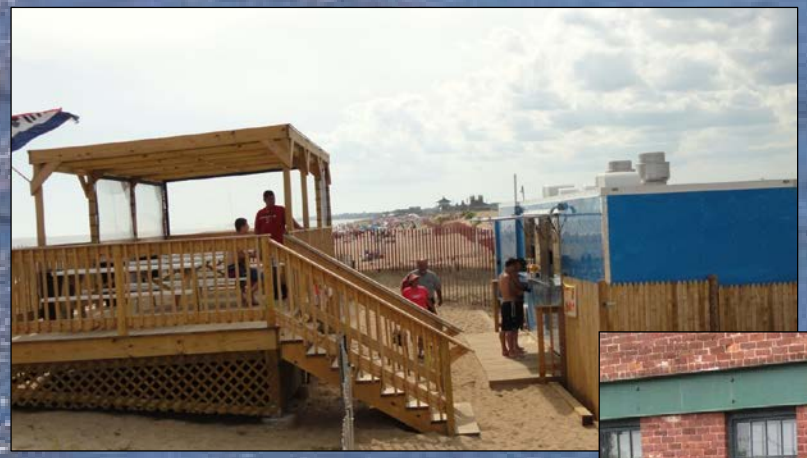
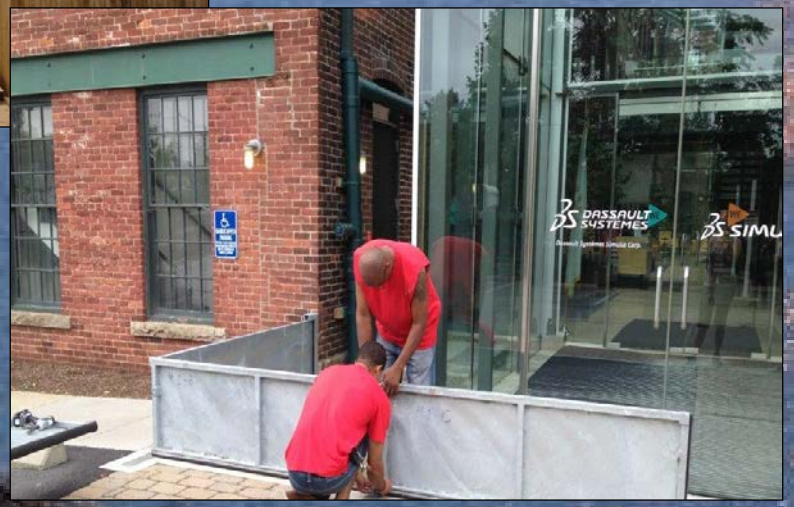
COASTAL RESILIENCE IN RHODE ISLAND

Introduction to STORMTOOLS & RI Adaptation in Progress





December 9, 2020
RI Rivers Council

Teresa A. Crean, AICP
University of Rhode Island Coastal Resources Center / RI Sea Grant

THE UNIVERSITY OF RHODE ISLAND GRADUATE SCHOOL OF OCEANOGRAPHY | CRC COASTAL RESOURCES CENTER | Sea Grant Rhode Island

Coastal Risk in Rhode Island

1938 Hurricane
High Water Mark

Wickford, RI
Brown Street

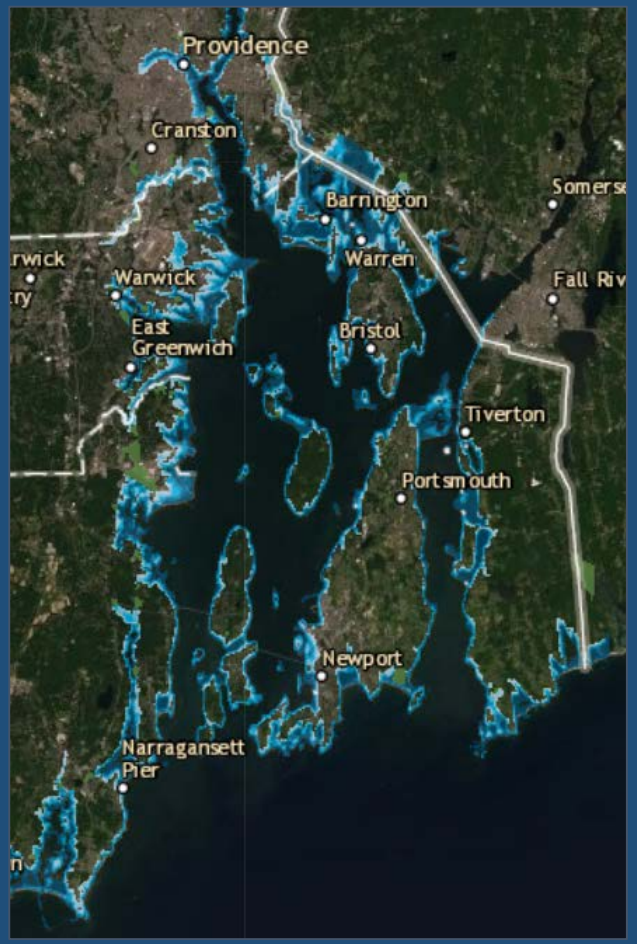
Superstorm Sandy
October 2012
4-foot storm surge

Wickford, RI
Brown Street
Parking Lot

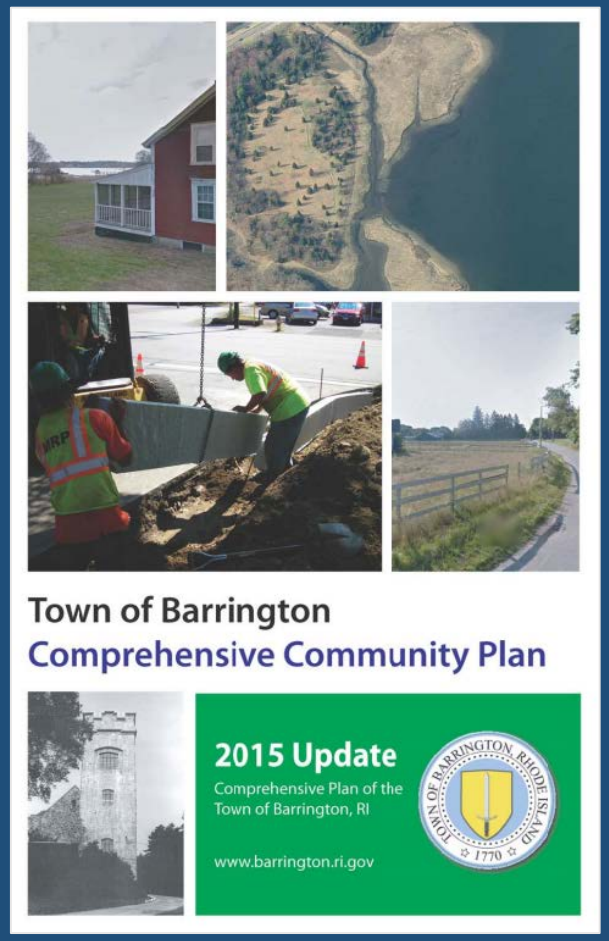
High Tide
March 3, 2018

East Bay Bike Path
Bristol, RI

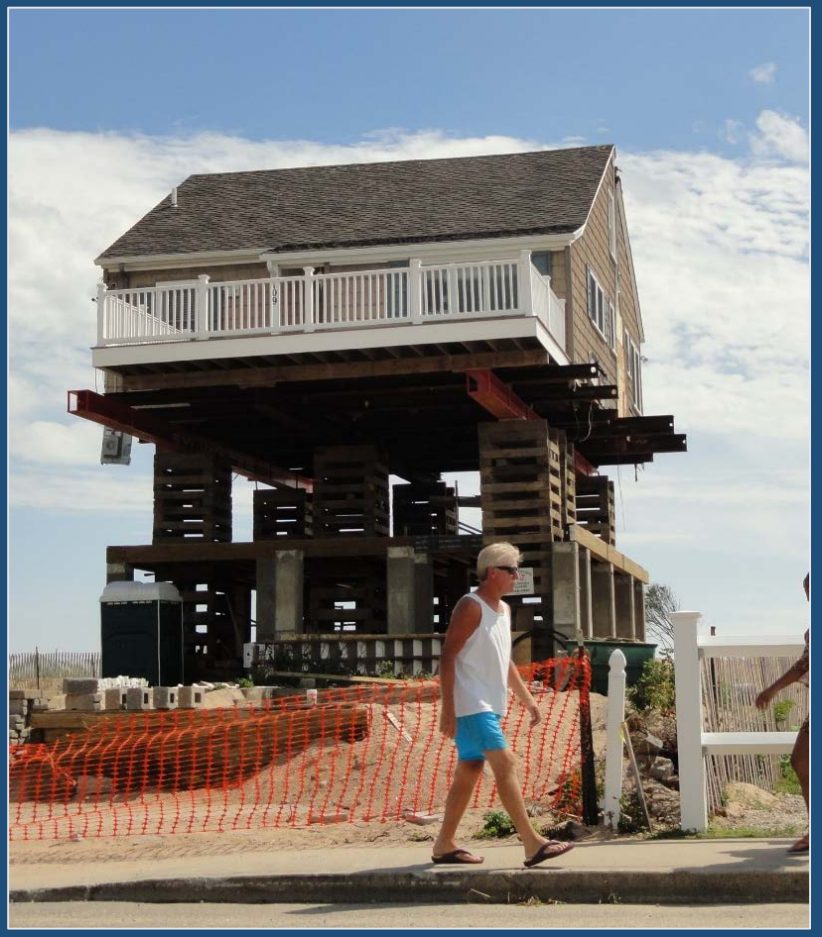
Know Your Risk

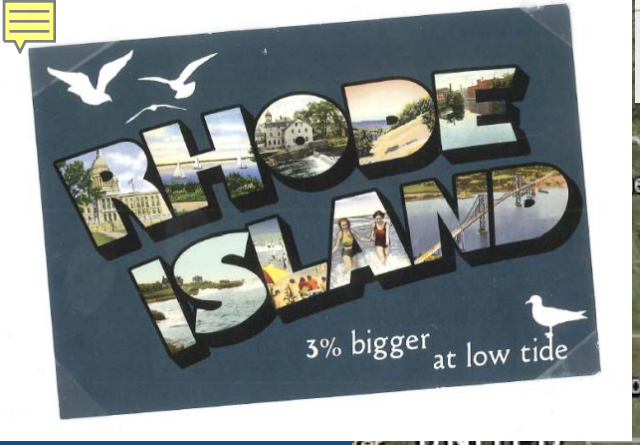


Make a Plan



Take Action





Historical Hurricane Tracks

Hurricanes

County Strikes

Ottawa
Montreal
Toronto
Wisconsin
Chicago
Detroit
New York
Illinois
Ohio
St Louis
Kansas
Missouri
Kentucky
Tennessee
Oklahoma
Arkansas
Dallas
Texas
Houston
Monterrey
MÉXICO
Mexico City
Havana
CUBA
Guatemala
Caribbean Sea
Caracas
Atlantic Ocean

