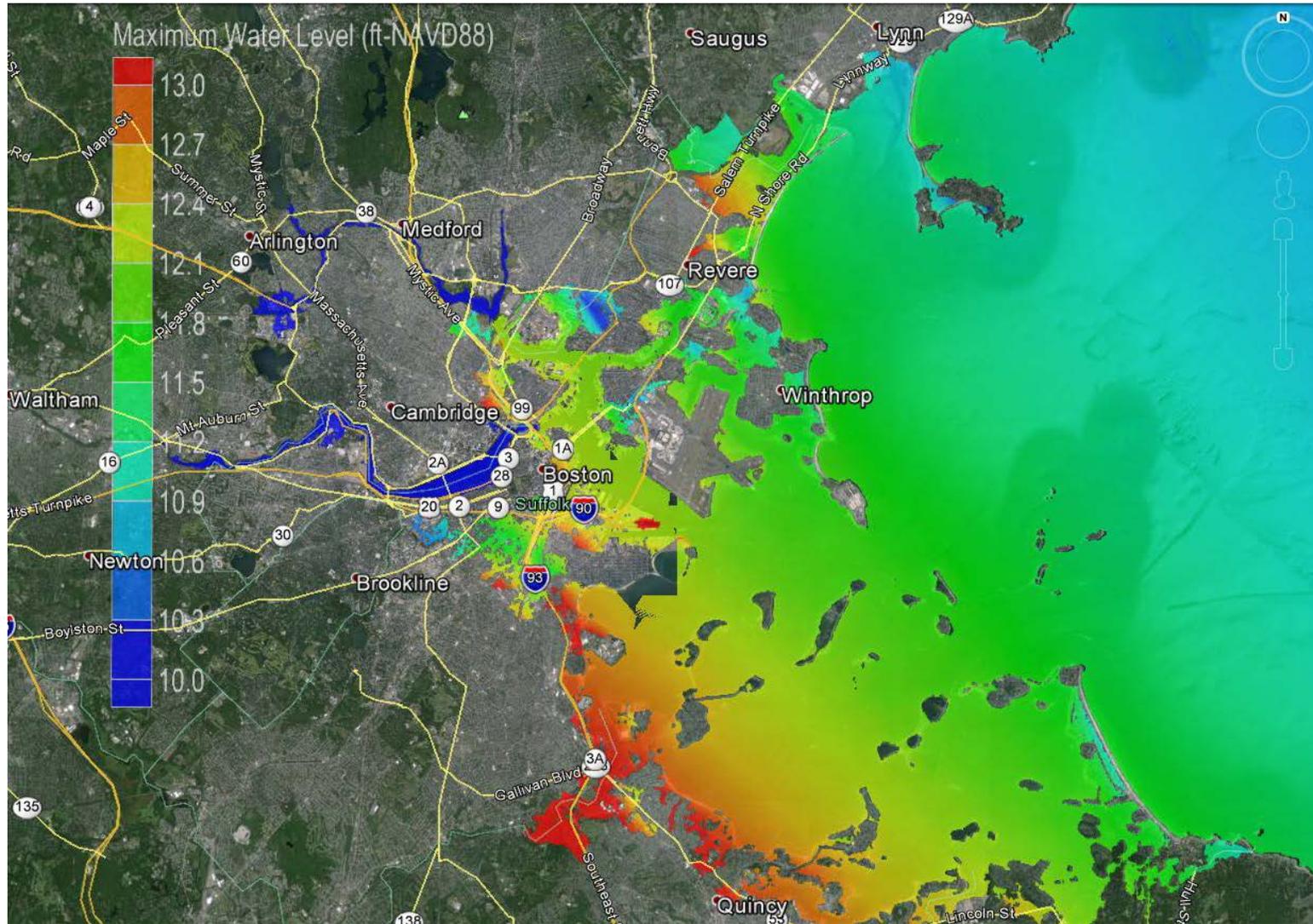
Hurricane Evacuation Maps

- **Worst possible scenario for emergency planning (worst storm at MHW)...no associated risk planning**
- **Coarse modeling domain results in local inaccuracies**
- **Does not include impacts of waves**
- **Just hurricanes**

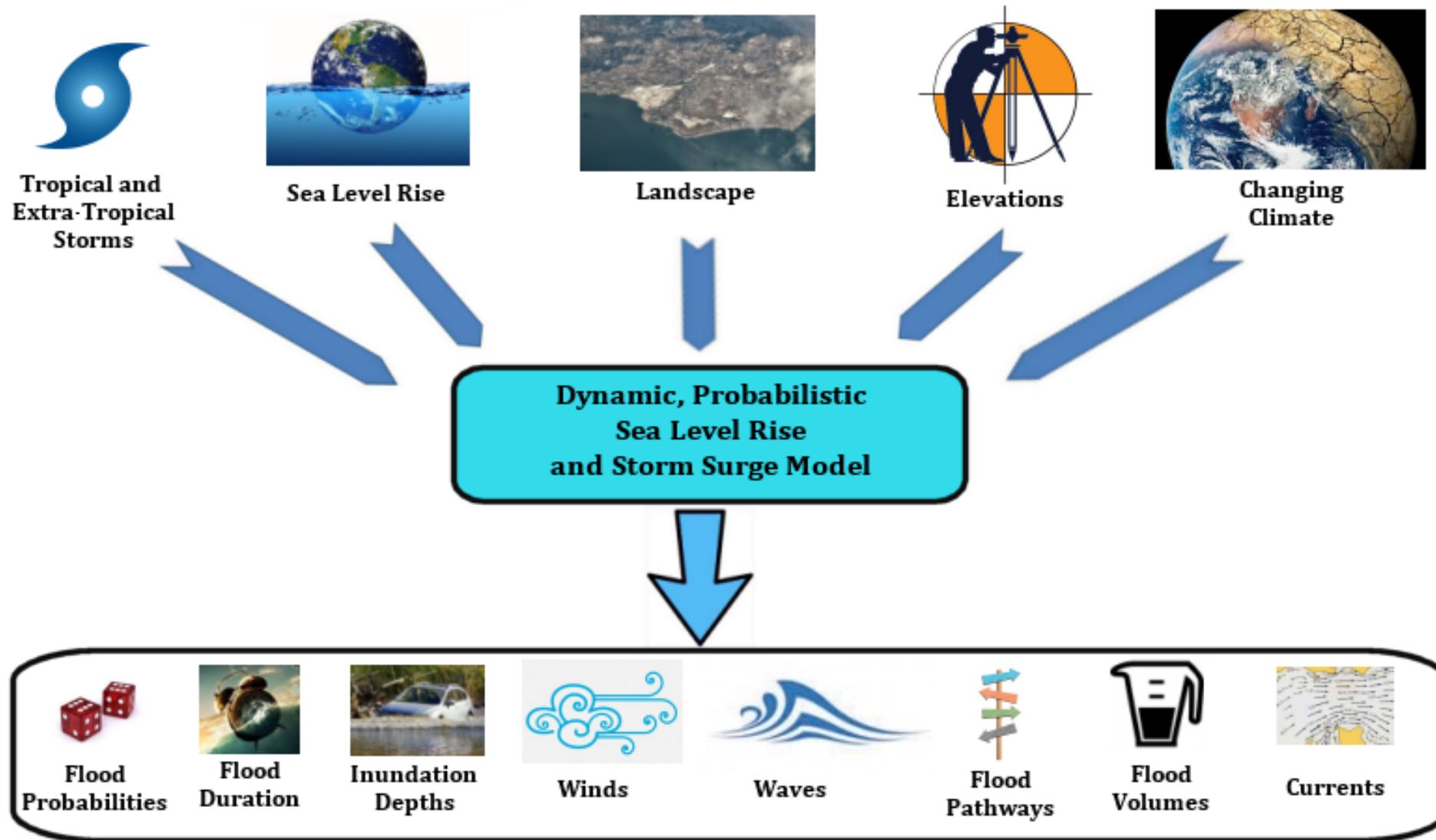
1. What is the probability of flooding?
2. What is vulnerable and what is the priority?
3. What interventions are available and what is the plan?