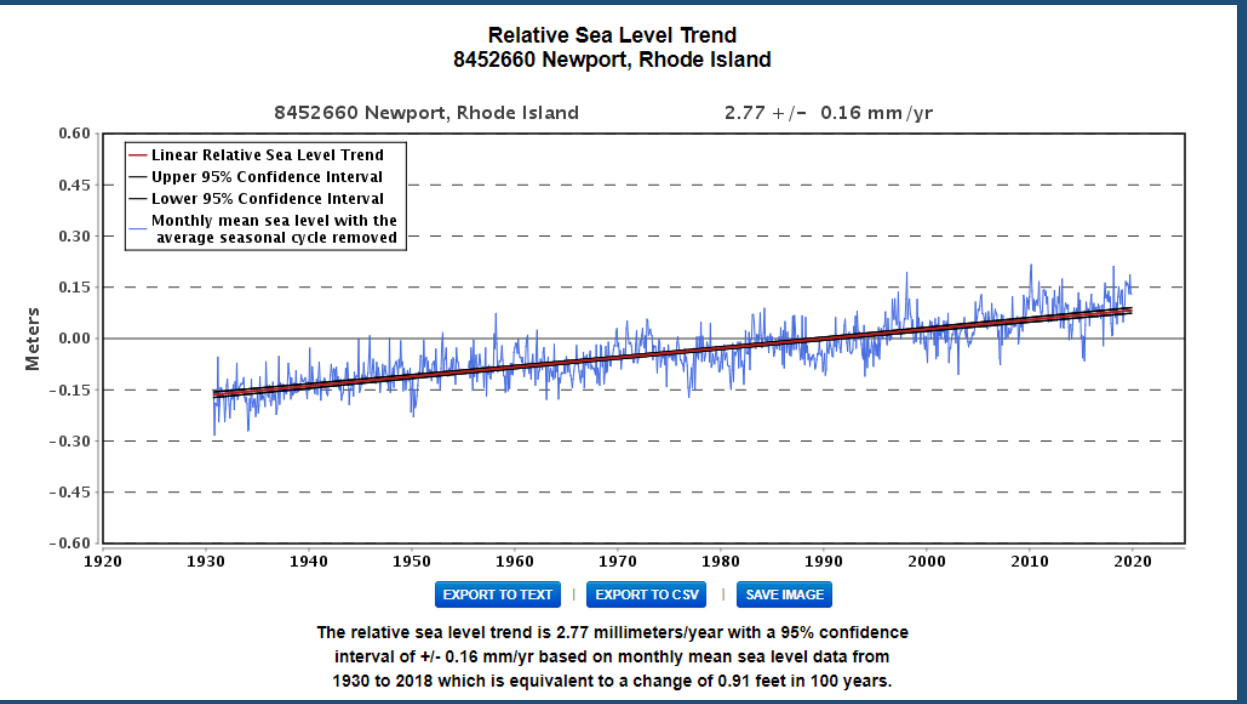
Category

TS	TD	ET	N/A
H1	H2	H3	H4	H5

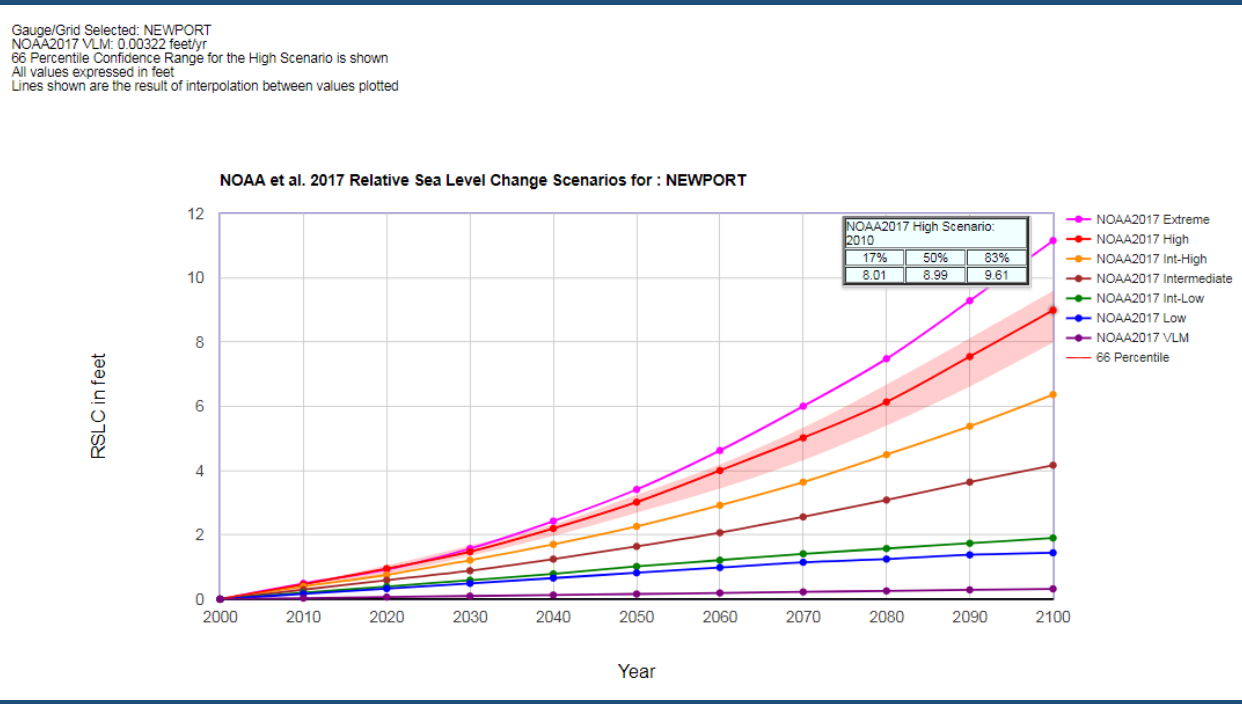
Pos: 8.32 , -58.36 Search Center: 41.59 , -71.47

Sea Level Rise

PAST



FUTURE



NOAA TIDES & CURRENTS

US Army Corps of Engineers

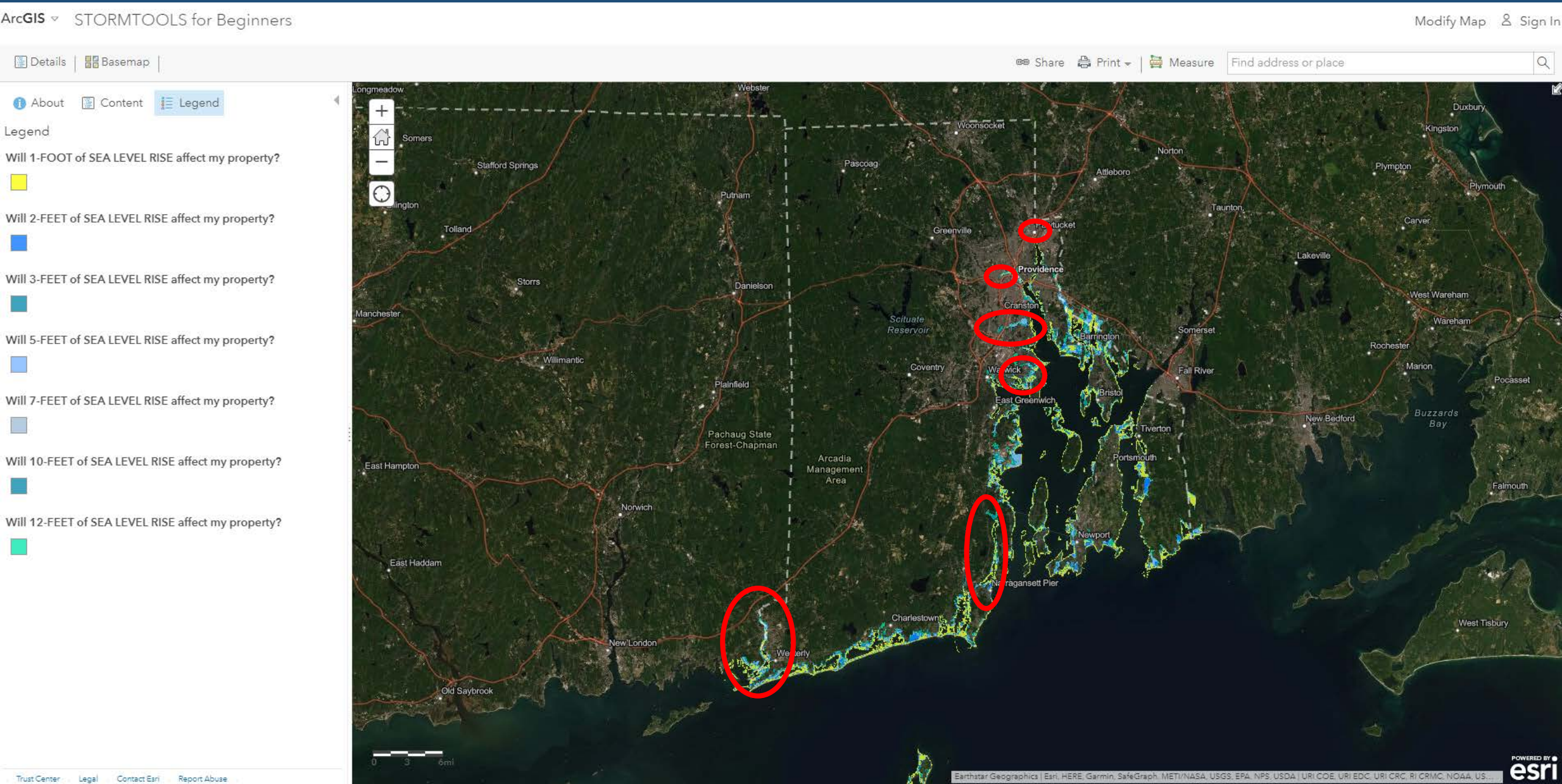
Sea-Level Change Curve Calculator (Version 2019.21)