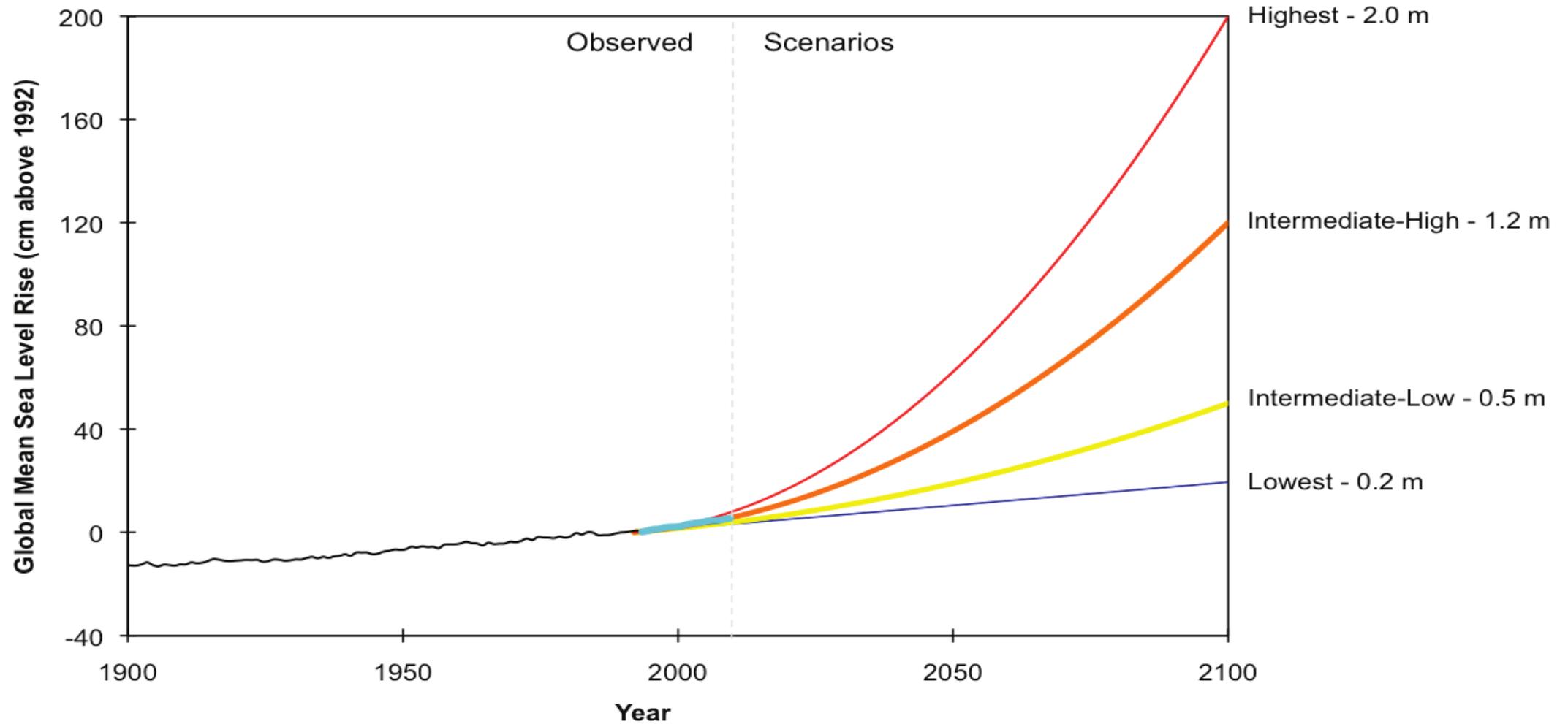
Sea Level Rise and Storm Surge



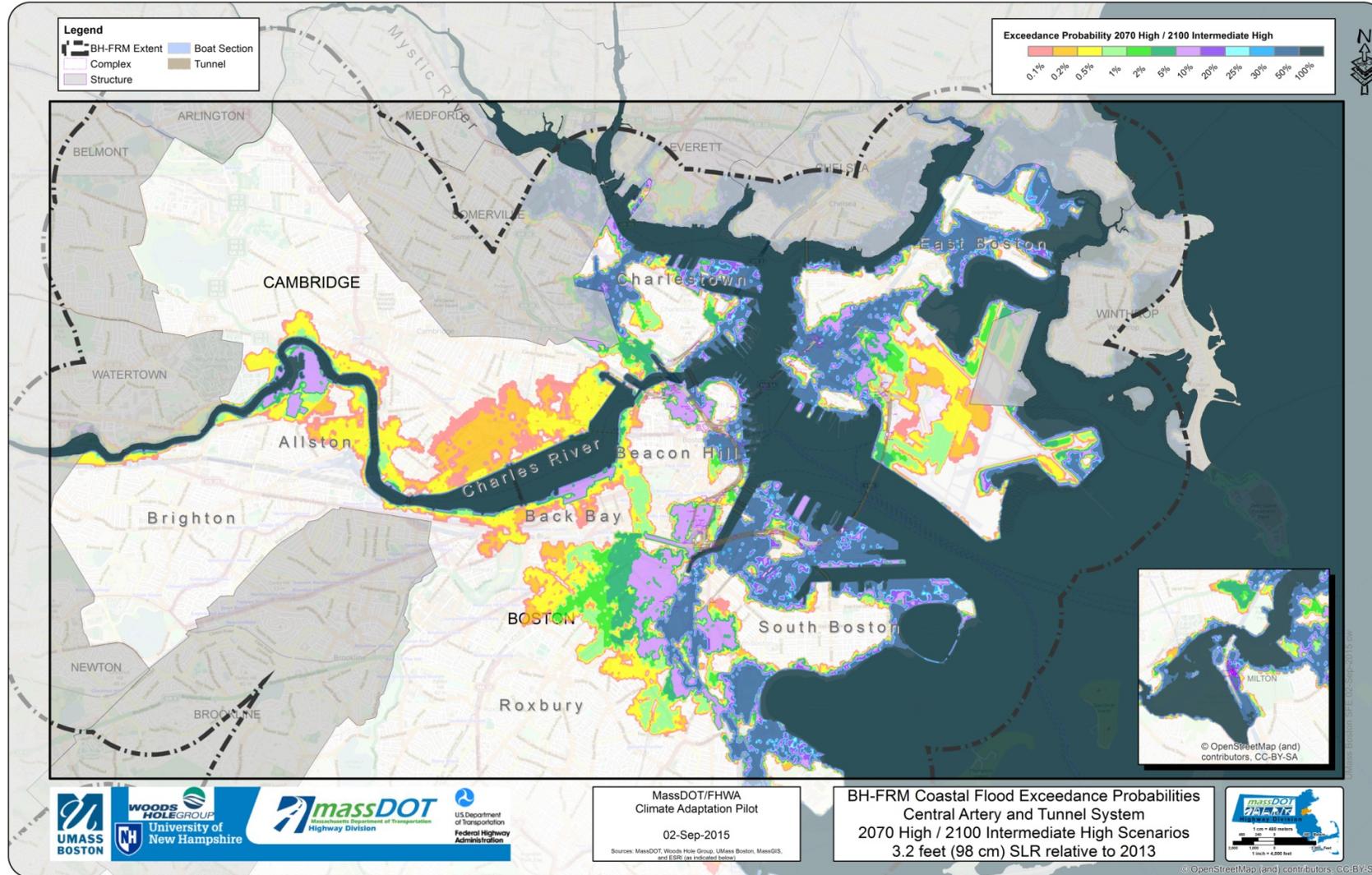
Dynamic Modeling



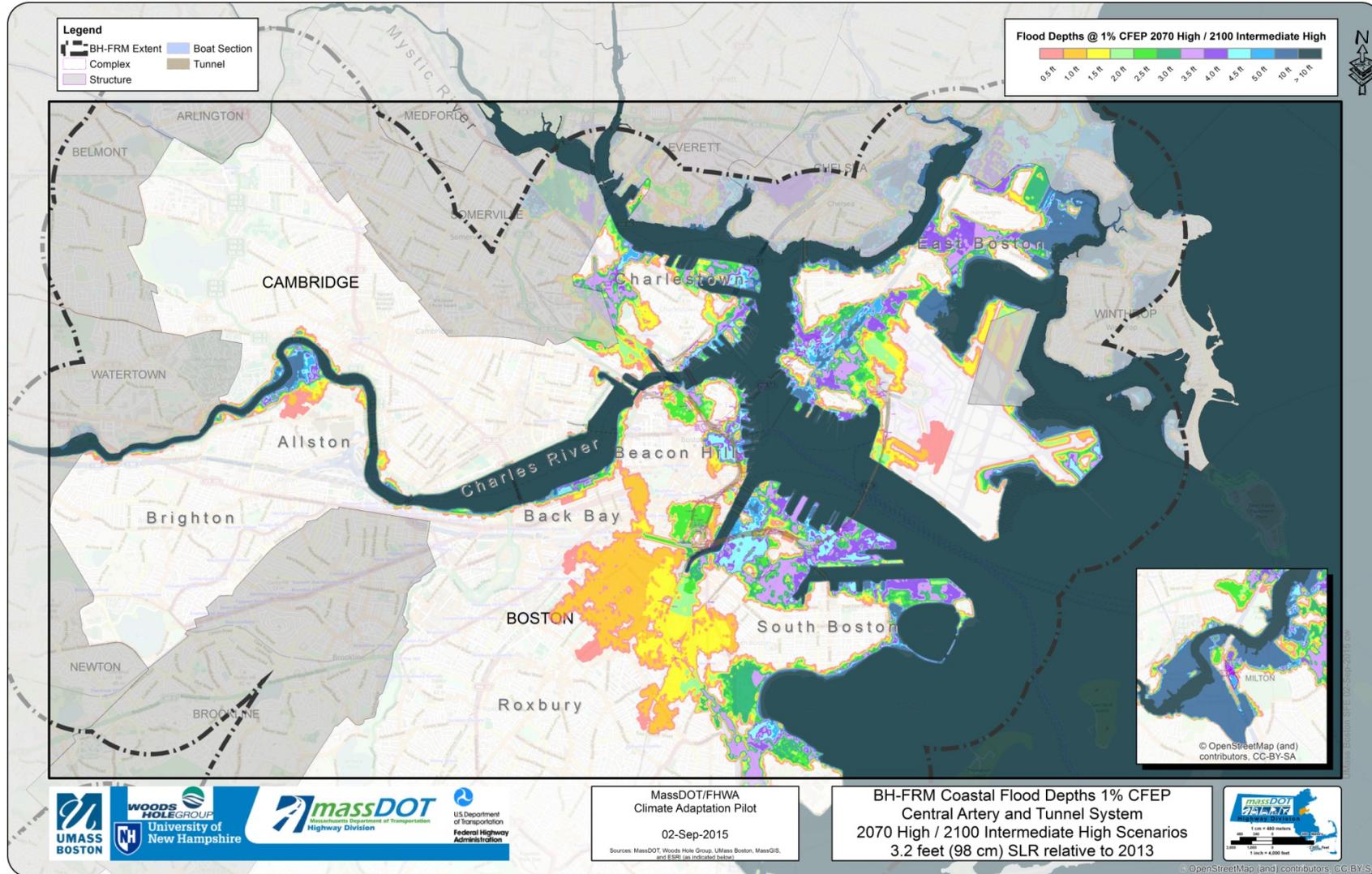
Determining the Sea Level Rise elevations



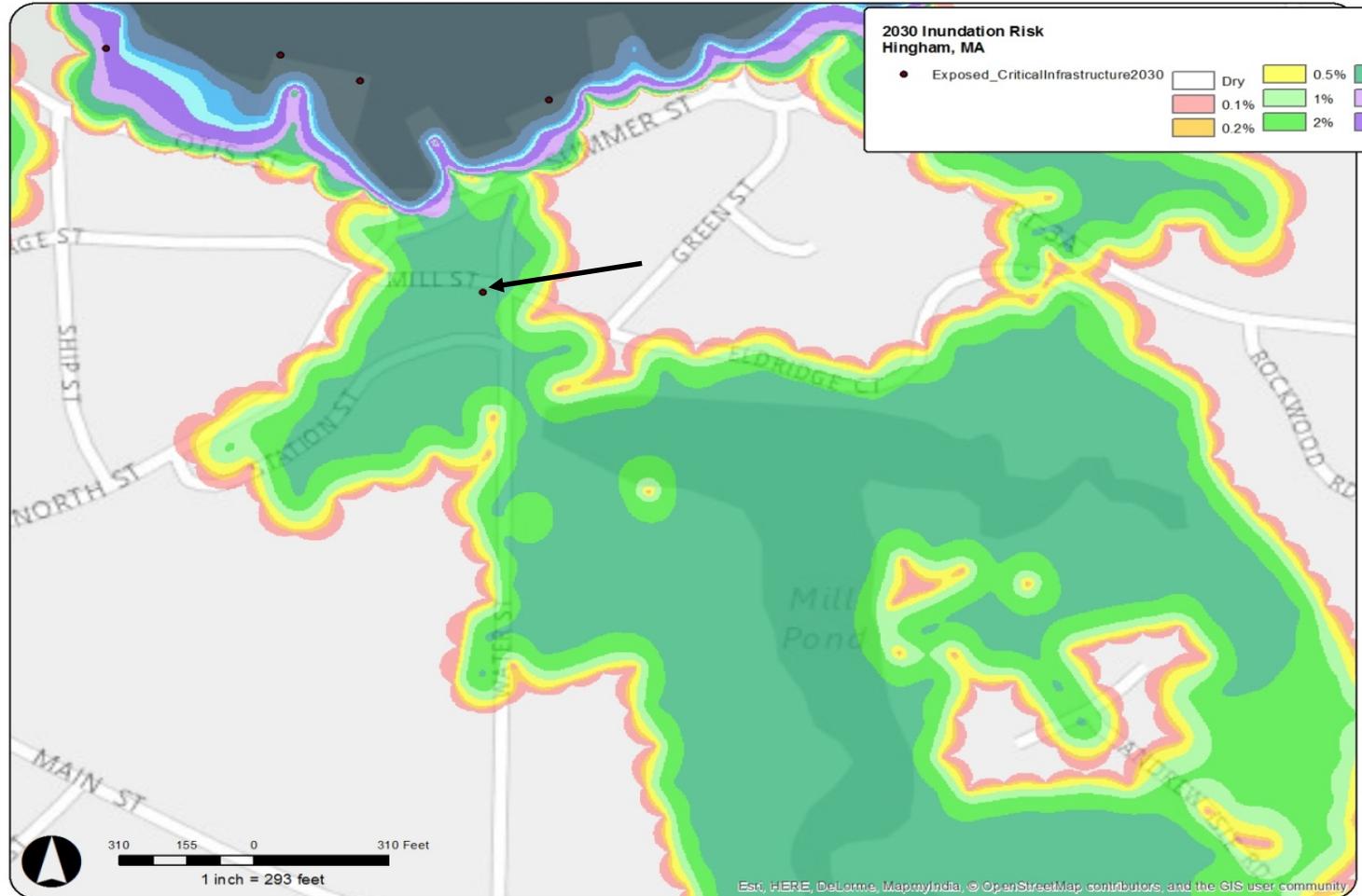
Probabilistic Mapping



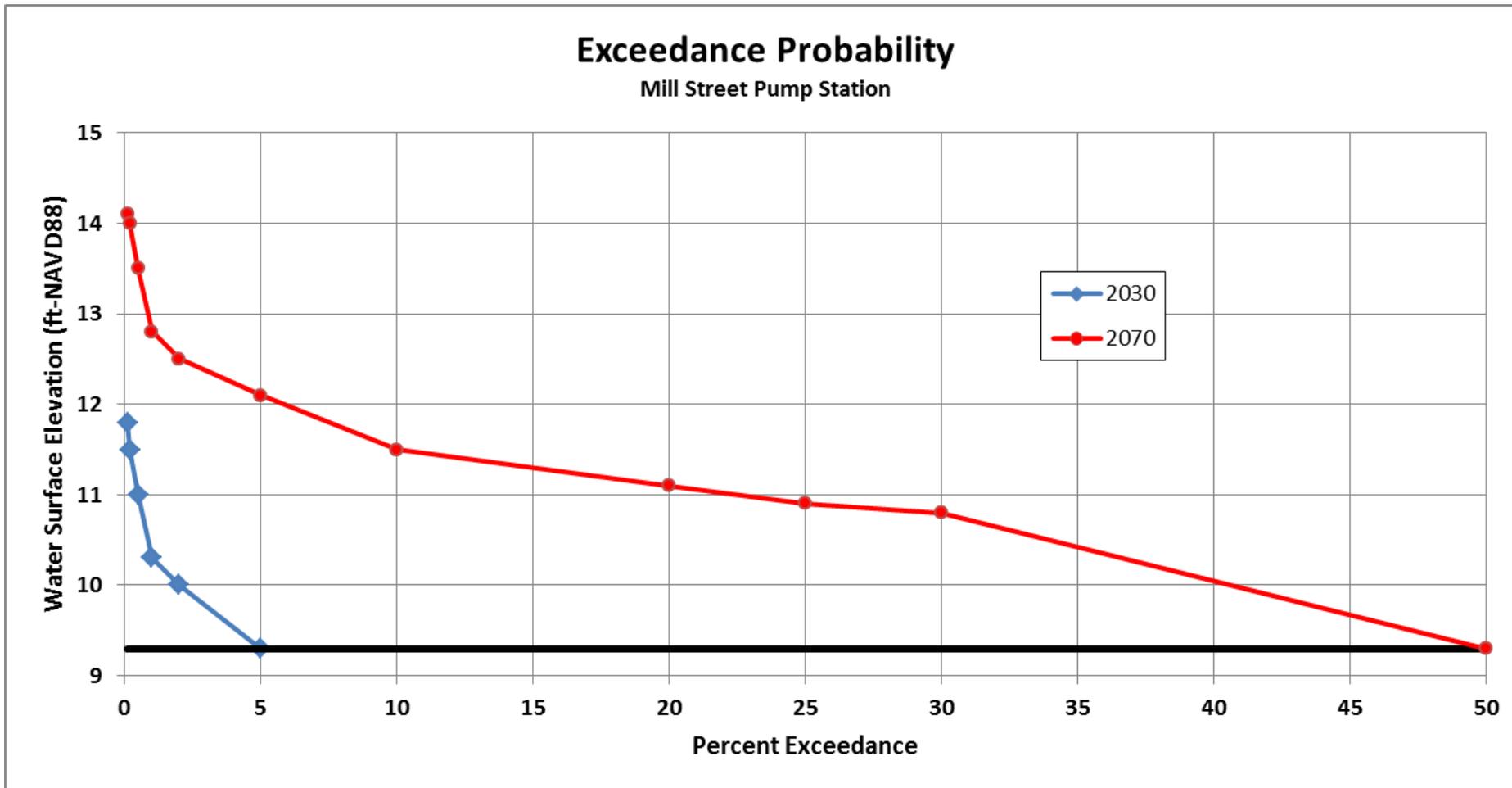
Probabilistic Mapping



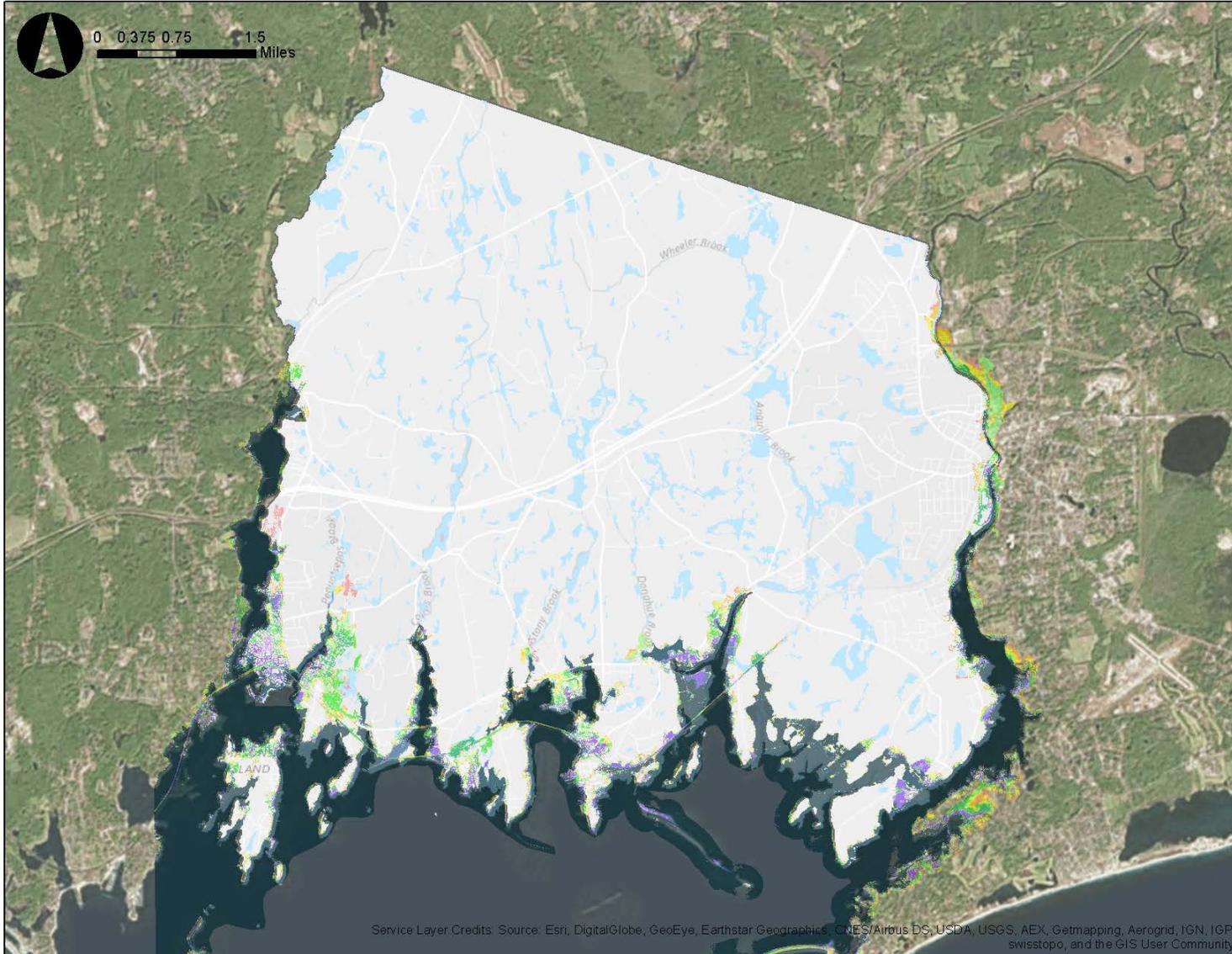
Local Engineering Assessment



Local Engineering Assessment

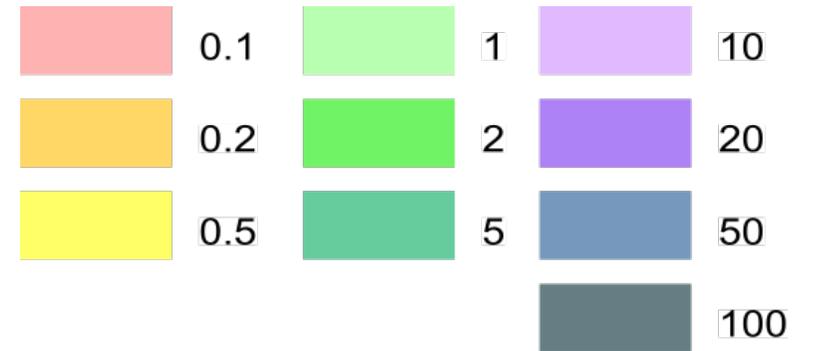


Stonington – 2030 Probability

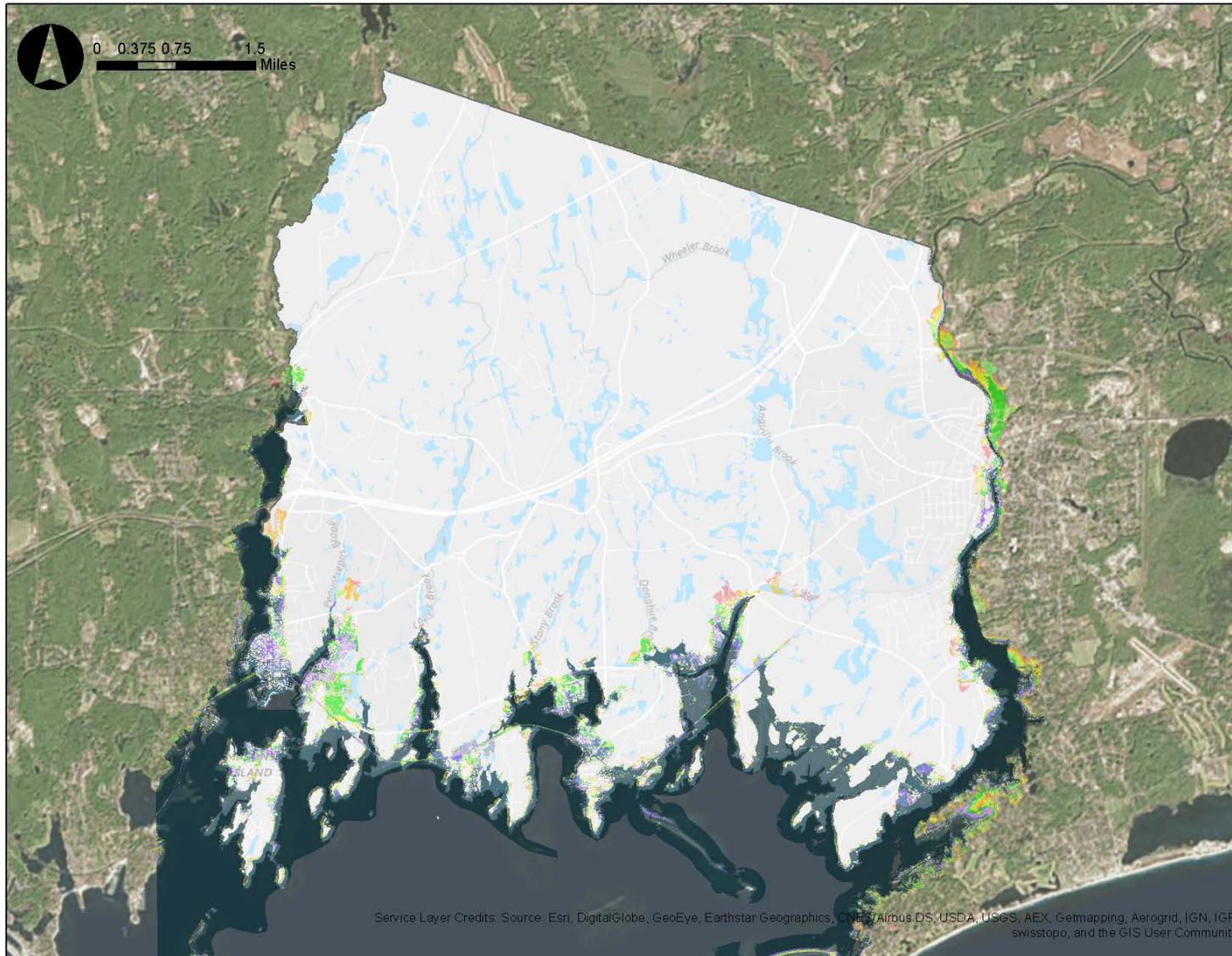


Legend

% Annual Chance of Flooding

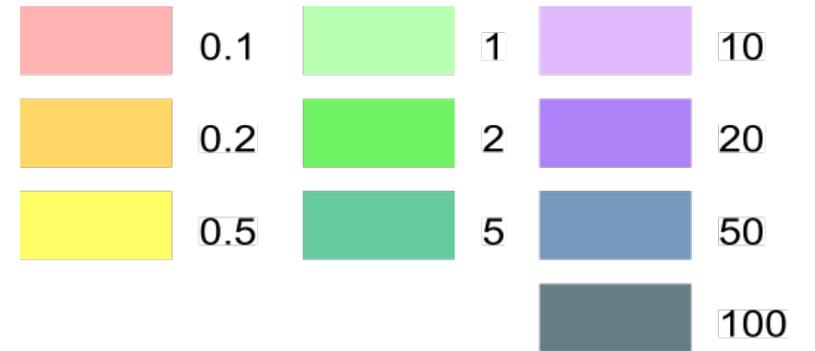


Stonington – 2050 Probability

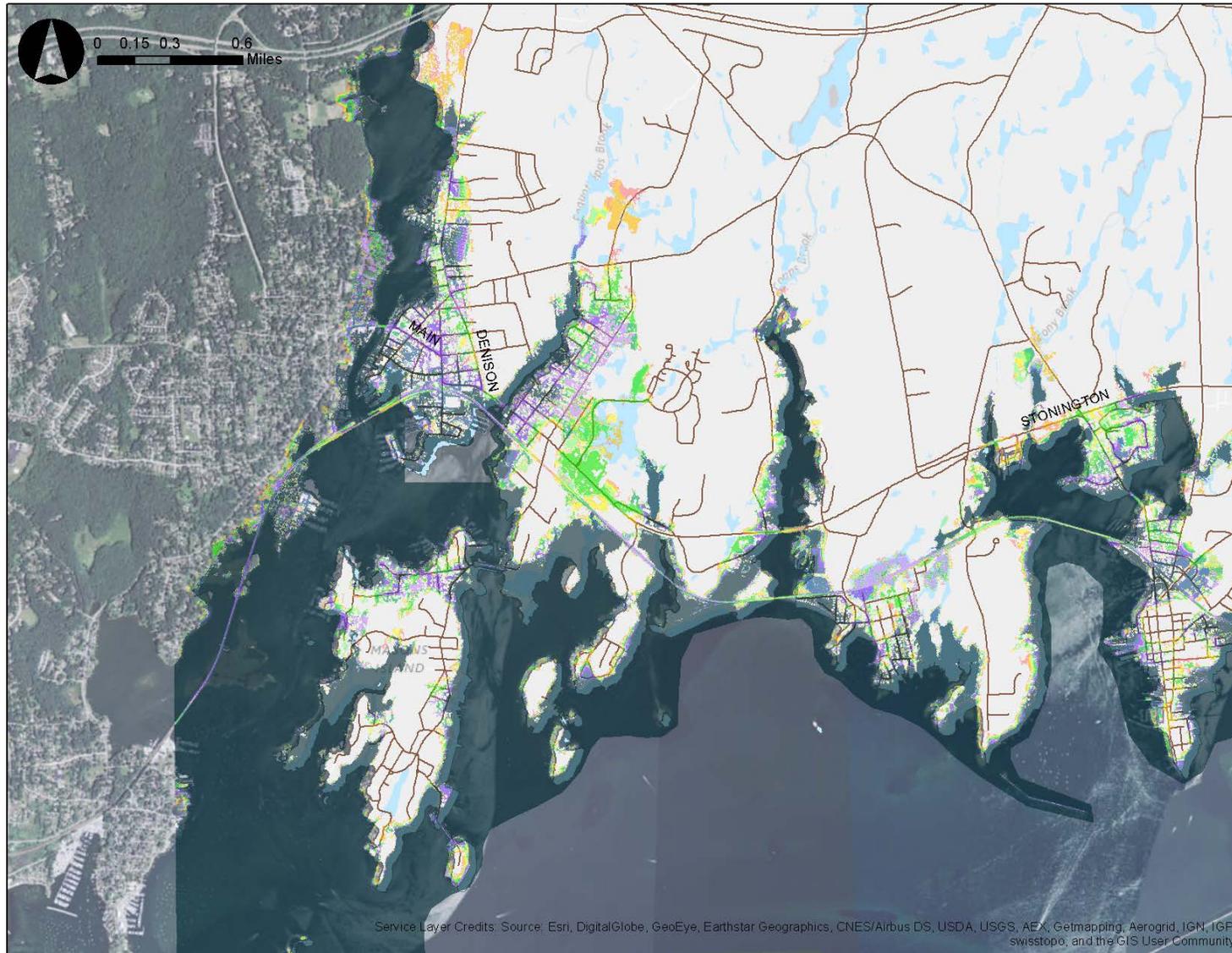


Legend