www.beachsamp.org/stormtools

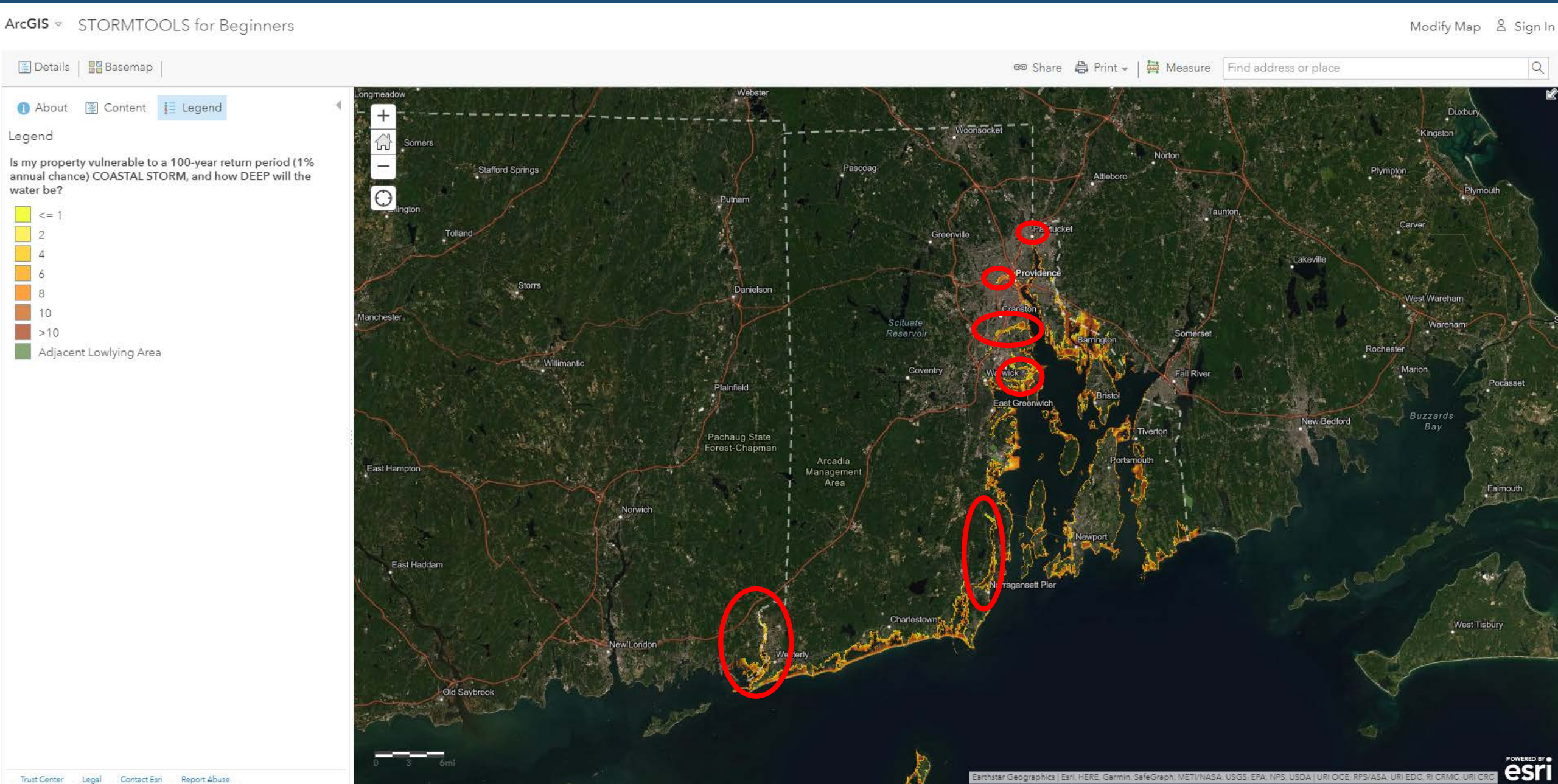
or

https://stormtools-mainpage-crc-uri.hub.arcgis.com/

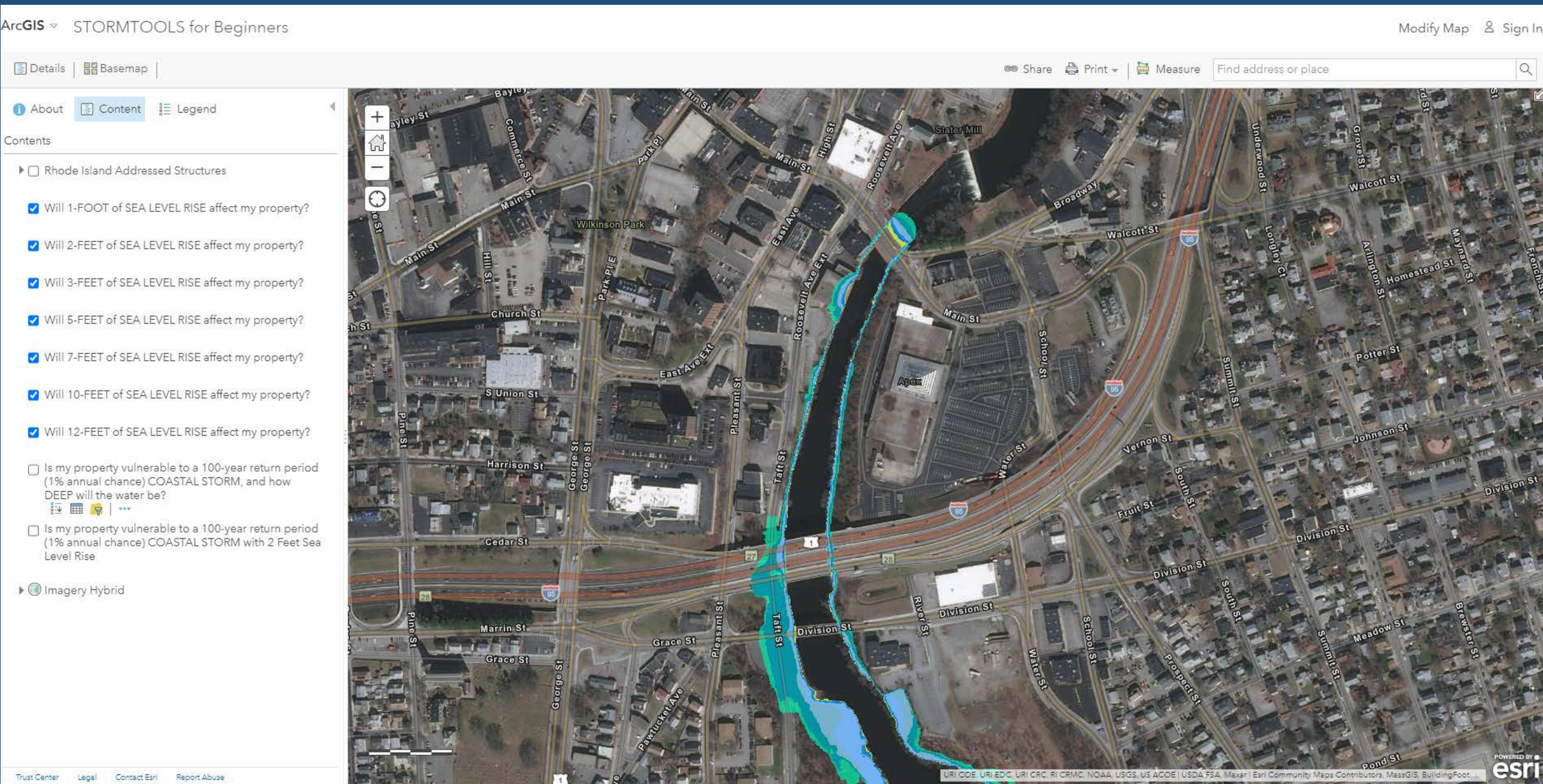
STORMTOOLS' Sea Level Rise Scenarios



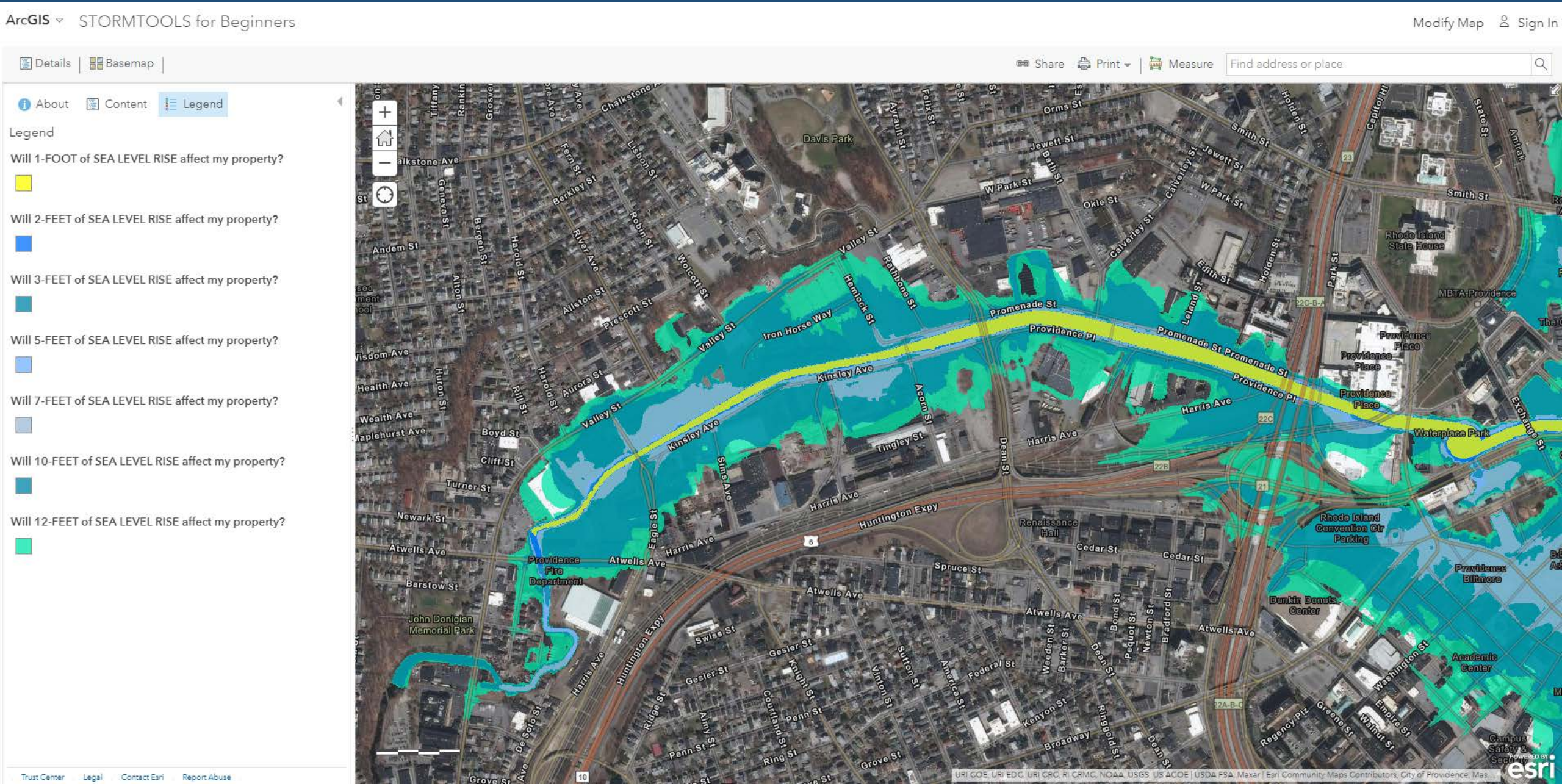
STORMTOOLS – Storm Surge Scenarios



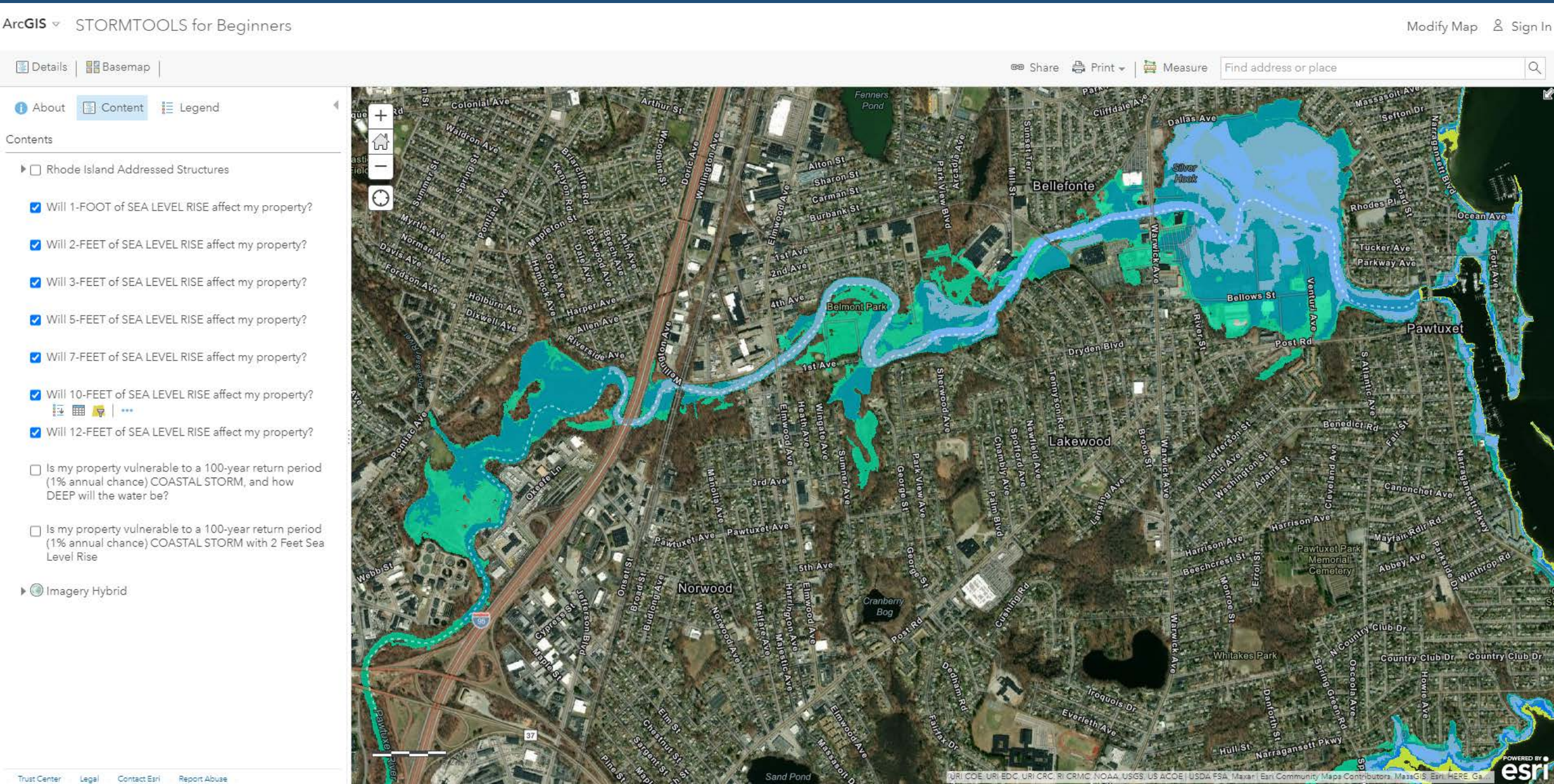
STORMTOOLS – Seekonk River to Blackstone River



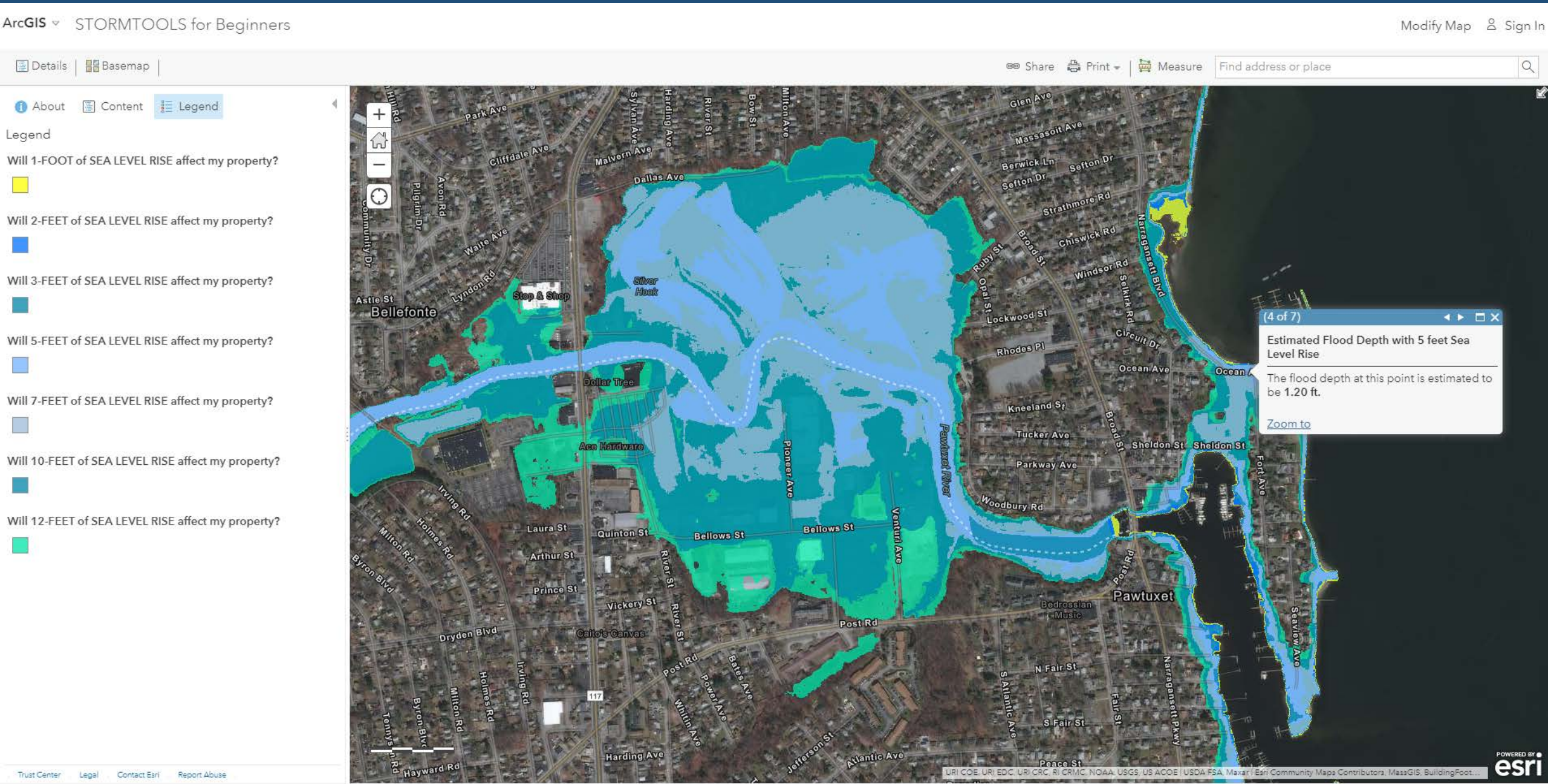
STORMTOOLS – Woonasquatucket River



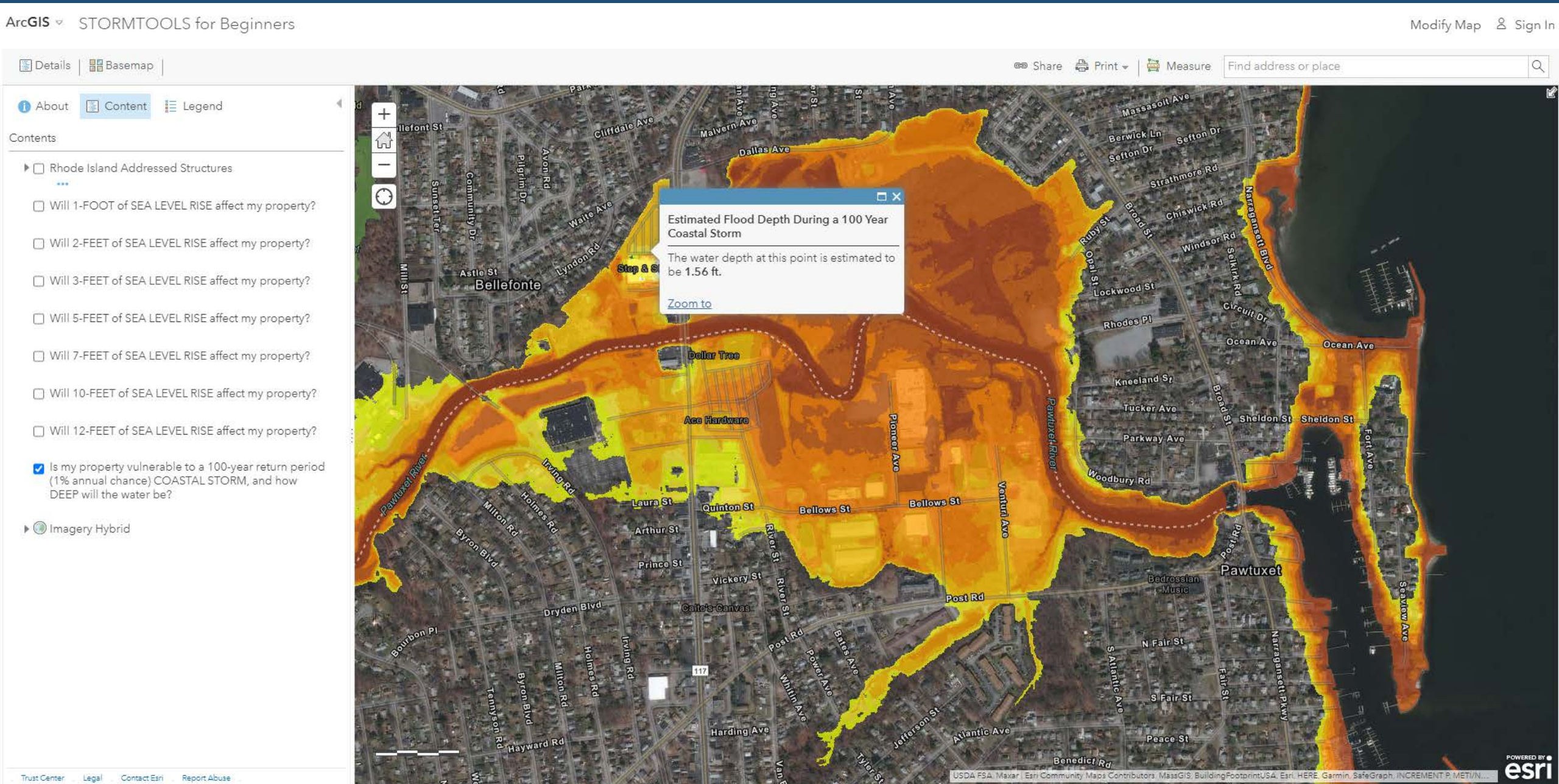
STORMTOOLS – Pawtuxet River



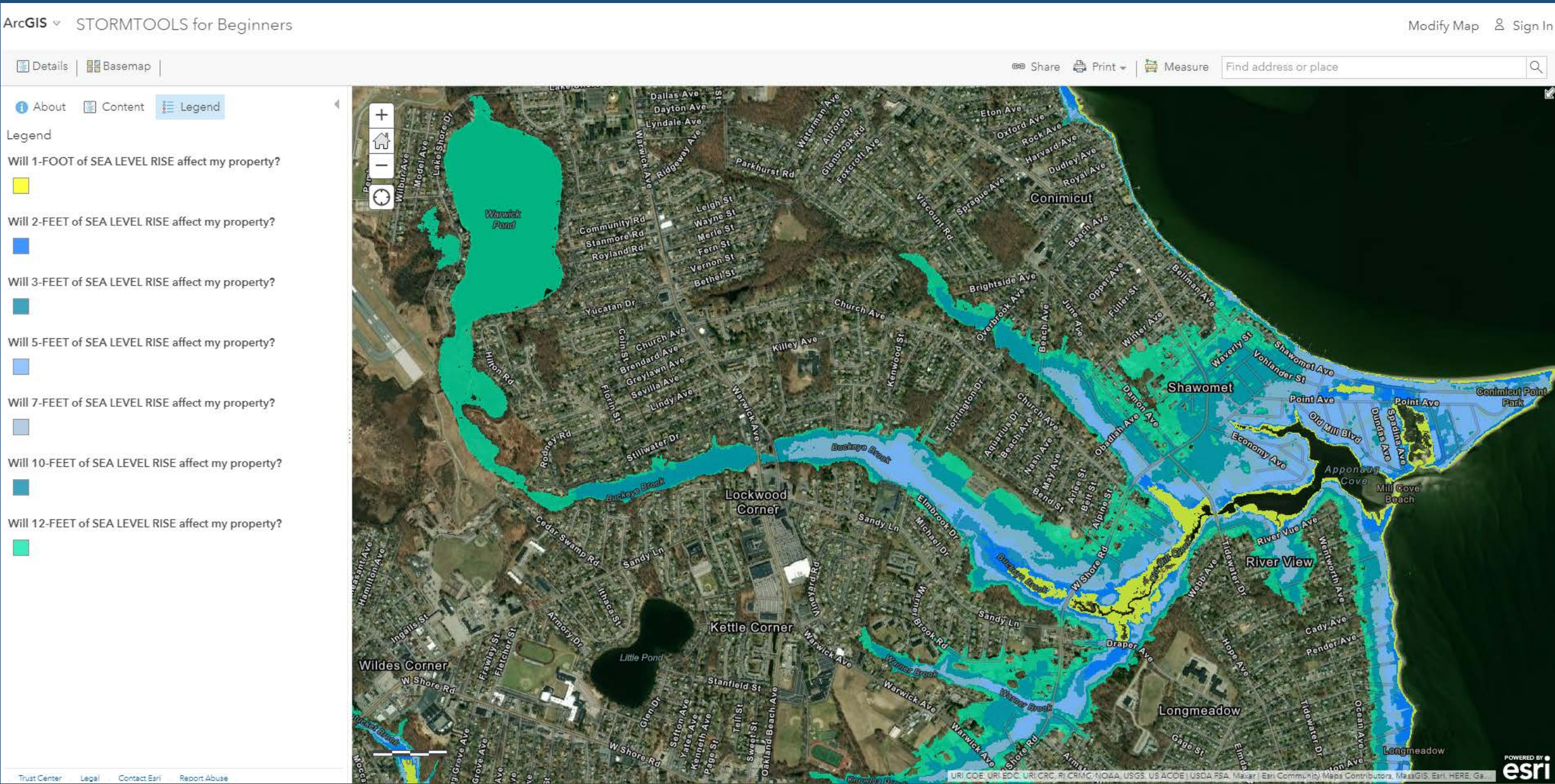
STORMTOOLS – Pawtuxet River



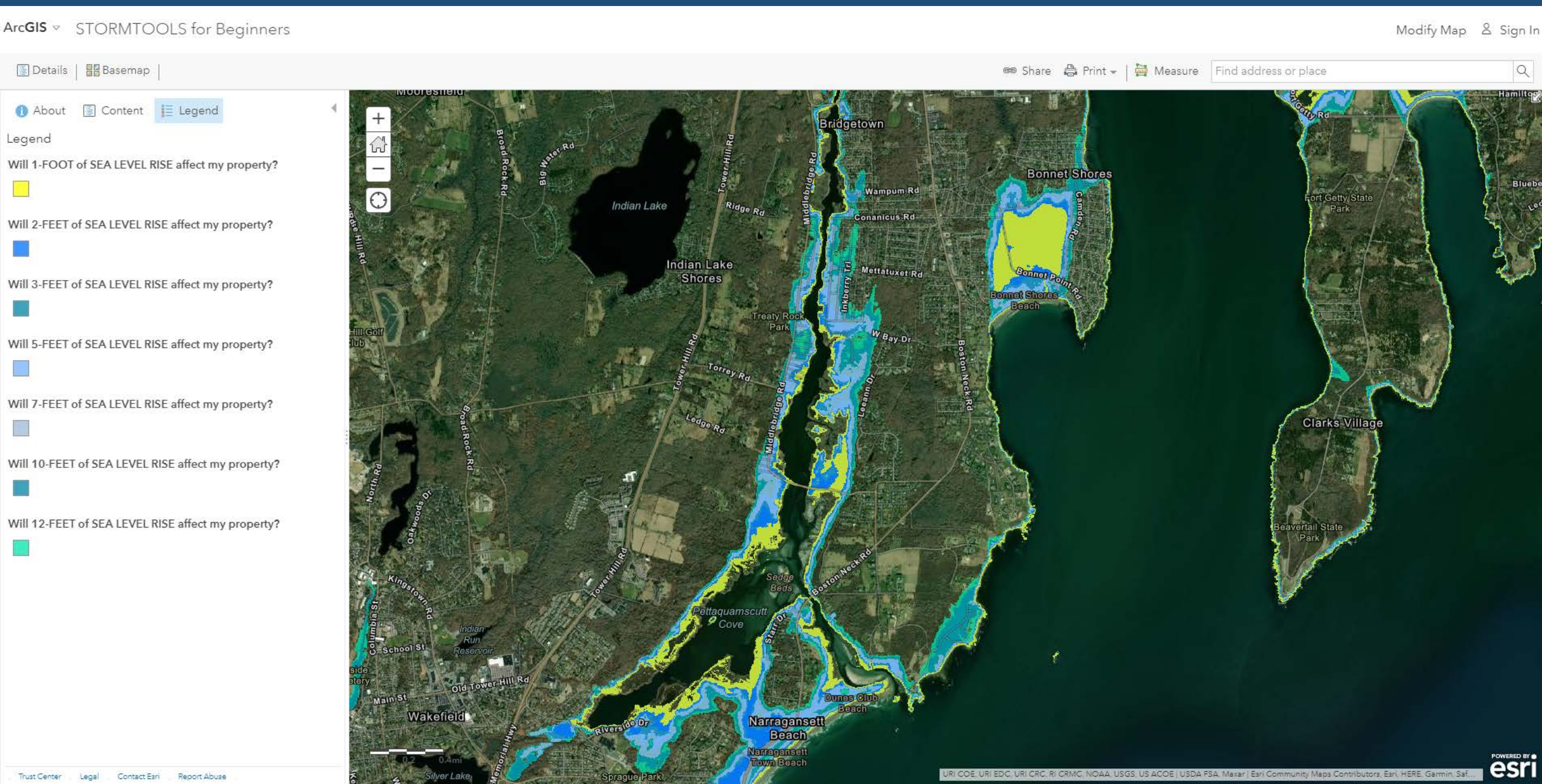
STORMTOOLS – Pawtuxet River