% Annual Chance of Flooding

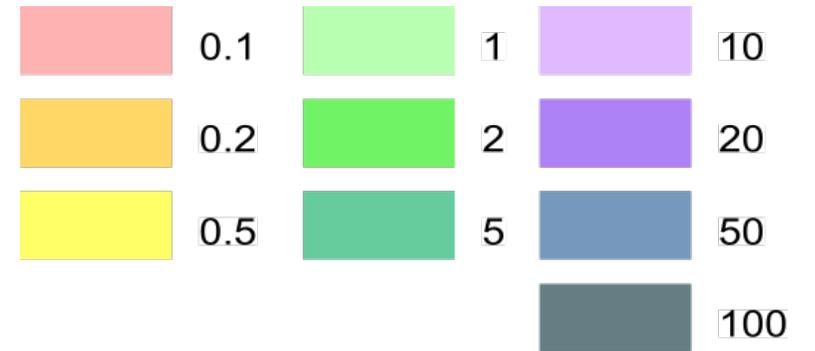


2050 Flooding Probability - Mystic Area

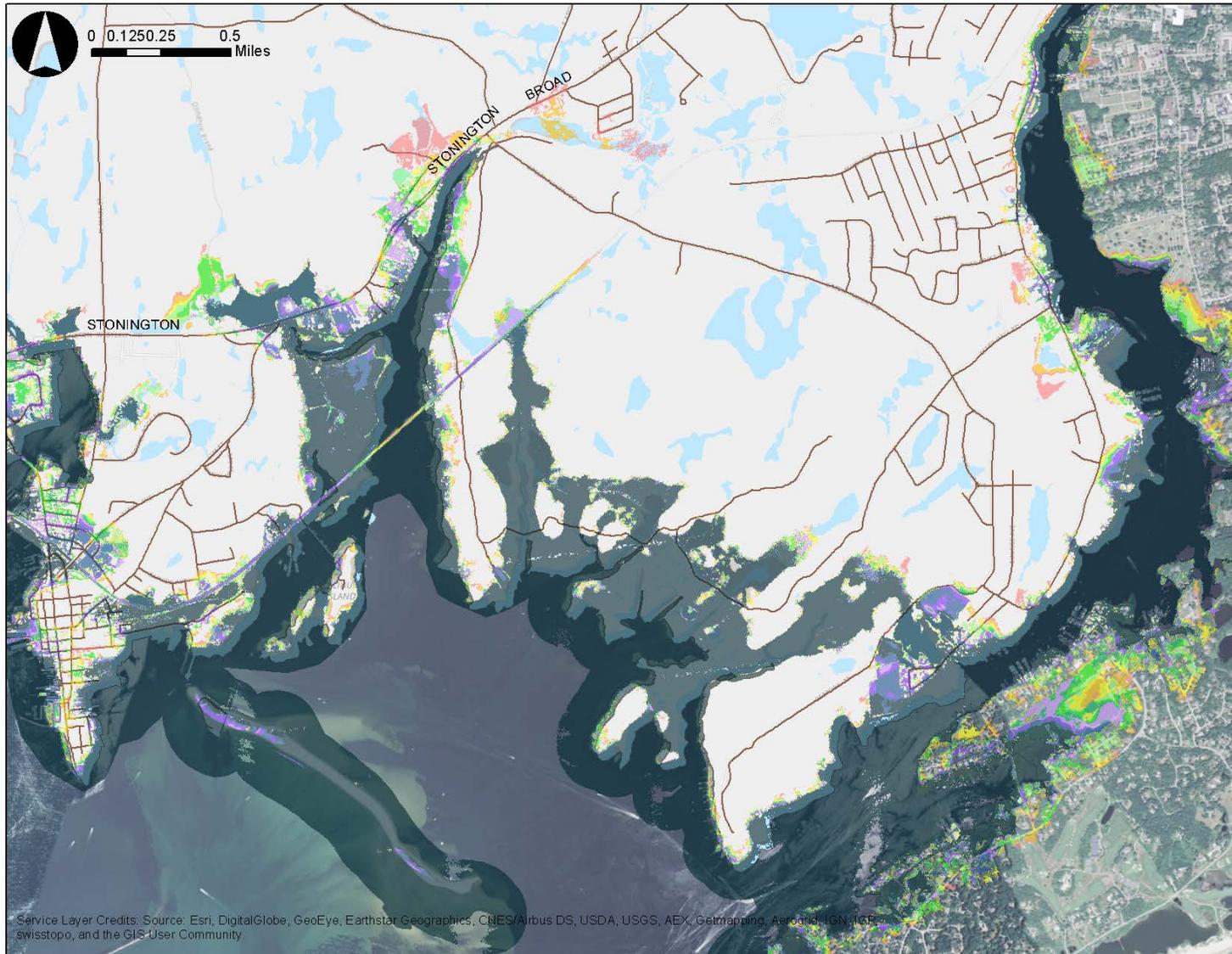


Legend

% Annual Chance of Flooding

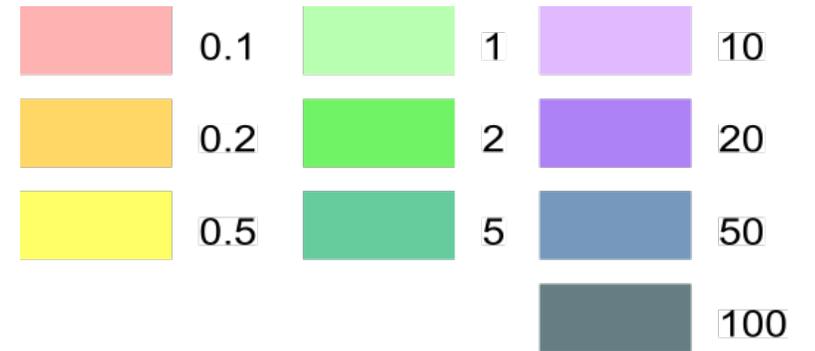


2050 Flooding Probability – Lower Pawcatuck Area

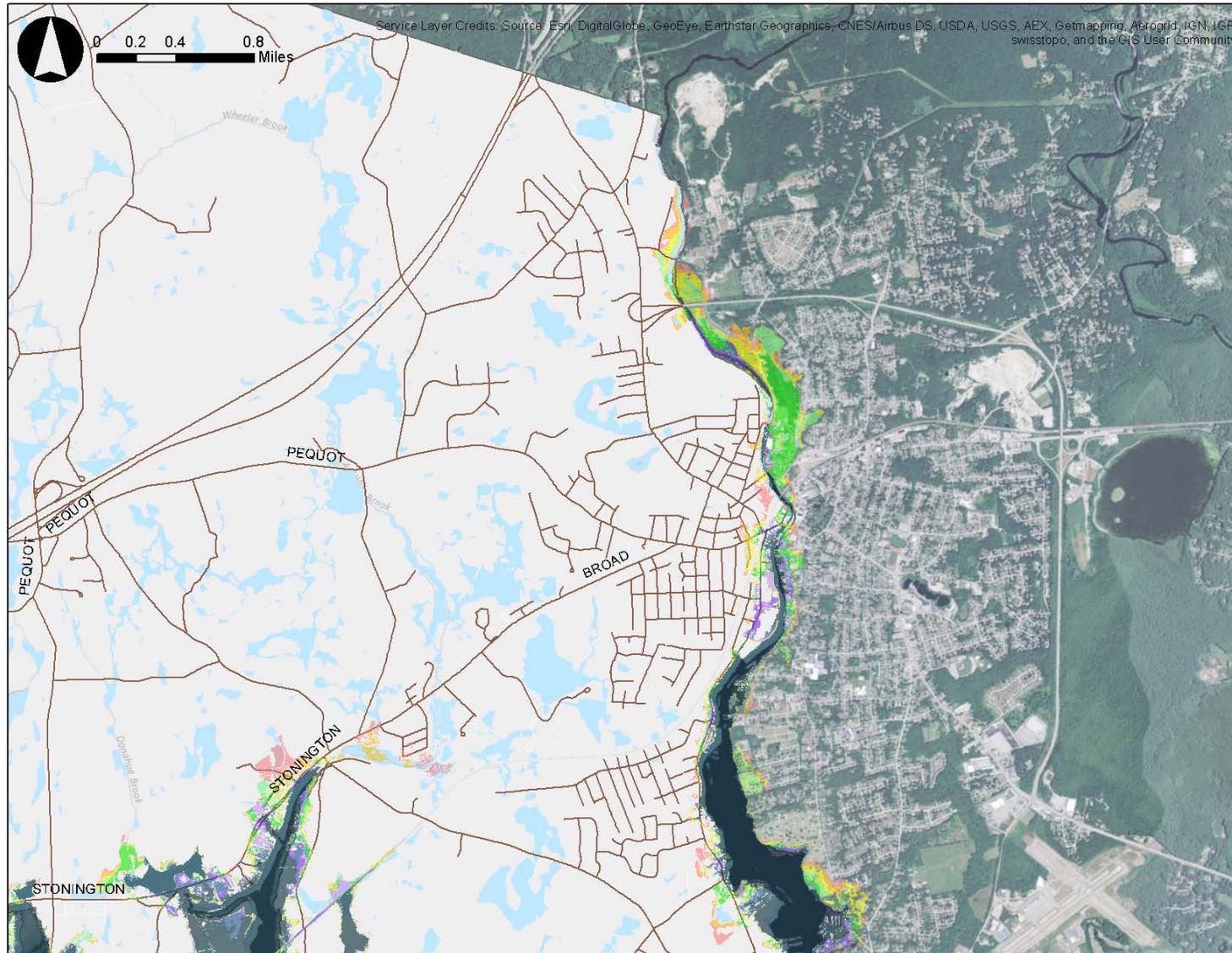


Legend

% Annual Chance of Flooding

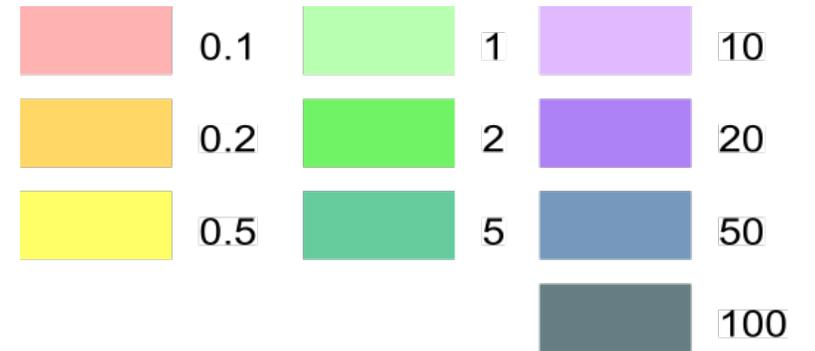


2050 Flooding Probability – Upper Pawcatuck Area

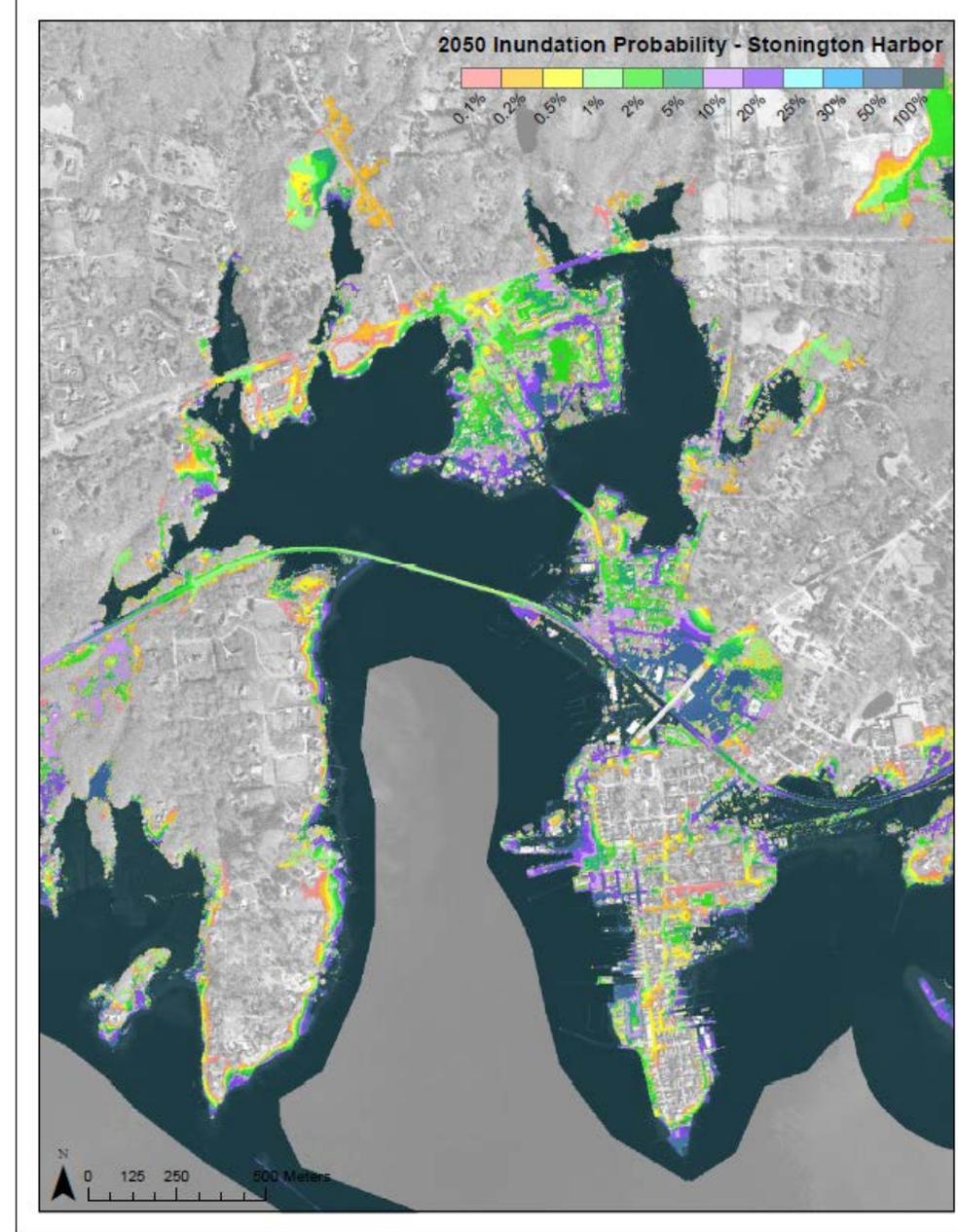
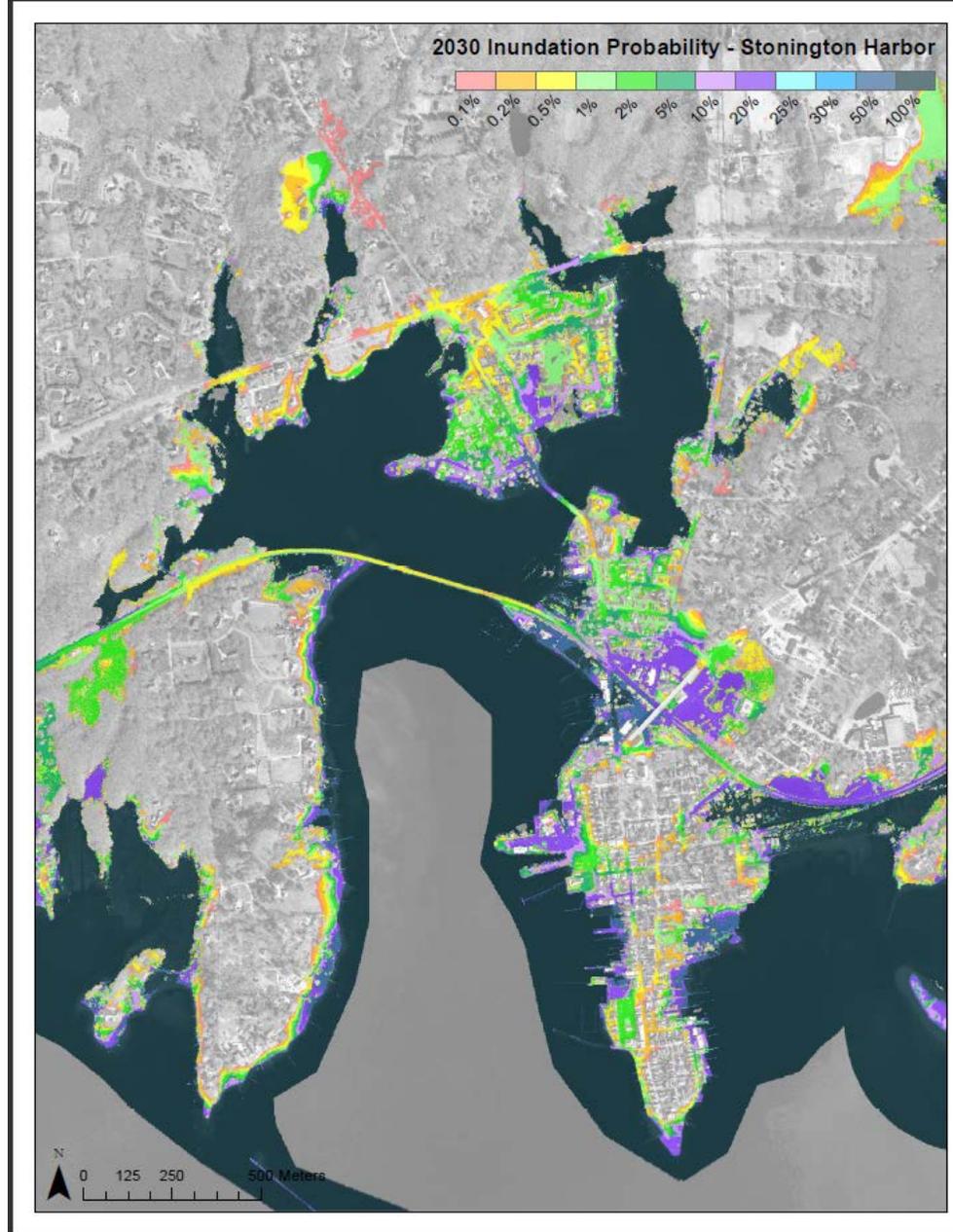