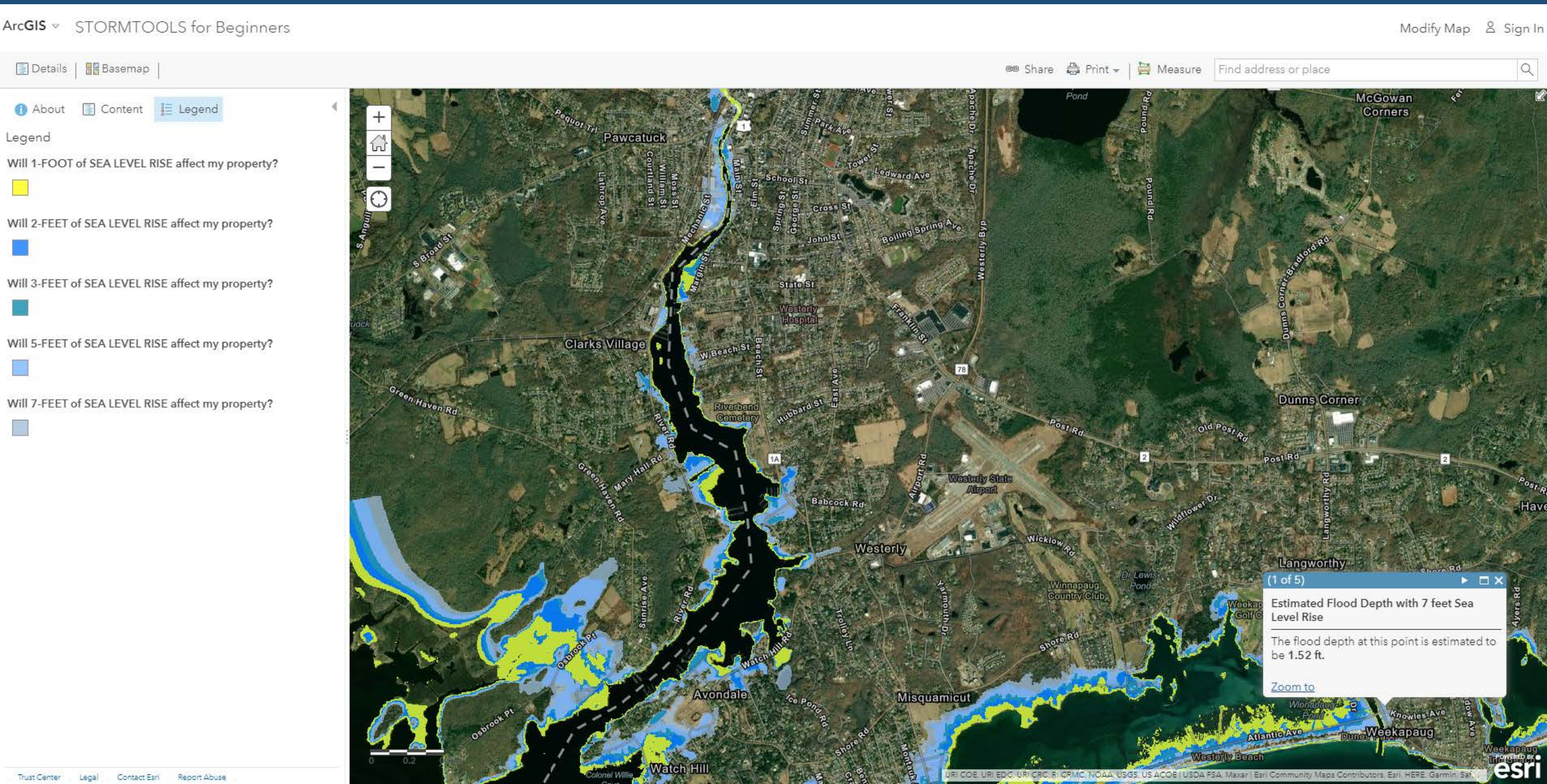
STORMTOOLS – Buckeye Brook



STORMTOOLS – Narrow River



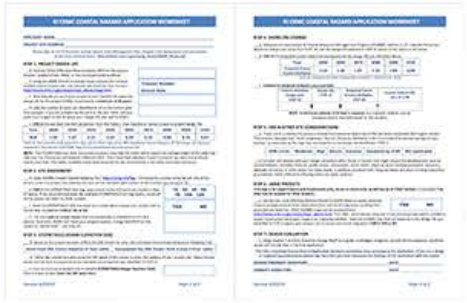
STORMTOOLS – Pawcatuck River



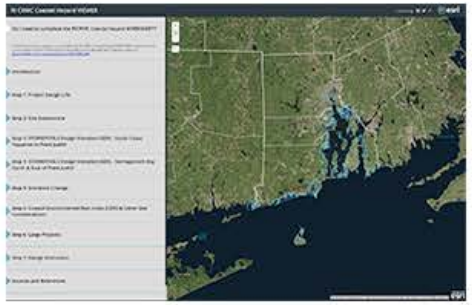
Coastal Hazard Application

Welcome to the RICRMC Coastal Hazard Application WORKSHEET and ONLINE VIEWER!

Please download and print the **RICRMC Coastal Hazard Application WORKSHEET from the link below**, and use the **ONLINE VIEWER** to access the maps and other information required for completion of the **WORKSHEET**.



Coastal Hazard Application Worksheet (PDF)



Coastal Hazards Application Online Viewer

The list of projects below must complete the RICRMC Coastal Hazard Application WORKSHEET to be filed in addition to and with your standard CRMC application (http://www.crmc.ri.gov/applicationforms.html).

Any of the following **new projects**, including tear downs and rebuilds, located on a coastal feature or within the 200-foot contiguous area:

1. construction of new residential buildings as defined in § 1.1.2;
2. construction of new commercial and industrial structures as defined in § 1.1.2;
3. construction of new beach pavilions as defined in § 1.1.2;
4. construction of any new private or public roadway, regardless of length;
5. construction of any new infrastructure project subject to §§ 1.3.1(F), (H), and (M); and
6. construction of any new subdivisions with six (6) or more lots, any portion of which is within 200 feet of a shoreline feature.

Online PHOTOBANK:
MyCoast
Rhode Island

MyCoast

RI MyCoast | King Tides | StormReporter | Register | Log in

King Tide Report by Janet Freedman

Oakland Beach | Kent County

VIEW ON STORMTOOLS

04/09/2020 | 10:06 am

(0 hours 23 minutes after high tide)

Weather Overview

Wind Speed: 12 MPH
Wind Direction: 164°
Temperature: 48°F
Rainfall (Calendar Day): 0.47"
Rainfall (Past 24 Hours): 0.03"

(Click here for full weather details)

Tidal Overview

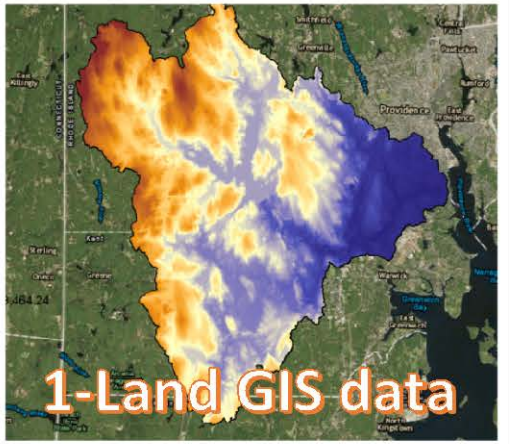
Data from East Greenwich (2.9 miles away)
Water Level: Not yet available
Predicted tide: 9:43 am, 4.9'

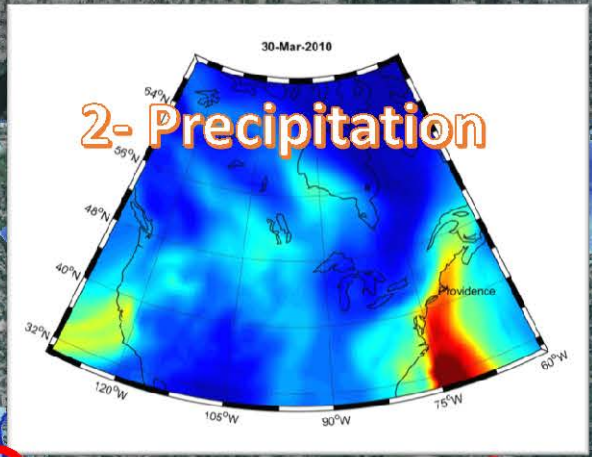
An integrated modeling system for the Pawtuxet River and Watershed flood management

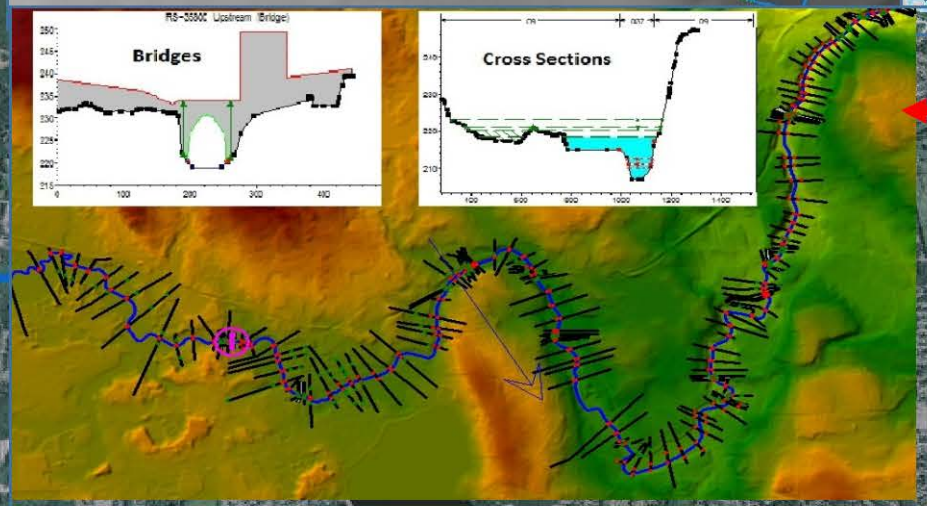
M Reza Hashemi, reza_hashemi@uri.edu
Sheets 212
Department of Ocean Engineering & Graduate School of Oceanography

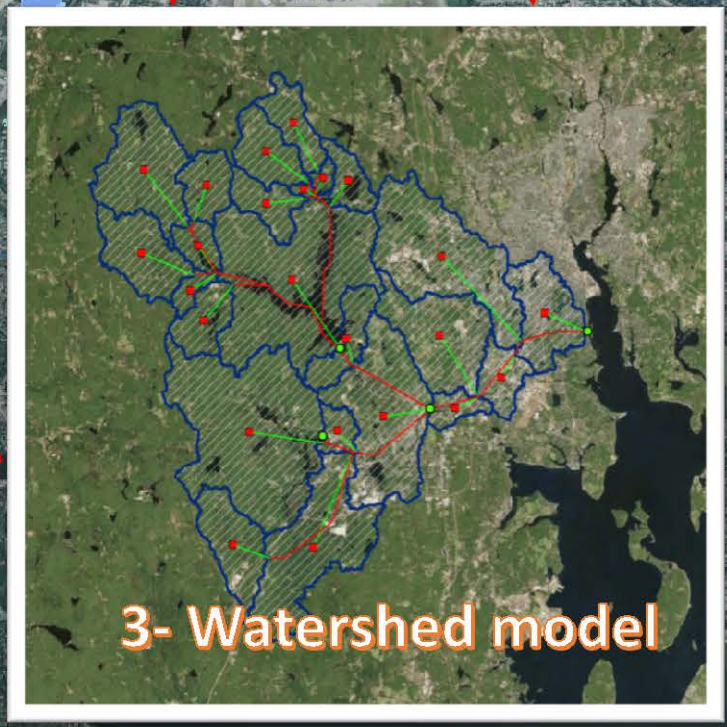
- The Narragansett Bay watershed includes 4 river basins:
  - **Taunton River Basin** 338,871 acres (529 square miles)
  - **Blackstone River Basin** 303,734 acres (475 square miles)
  - **Coastal Narragansett Basin** 300,124 acres (469 square miles)
  - **Pawtuxet River Basin** 148,404 acres (232 square miles)
- The Narragansett Bay Watershed lies 40% in Rhode Island and 60% in Massachusetts (NBEP)
- **Objectives of Pawtuxet River/Watershed study:**
  1. Developing a validated web/GIS-Based watershed/river model for the Pawtuxet watershed, flood prediction along the river flood plains
  2. Impact of the Scituate and Flat River Reservoirs on other structures on flooding as well as climate change
  3. Paving the way for a real-time forecasting system for this river, and other rivers in RI, adding it to STORMTOOLS
- **Results:**
- Link to open access journal article (Flood Risk Management)

Overview of the modeling system









Summary

I. Web-based river/watershed model of Pawtuxet river (integrated to STORMTOOLS) has been developed

II. Scituate reservoir always reduces the flood impact.

III. Scituate reservoir dam can be managed/modified to control flooding (considering water supply).

IV. Some (not all) of the diversion dams in the Pawtuxet river increase the flooding extent.

V. Debris can significantly increase the flooding risk in this area.

VI. Now, it is feasible to setup an ensemble flood forecasting model for the entire floodplain of the river and present the results on an online map.

Recommendations

I. Operational flood forecasting model for the Pawtuxet watershed/river

II. Consequence of possible catastrophic dam failure during major floods (water quality, flooding,..)

III. Simulating the impacts of climate change on the watershed-river flooding risk

IV. Installing a river gauge downstream of the Scituate reservoir, and a precipitation/temperature gauge on the watershed

V. Effective management of the Scituate reservoir for flood control

Received: 31 May 2019 | Revised: 23 April 2020 | Accepted: 1 July 2020

DOI: 10.1111/jfr3.12655

ORIGINAL ARTICLE

CIWEM Chartered Institution of Water and Environmental Management | Journal of Flood Risk Management | WILEY

Flood risk in past and future: A case study for the Pawtuxet River's record-breaking March 2010 flood event

Soroush Kouhi[1] | **M. Reza Hashemi**[1,2] | **Rozita Kian**[1] | **Malcolm Spaulding**[1] | **Matthew Lewis**[3] | **Isaac Ginis**[2]

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[2]Graduate School of Oceanography, University of Rhode Island, South Kingstown, Rhode Island

[3]School of Ocean Sciences, Bangor University, Bangor, UK

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Email: reza_hashemi@uri.edu

Funding information
Rhode Island Coastal Resources Management Council, Grant/Award Number: CFDA 14.228; U.S. Department of Homeland Security, Grant/Award Number: 2015-ST-061-ND0001-01; U.S. Department of Housing and Urban Development, Grant/Award Number: B-10-DF-44-0001

Abstract

In March 2010, a sequence of three major rainfall events in New England (United States) led to a record-breaking flooding event in the Pawtuxet River Watershed with a peak flow discharge of about 500-year return period. After development of hydrological and hydraulic models, a number of factors that played important roles in the impact of this flooding and other extreme events including river structures (reservoirs, historical textile mill dams, and bridges) were investigated. These factors are currently omitted within risk assessments tools such as flood insurance rate maps. Some management strategies that should be considered for future flood risk mitigation were modeled and discussed. Furthermore, to better understand possible future risks in a warmer climate, another extreme flood event was simulated. The synthetic/hypothetical storm (Hurricane Rhody with two landfalls) was created based on the characteristics of the historical hurricanes that severely impacted this region in the past. It was shown that while the first landfall of this hurricane did not lead to significant flood risk, the second landfall could generate more rain and flooding equivalent to a 500-year event. Results and the methodology of this study can be used to better understand and assess future flood risk in similar watersheds.