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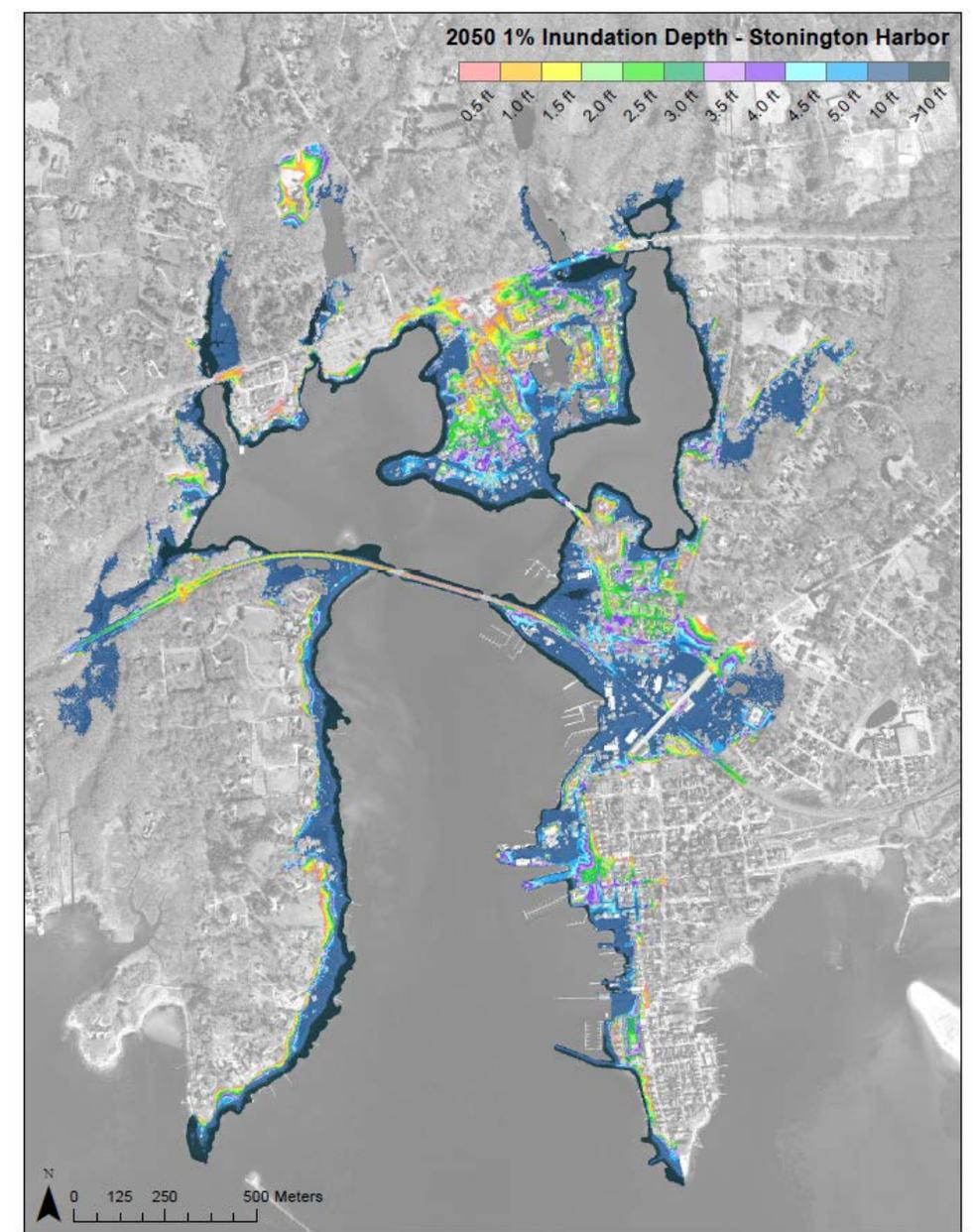
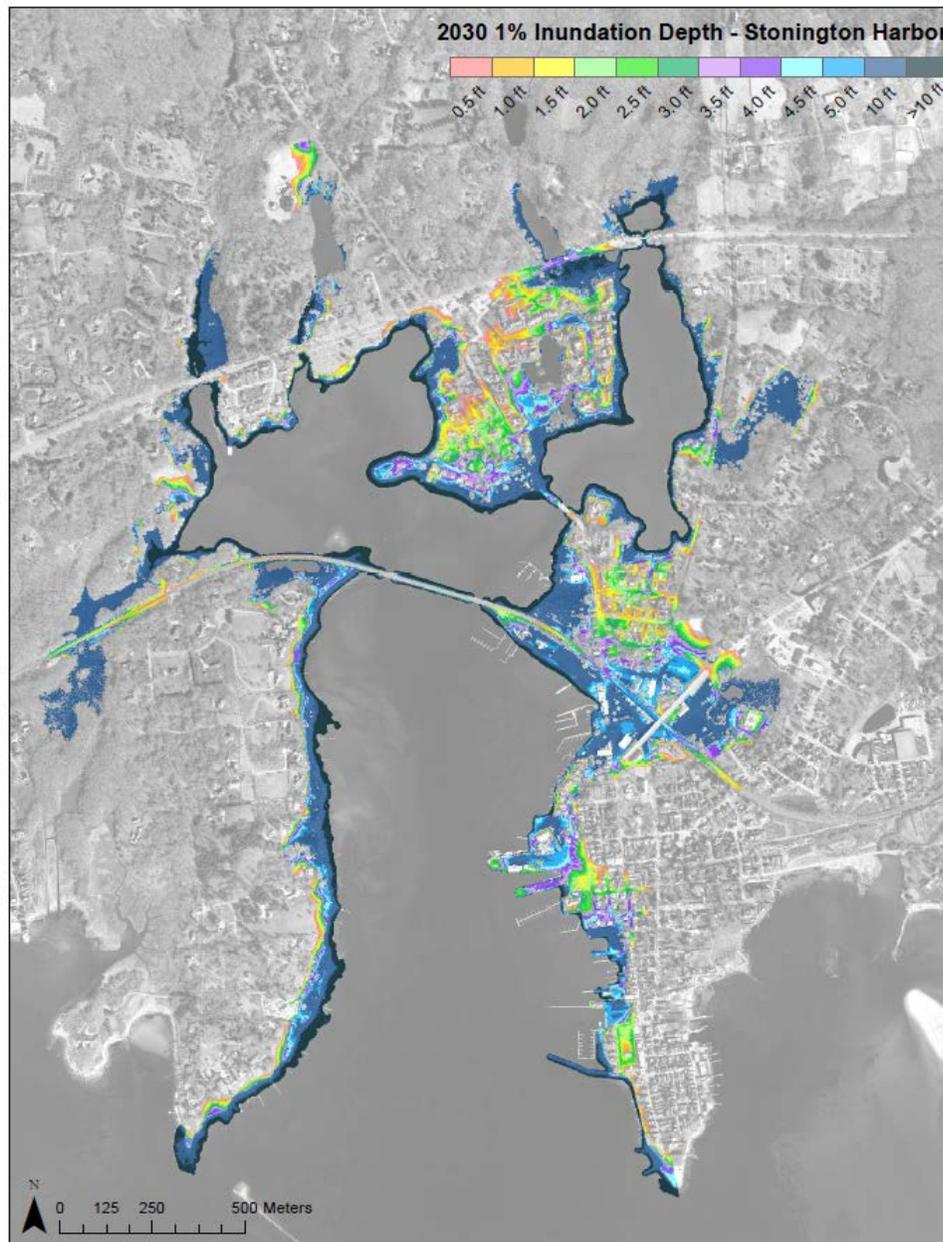
% Annual Chance of Flooding



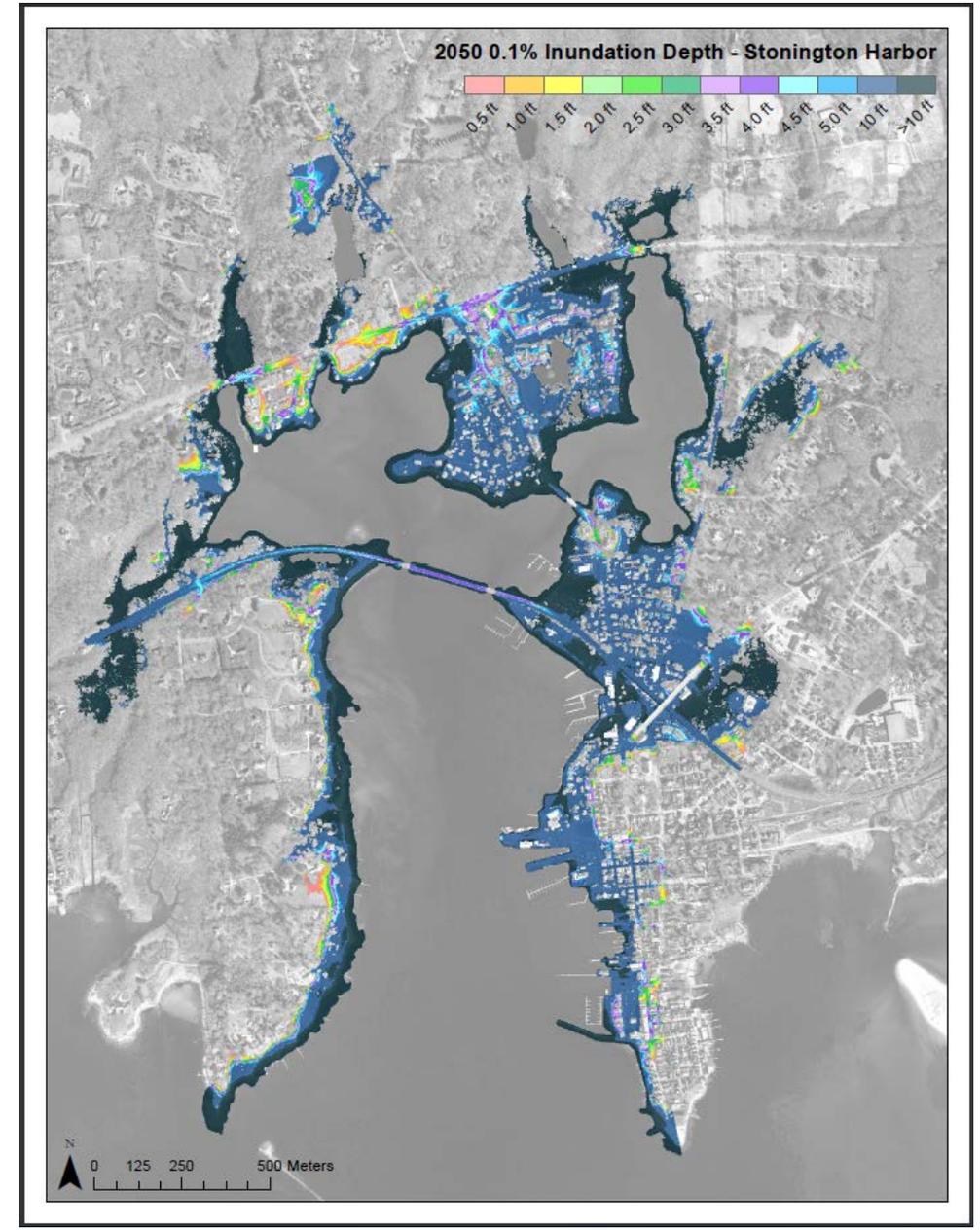
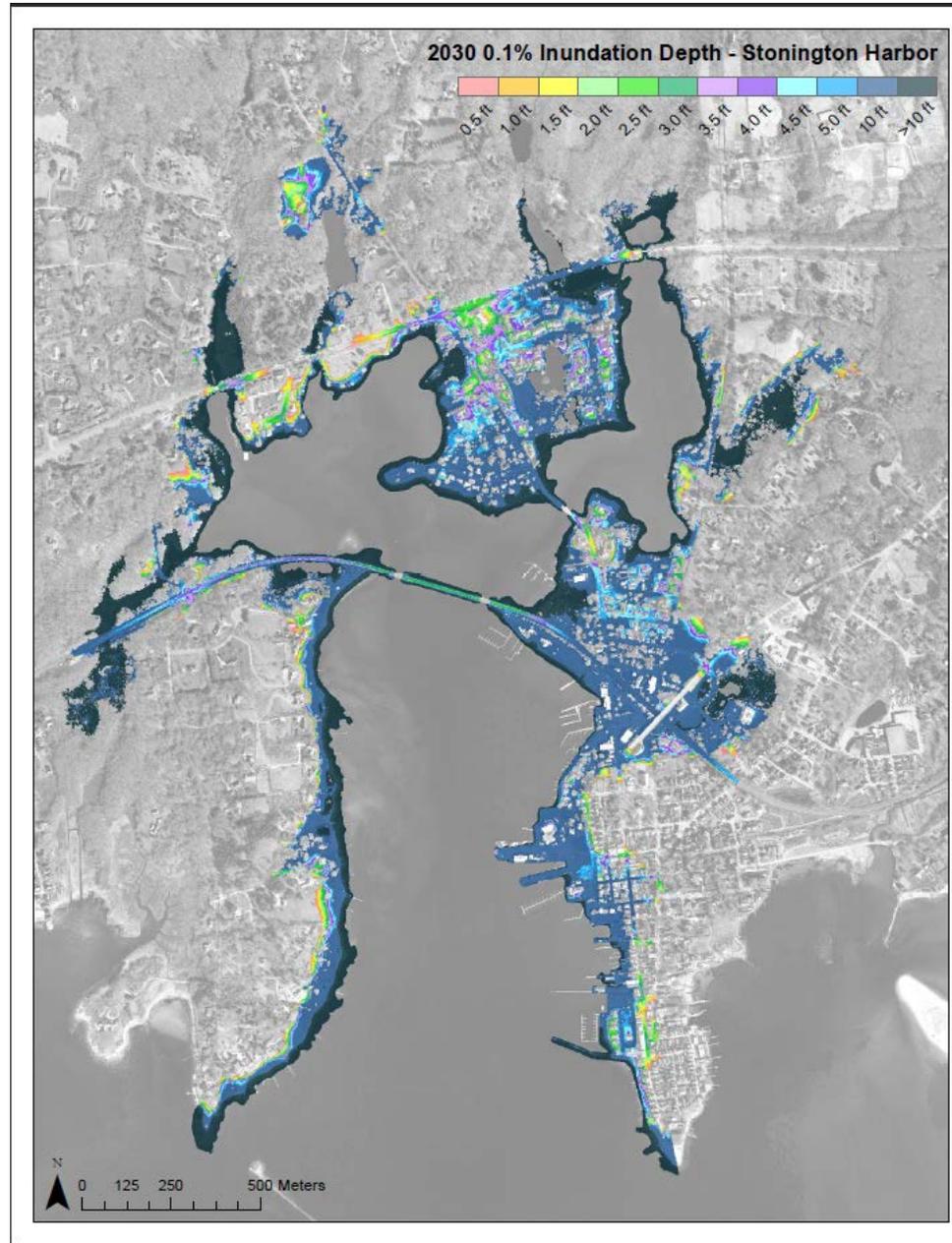
Stonington Harbor - Probability