KEYWORDS

climate change, flood risk, HEC-RAS, hurricane, river flooding

1 | INTRODUCTION

River flooding is a major cause of catastrophic loss in the United States and around the world. Table 1 shows catastrophic loss by cause for about two decades in the United States (1996–2016[1]). Losses of 91.9% were caused by weather-related events including tornadoes, hurricanes, and winter storms in which flooding has a significant contribution. Previous studies indicated that the risk of riverine flooding is increasing due to climate change (Booij, 2005), sea level rise (Le, Nguyen, Wolanski, Tran, & Haruyama, 2007) (for the rivers draining to the open seas and the ocean), and growth in populations/urbanization (Campbell et al., 2018; Suriya & Mudgal, 2012) in flood zones.

In the United States, Federal Emergency Management Agency (FEMA, https://www.fema.gov/) generates Flood Insurance Rate Maps (FIRMs) for the assessment of flood risk in the flood zone. FIRMs provide a general guidance to estimate the river and coastal storm risk to

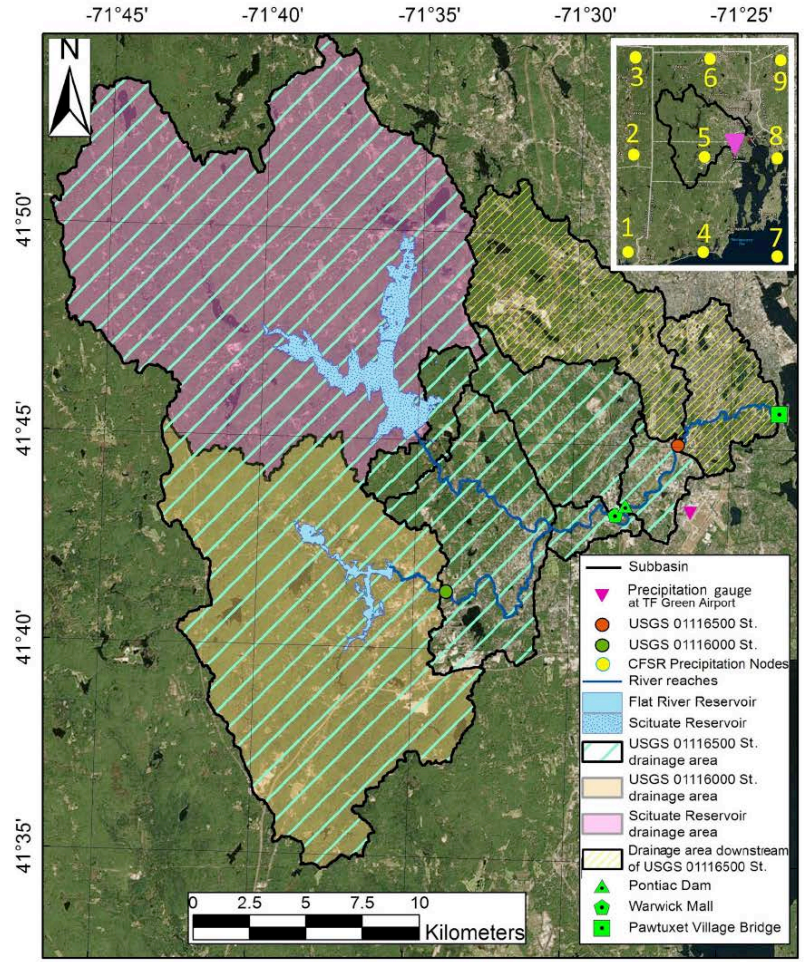


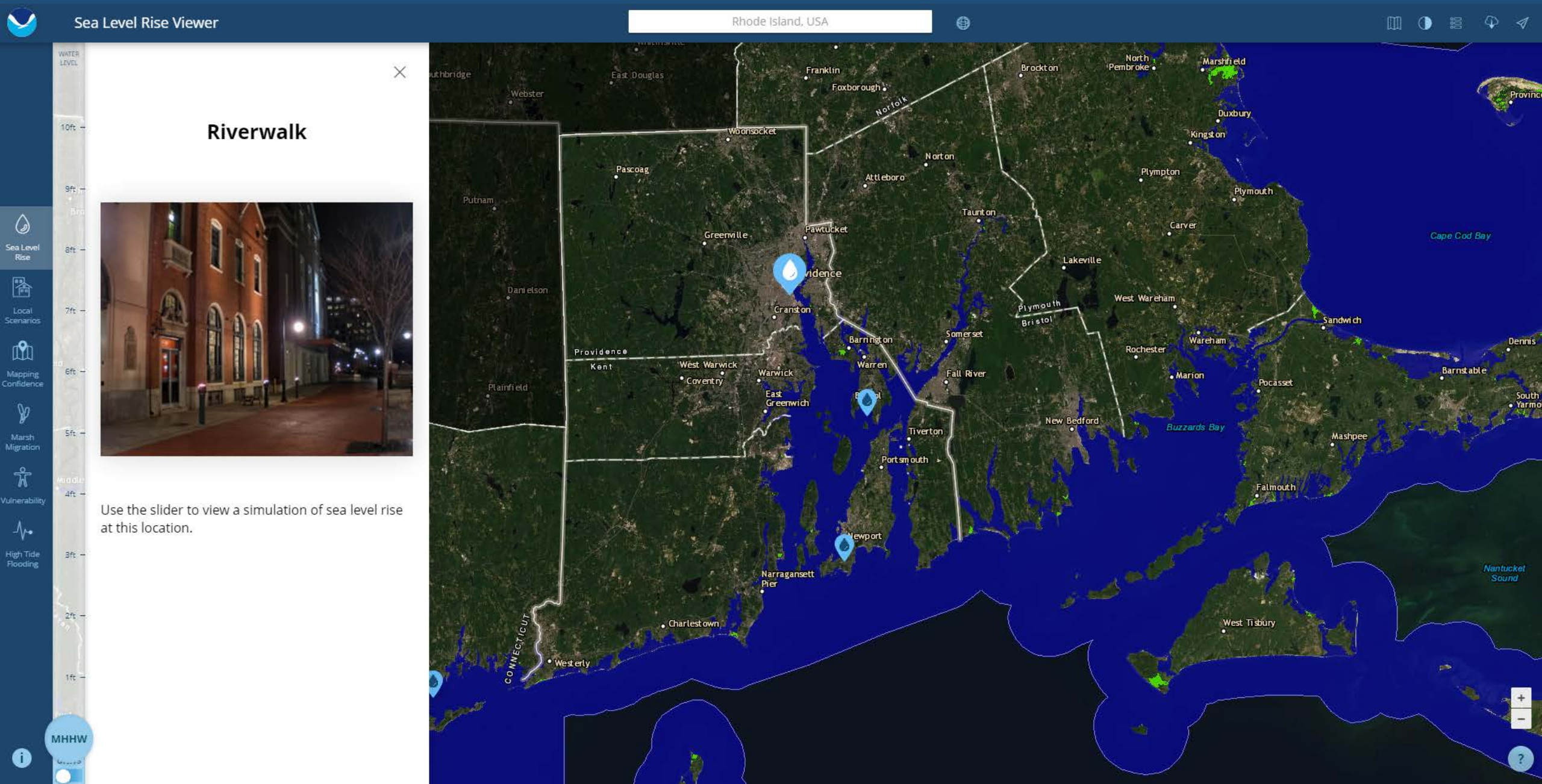
FIGURE 1 Map of the Pawtuxet River watershed. The watershed and subbasins borders are shown in black. The locations of the USGS stream gauges, meteorological station, reservoirs, and a few river structures are also shown. Locations of CFSR nodes to extract hindcast rainfall data are shown on the top right subfigure. CFSR, Climate Forecast System Reanalysis; USGS, United States Geological Survey

South and North Branches, and drains to the Providence River in upper Narragansett Bay. Two USGS stream gauges are located in the watershed: the USGS 01116500 on the Main Branch at Cranston and the USGS-01116000 on the South Branch at Washington (see Figure 1). Table 2 provides more details about drainage areas in this watershed.

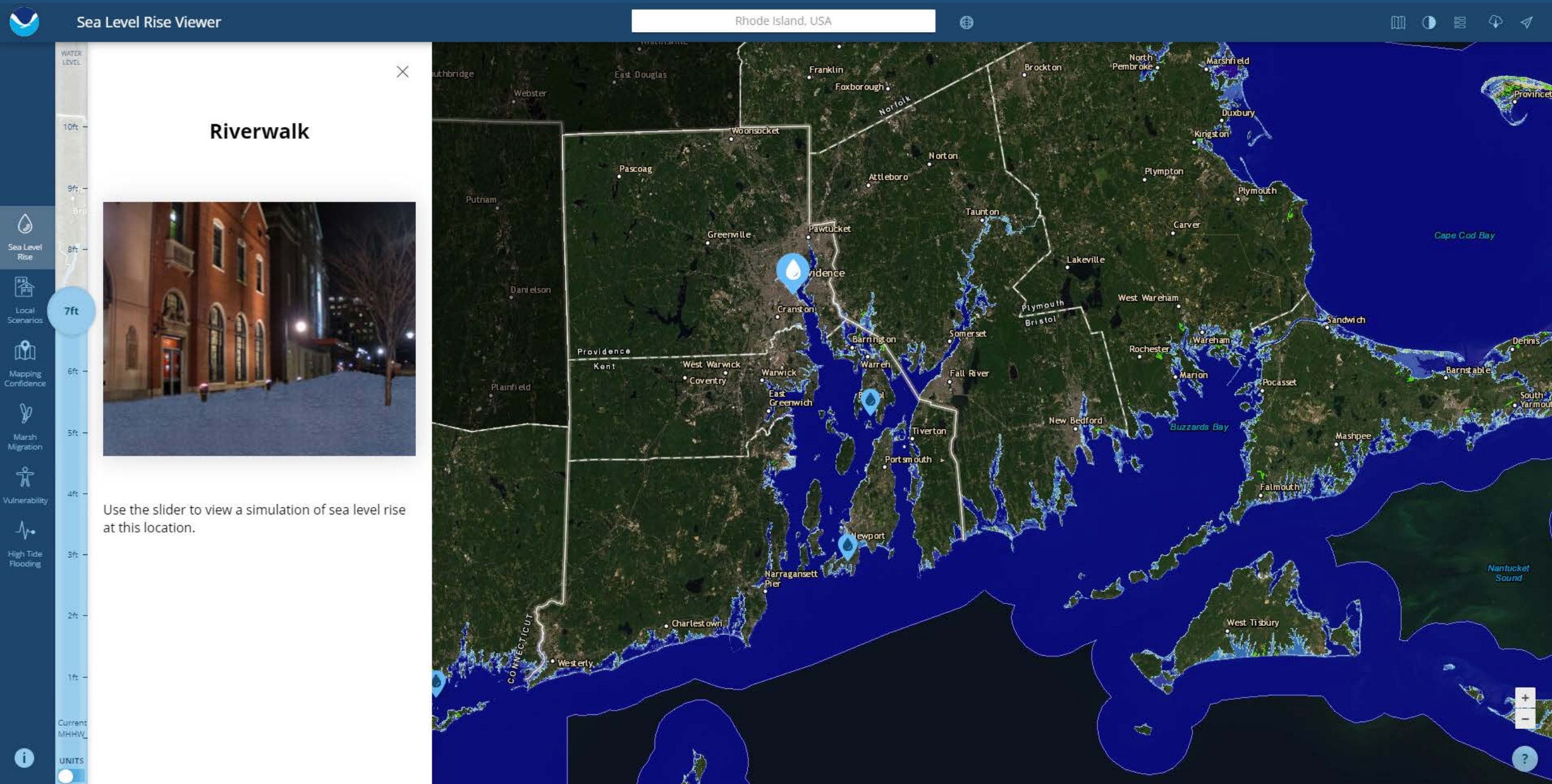
2.2 | River structures and their role in flooding