Stonington Harbor - 1% Depth

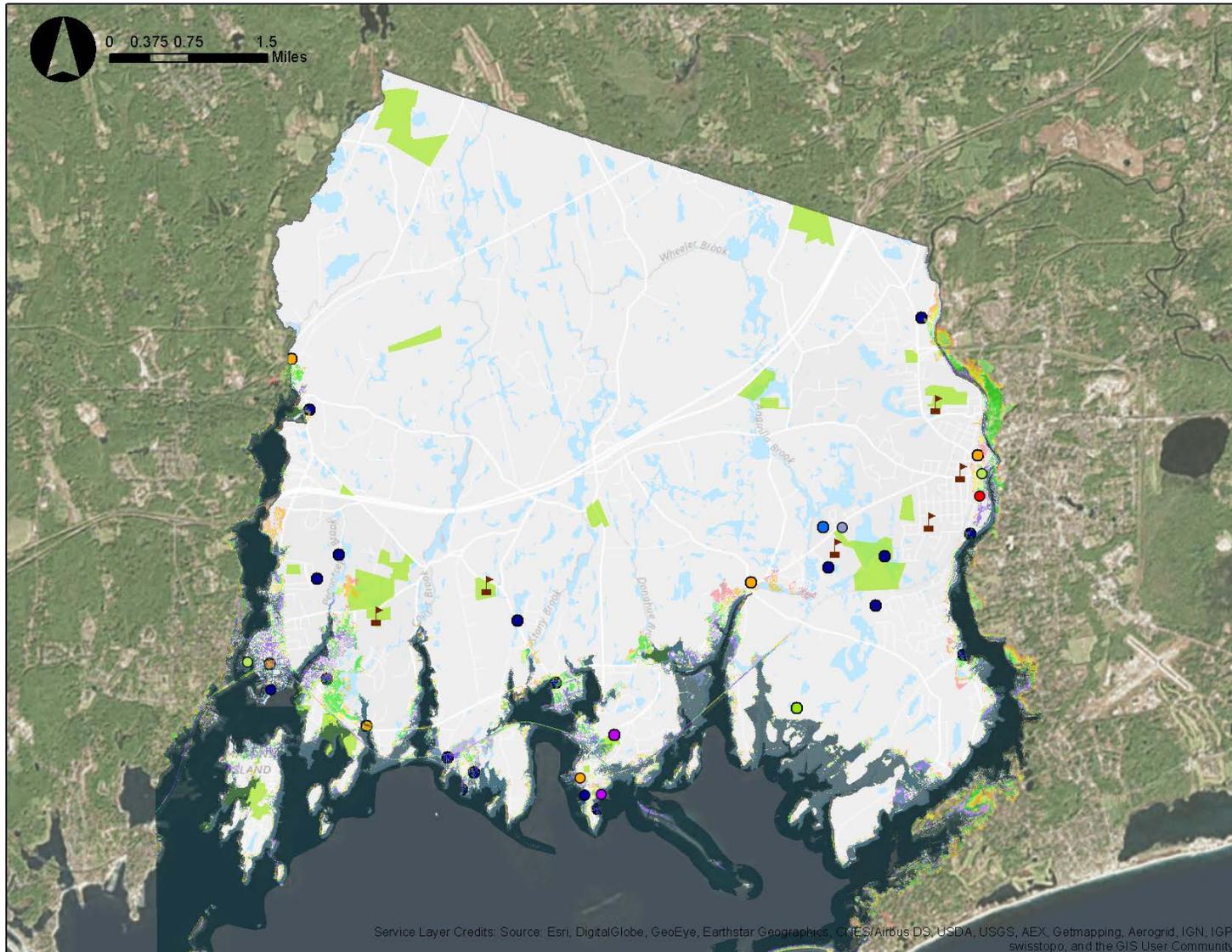


Stonington Harbor - 0.1% Depths



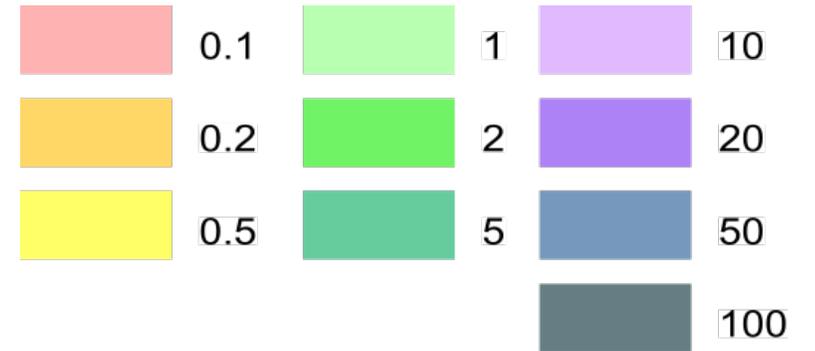
Vulnerability Assessment: Preliminary Results

Public Infrastructure



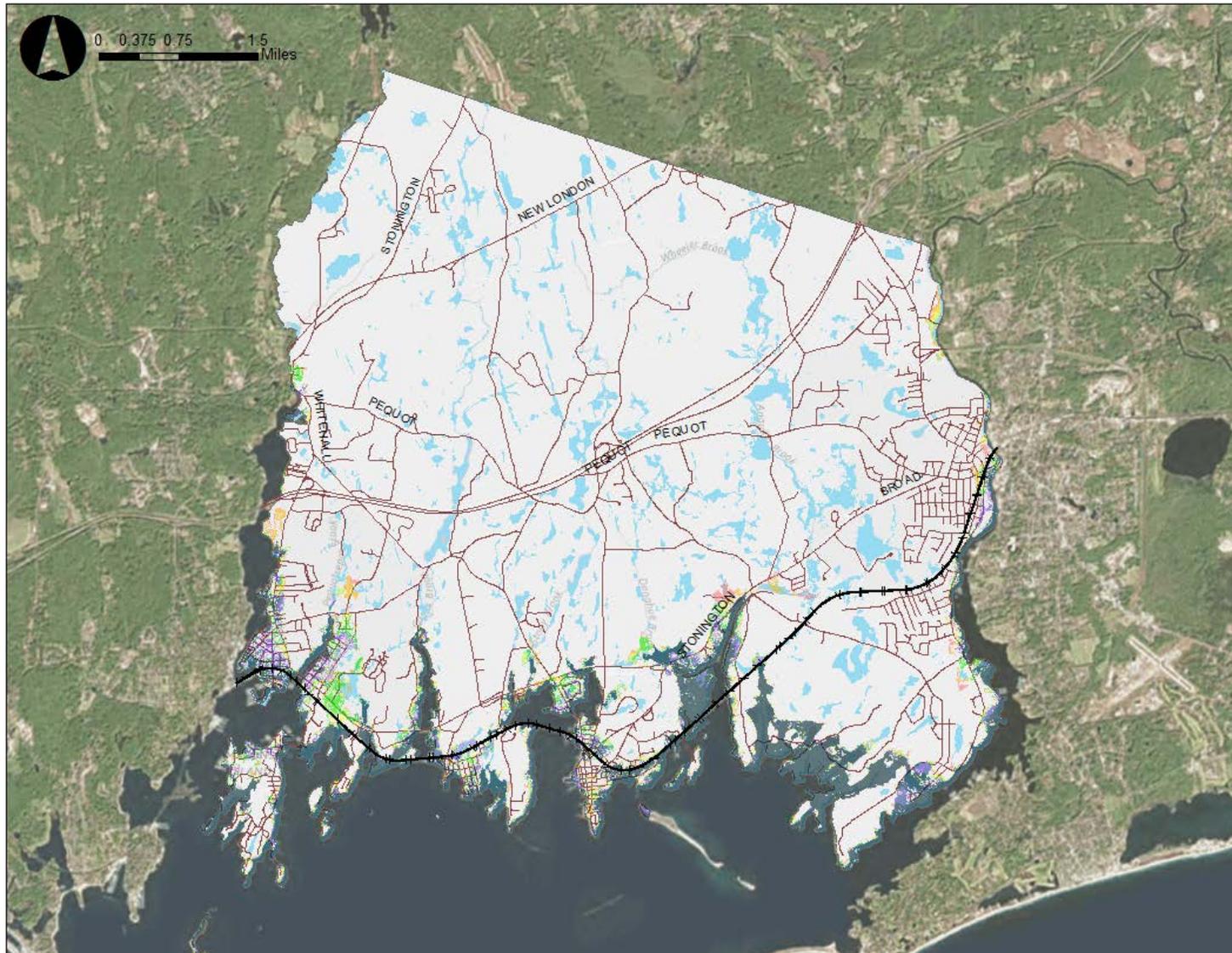
Legend

% Annual Chance of Flooding



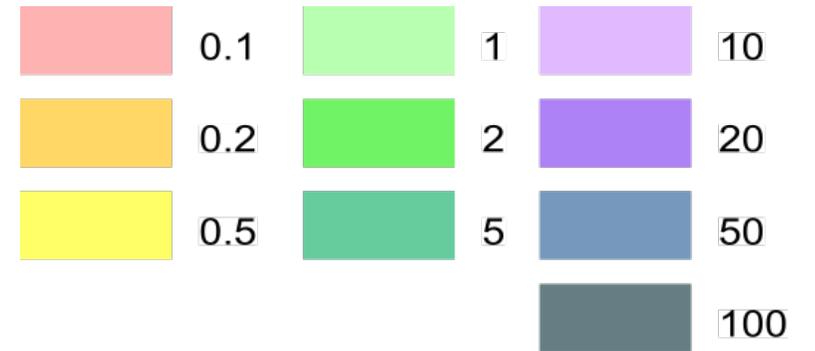
-  Pump Station & Treatment Plant
-  Fire Station
-  Police Station
-  Park
-  Town and Borough Hall
-  School
-  Human Services Building
-  Senior Center

Transportation



Legend

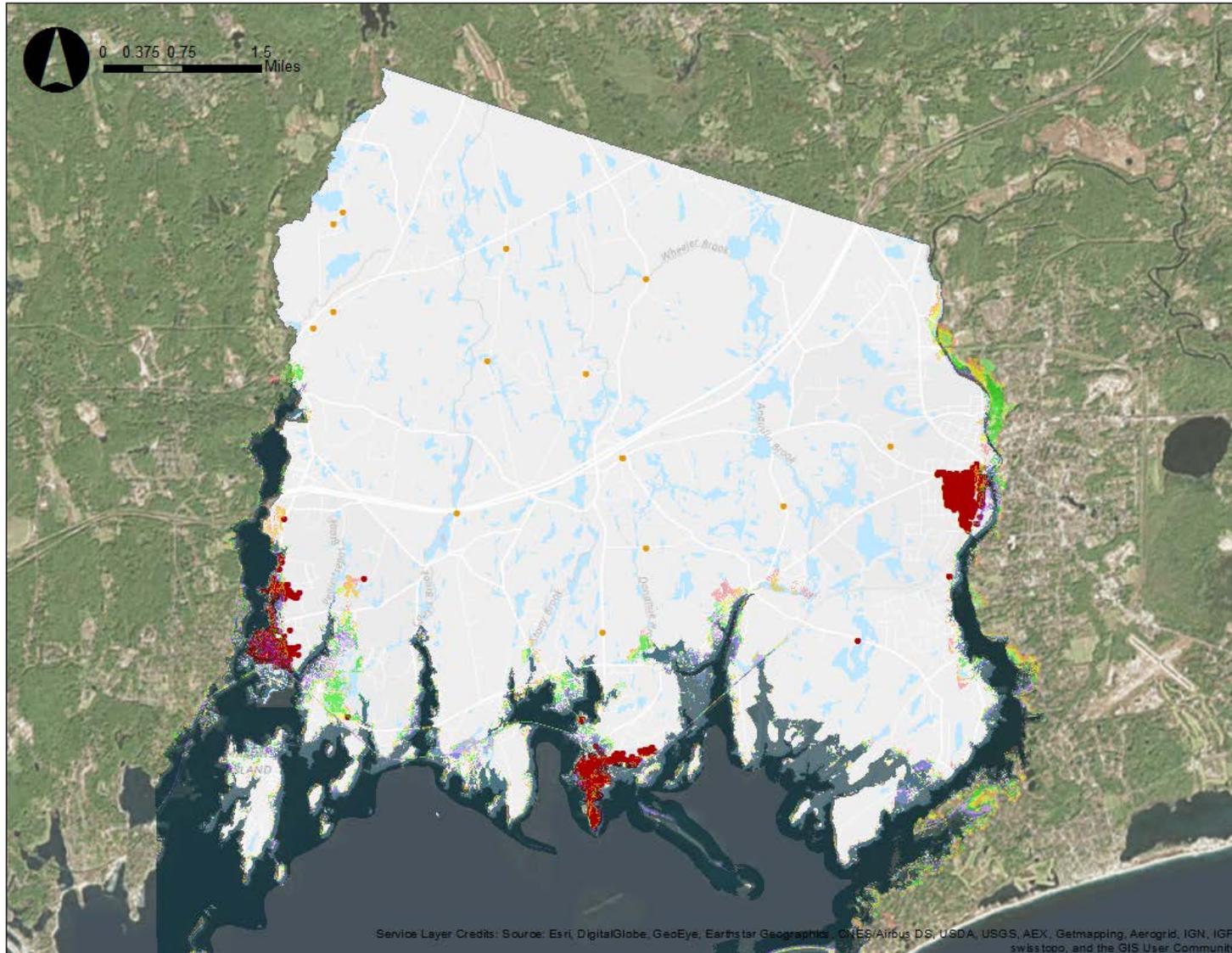
% Annual Chance of Flooding



 Road

 Railroad

Cultural Resources



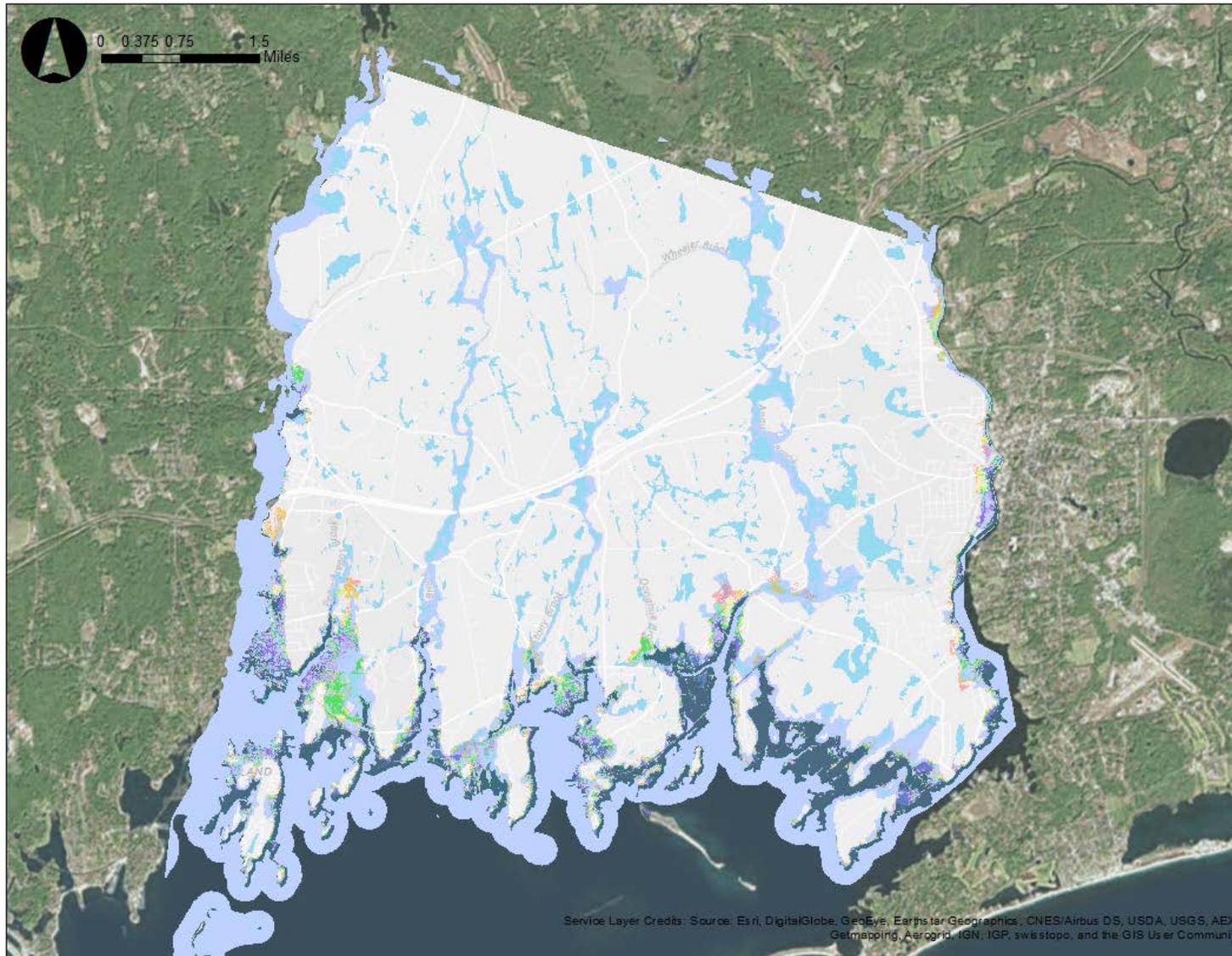
Legend

% Annual Chance of Flooding



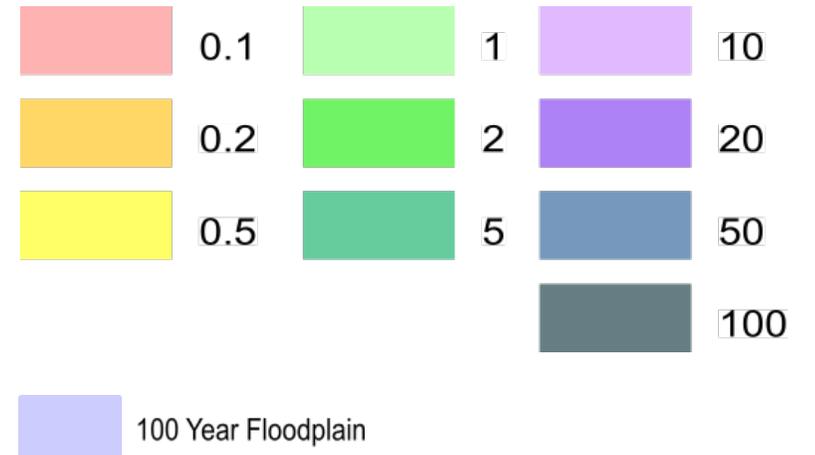
-  National Register Structures
-  State Register Structures
-  Local Register Structures

FEMA – Current Flood Zones

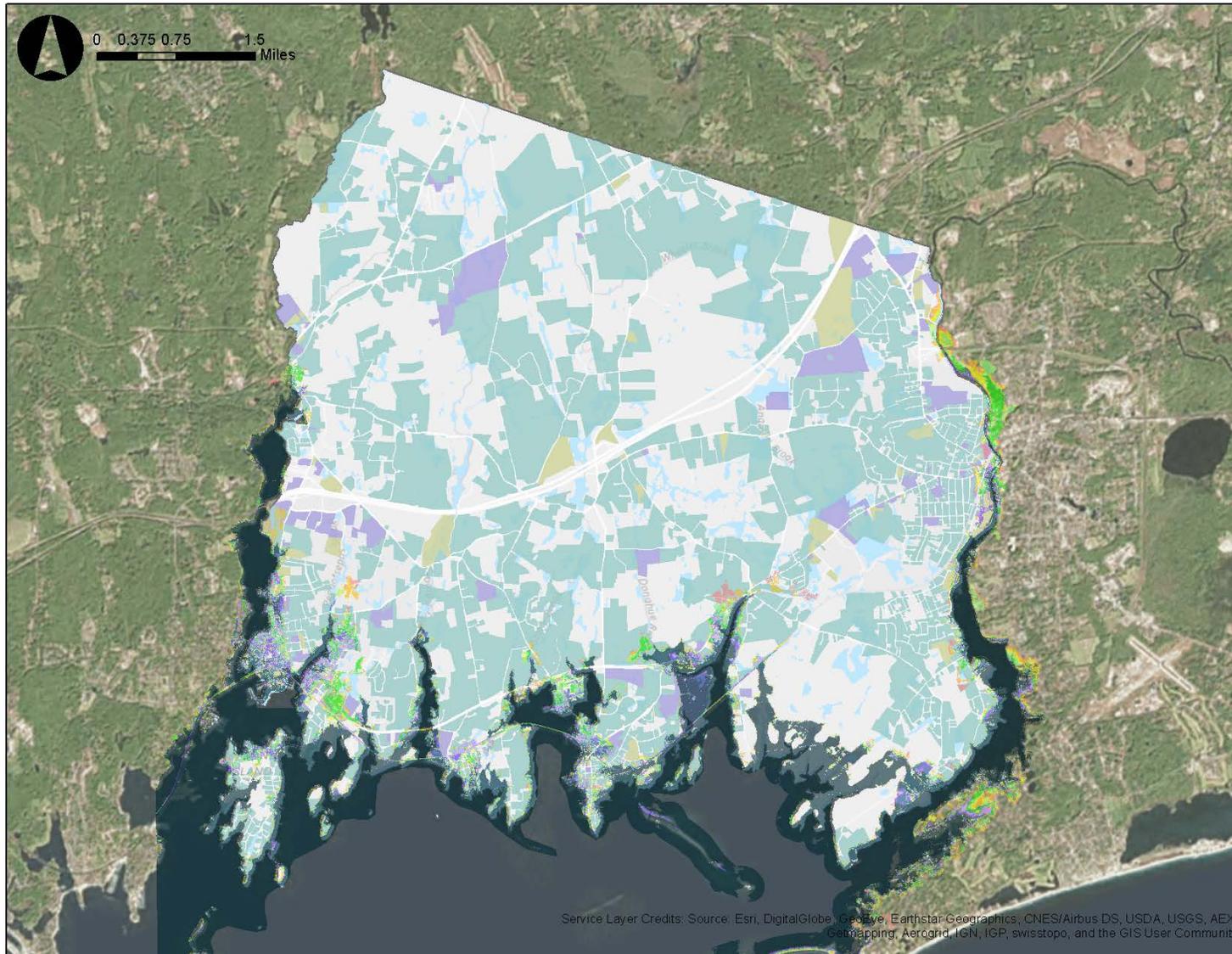


Legend

% Annual Chance of Flooding

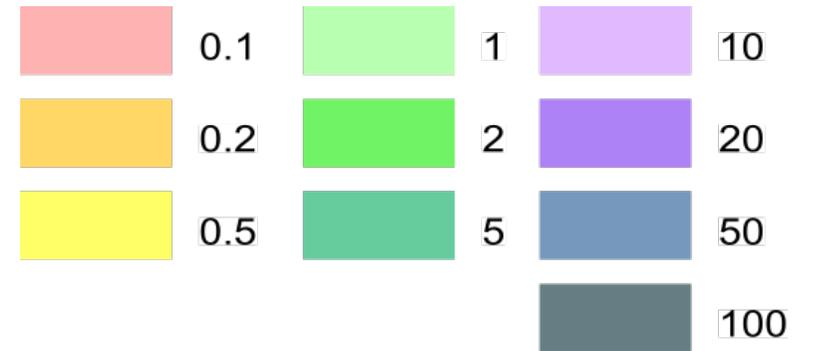


Major Land Uses

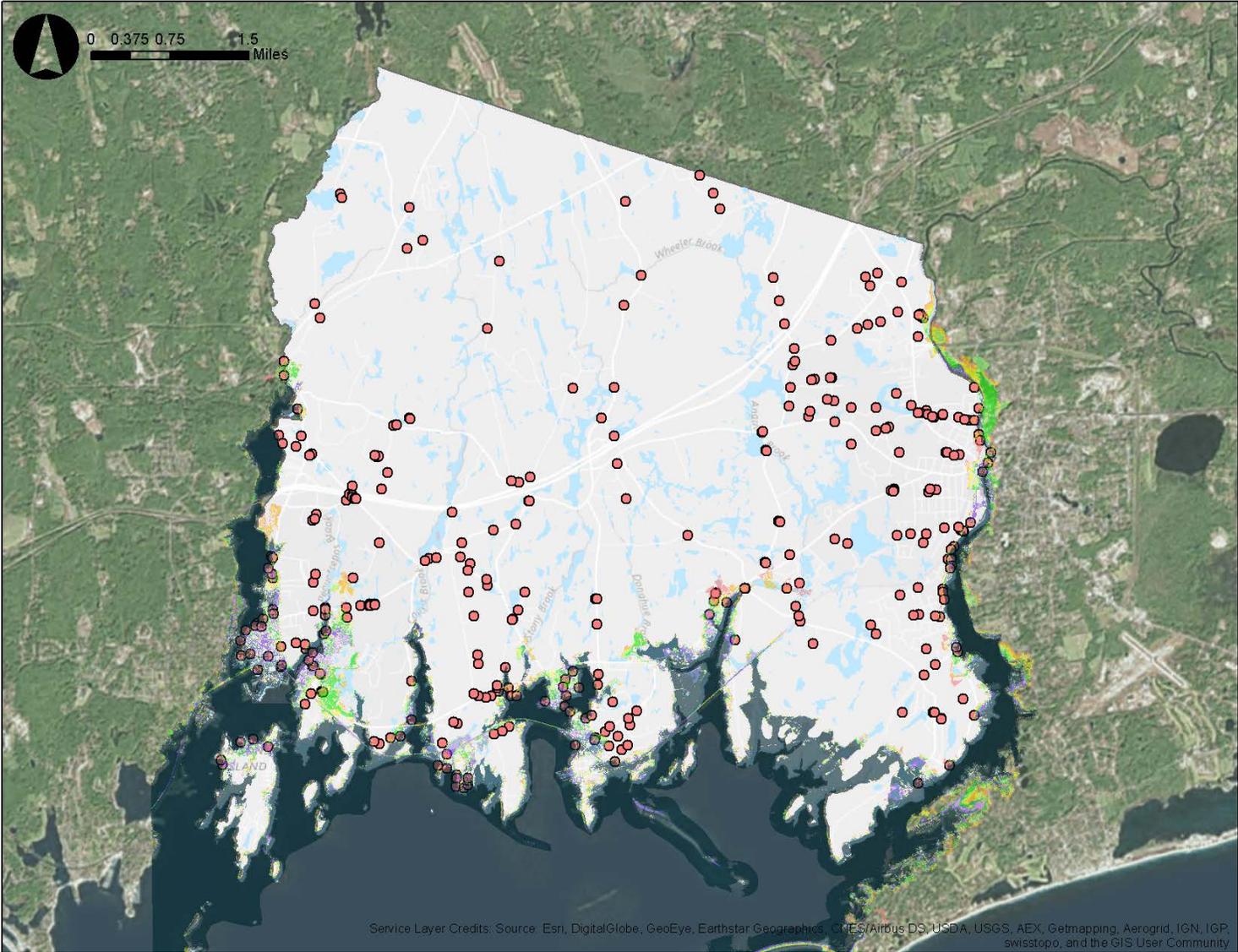


Legend

% Annual Chance of Flooding

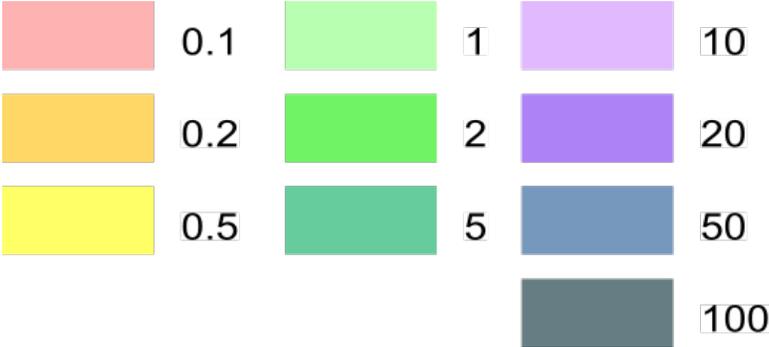


Outfalls



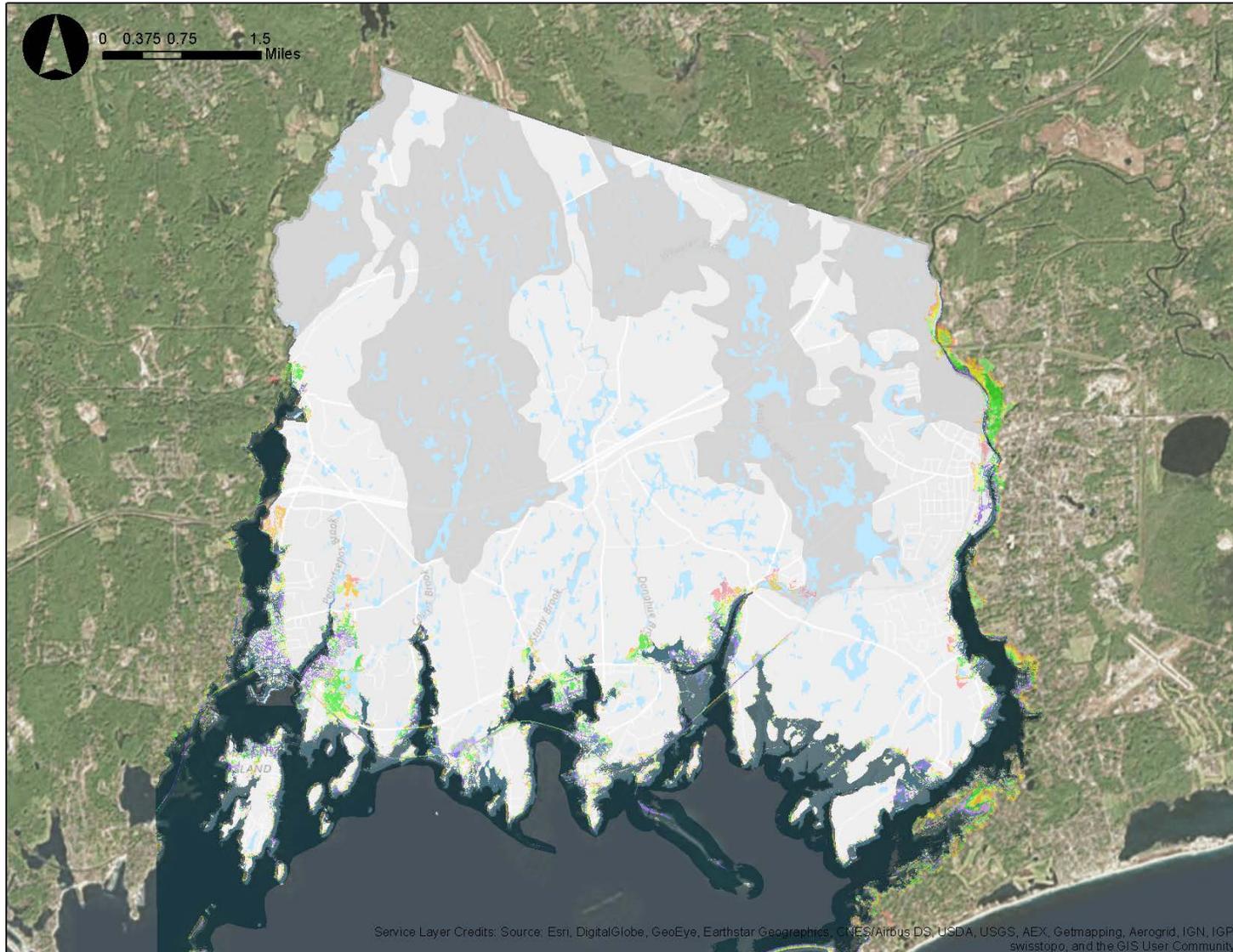
Legend

% Annual Chance of Flooding



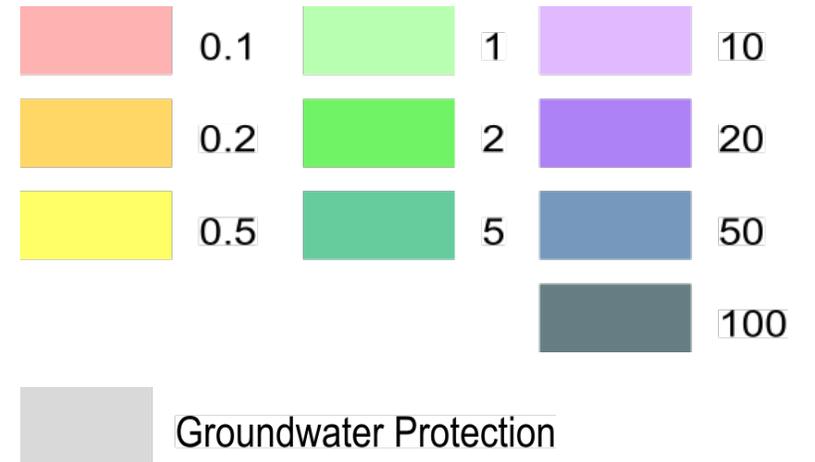
 Outfalls

Groundwater Protection



Legend

% Annual Chance of Flooding



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

A Brief Time Out:
Survey results + a talk with
the person next to you

What people are thinking...

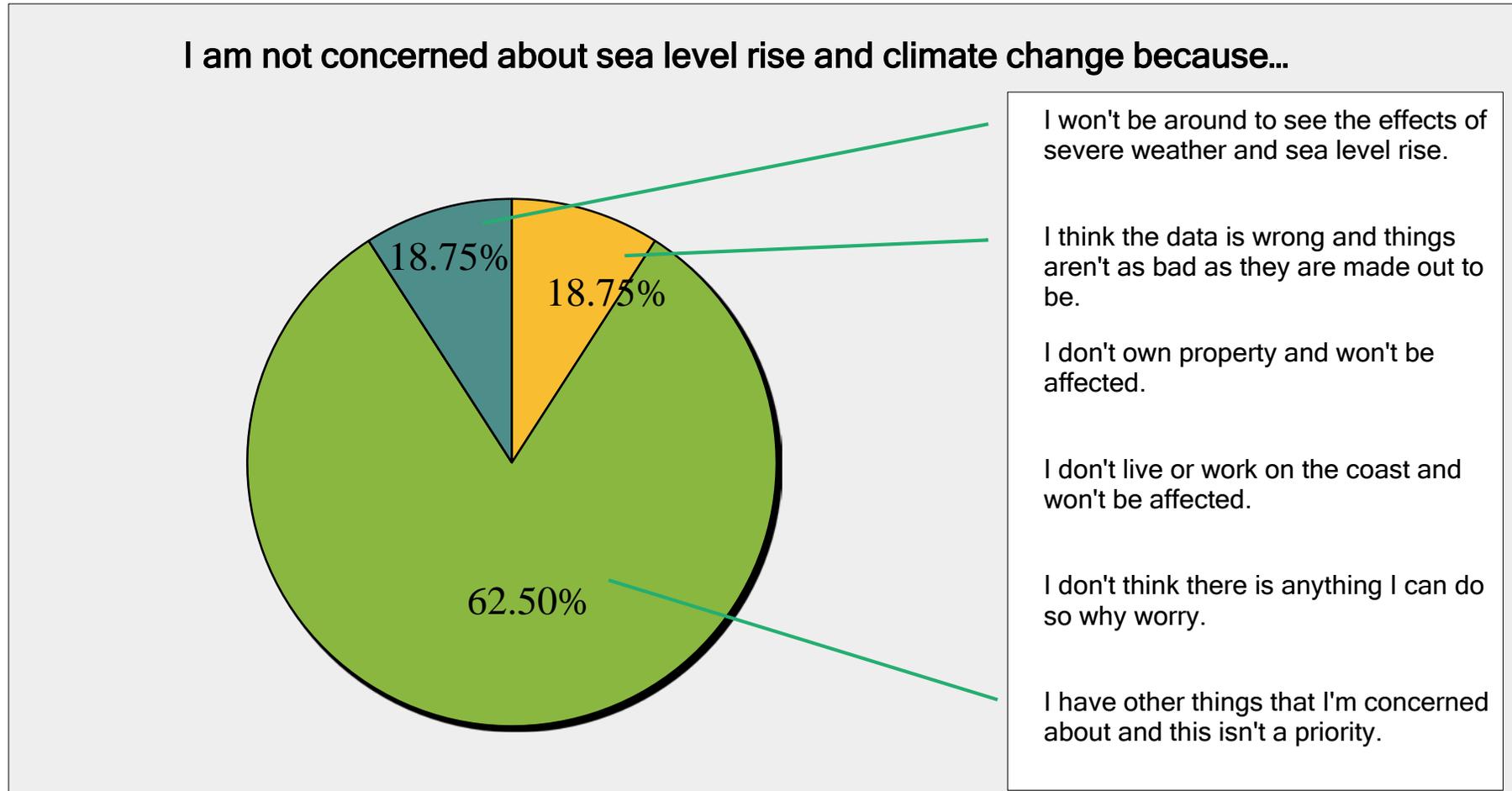
- 143 people responded to the online survey
- Respondents describe resiliency in equal measure as:
 - Bouncing back quickly after a catastrophic weather event
 - Having adequate capacity in infrastructure and services
 - Changing over the long run to respond to new situations and threats

How concerned are you about sea level rise and/or severe weather events?

Answer Choices	Responses
Not concerned at all	7.75% 11
Just a little bit concerned	11.27% 16
Moderately concerned	37.32% 53
Very concerned	43.66% 62
Total	142

For those not concerned about sea level rise and climate change:

Answered: 11



I won't be around to see the effects of severe weather and sea level rise.

I think the data is wrong and things aren't as bad as they are made out to be.

I don't own property and won't be affected.

I don't live or work on the coast and won't be affected.

I don't think there is anything I can do so why worry.

I have other things that I'm concerned about and this isn't a priority.

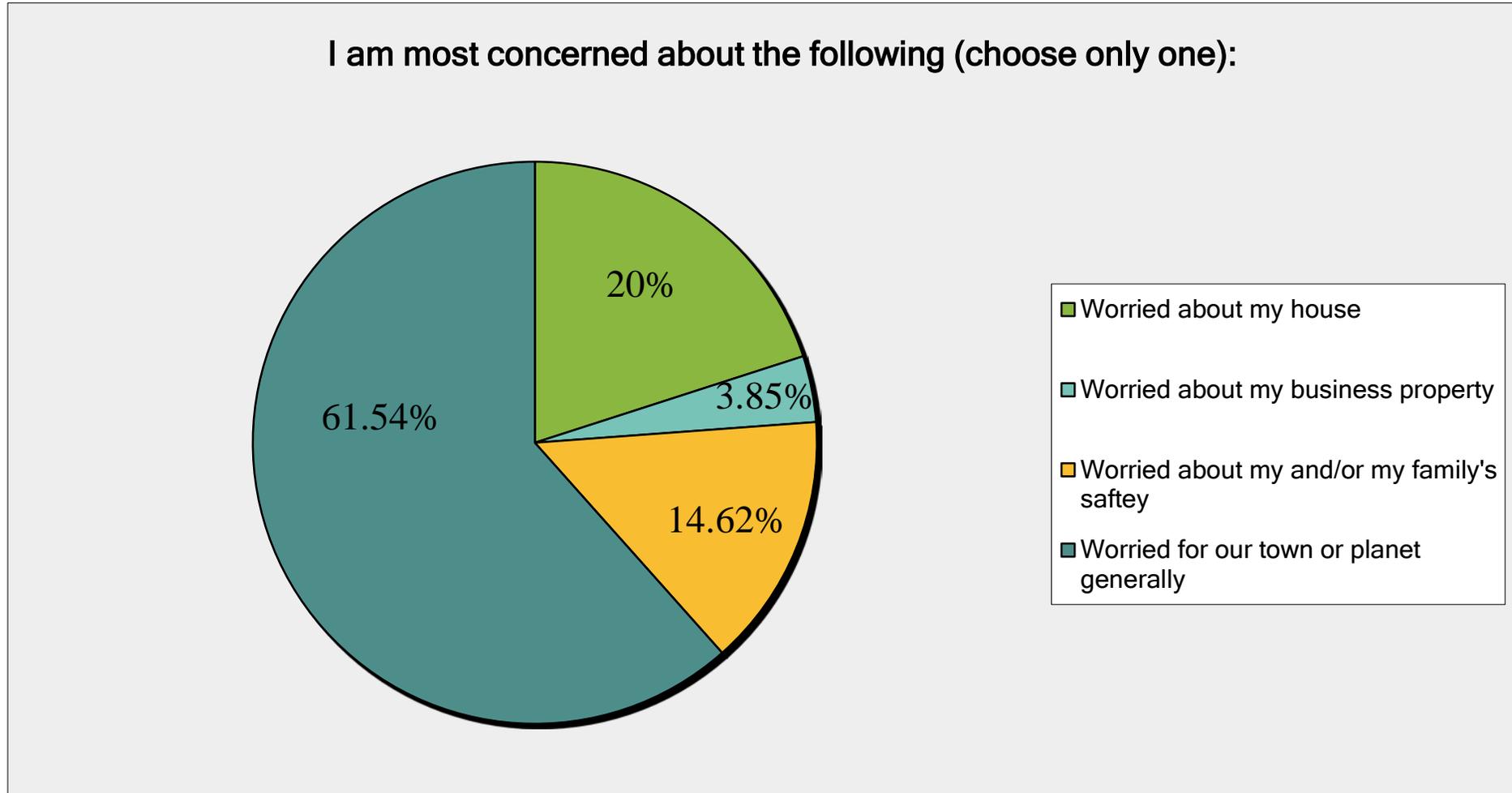
For those only a little bit concerned about sea level rise and severe weather events:

Answered: 16 Skipped: 127

Answer Choices	Responses
I won't be around to see the effects of sea level rise and severe weather.	0.00% 0
I think the data is wrong and things aren't as bad as they are made out to be.	18.75% 3
I don't own property and won't be affected.	0.00% 0
I don't live or work on the coast.	0.00% 0
There is nothing I can do so why worry about this.	18.75% 3
I have other things I am concerned about and this isn't a priority.	62.50% 10
Total	16

For those moderately or very concerned:

Answered: 130



How would you like to participate in this planning process?

Answered: 134

Answer Choices	Responses
Attend a public meeting	58.21% 78
Attend a focus group or working group	33.58% 45
Participate in surveys like this one	38.81% 52
Have the project team or town staff attend an event/meeting of my organization, church, or other group(if other, please list below)	6.72% 9
Read updates on the Town website	27.61% 37
Get project news on the Town Facebook page	24.63% 33
Receive email updates	55.22% 74
Total Respondents: 134	

You live in...

Answered: 133

Answer Choices	Responses
Mystic	25.56% 34
Lords Point	3.76% 5
Pawcatuck	20.30% 27
Mason's Island	12.03% 16
Stonington Borough	12.78% 17
Stonington Uplands	9.02% 12
Someplace else:	16.54% 22
Total	133

Your relationship to the water...

Answered: 133

Answer Choices	Responses	
Inland	31.58%	42
On the coast	27.07%	36
I can see the water but am not directly on the coast or river	41.35%	55
Total	133	

Your living situation:

Answered: 133

Answer Choices	Responses
I own my own home	85.71% 114
I rent my apartment/home	8.27% 11
I live with friends/family	3.01% 4
I live in senior housing	0.75% 1
Other (please specify)	2.26% 3
Total	133

Your age...

Answered: 133

Answer Choices	Responses	
65+ years old	31.58%	42
57-64	28.57%	38
50-56	15.04%	20
31-49	20.30%	27
21-30	4.51%	6
under 21	0.00%	0
Total		133

Take 5 minutes to talk to the
person next to you and
complete your survey sheet

Discussion, Questions & Next Steps

Next Steps

- Please make sure you signed in at the entry table
- You will be added to email list for project updates and meeting notices
- For additional information on the project, please contact:

Keith Brynes

kbrynes@stonington-ct.gov

860-535-5095

- OR follow us on social media!

#StoningtonReady

@StoningtonCTGov

@ArupAmericas