In the aftermath of March 2010 event, the affected communities, stakeholders, and flood management authorities were looking for main causes of this catastrophe and what could have been done to reduce the impacts of this

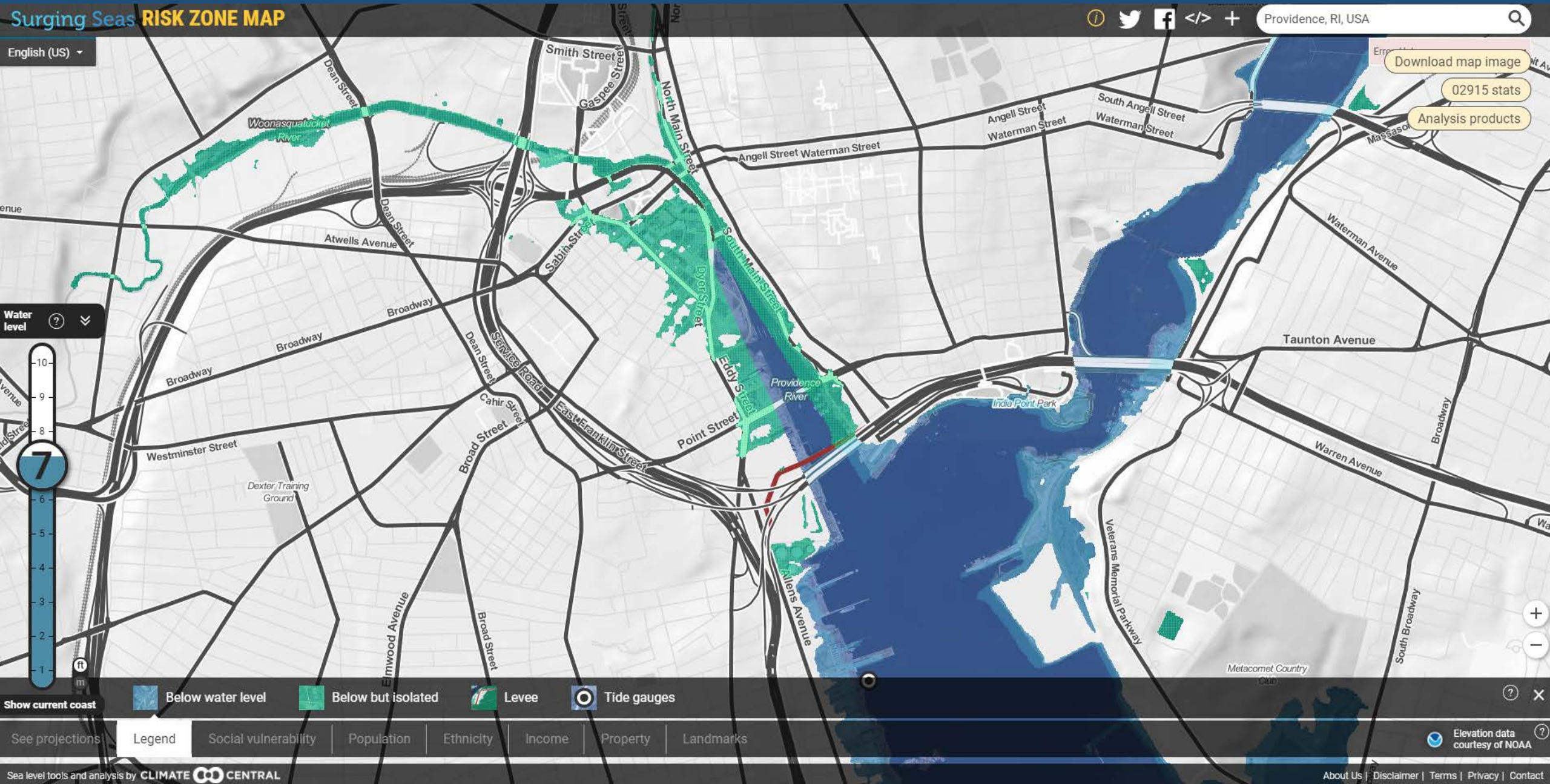
NOAA Digital Coast – Sea Level Rise Viewer



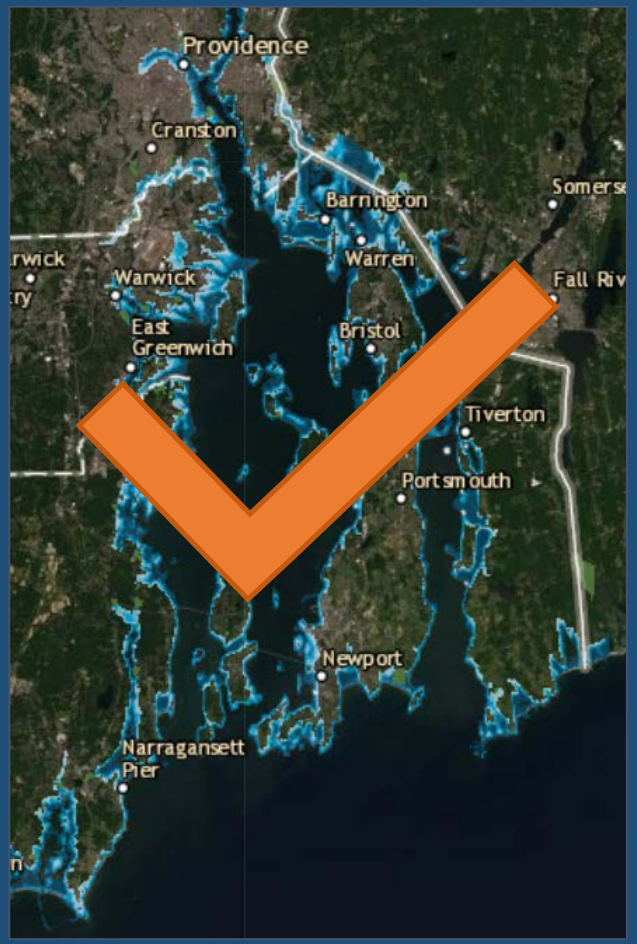
NOAA Digital Coast – Sea Level Rise Viewer



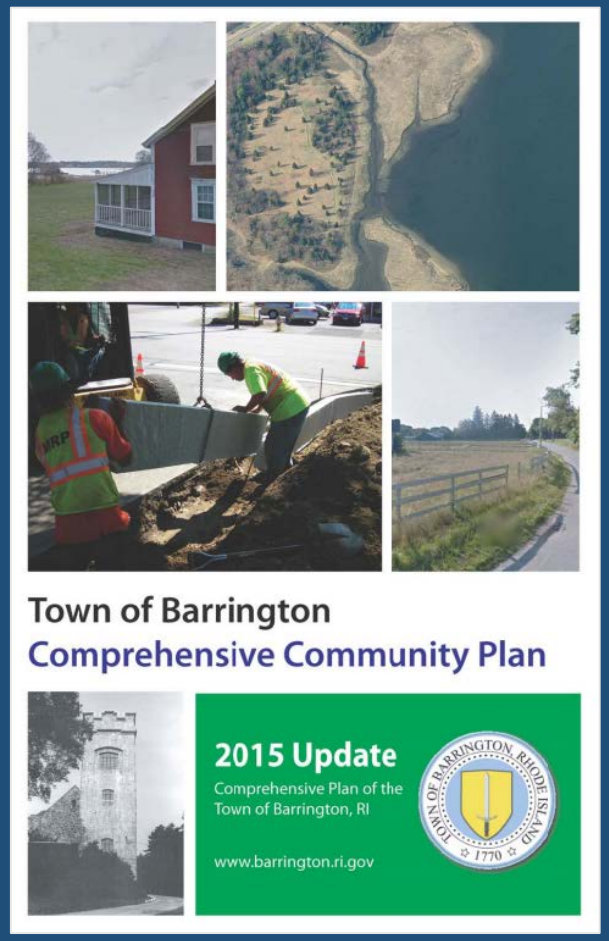
Climate Central – Surging Seas



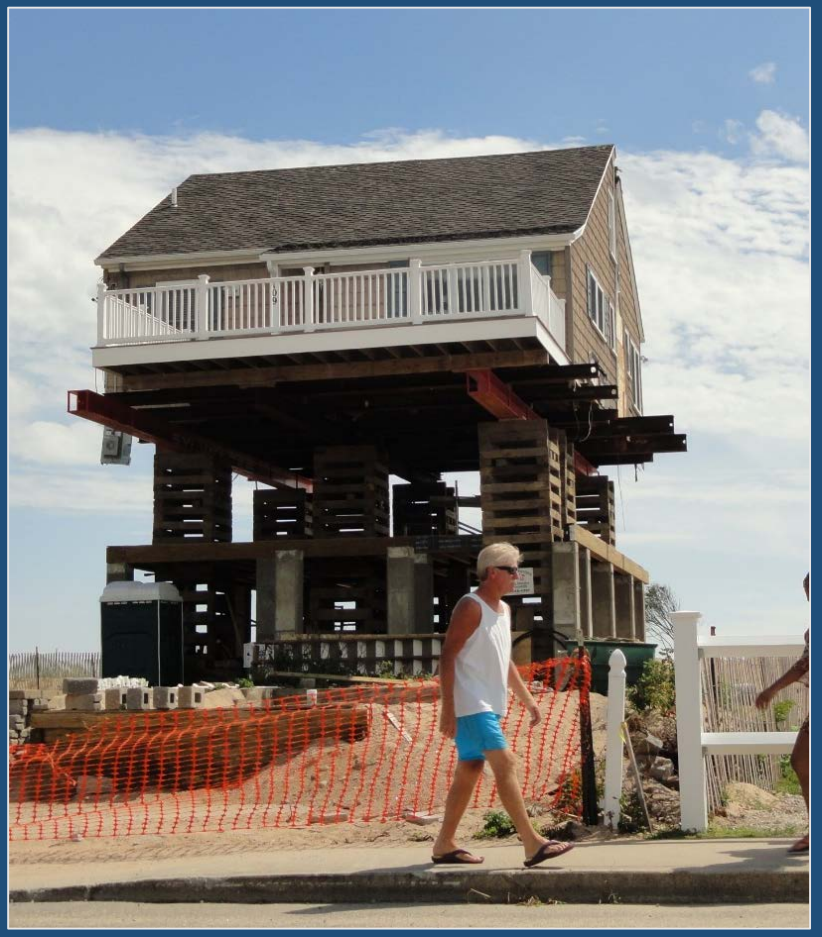
Know Your Risk



Make a Plan

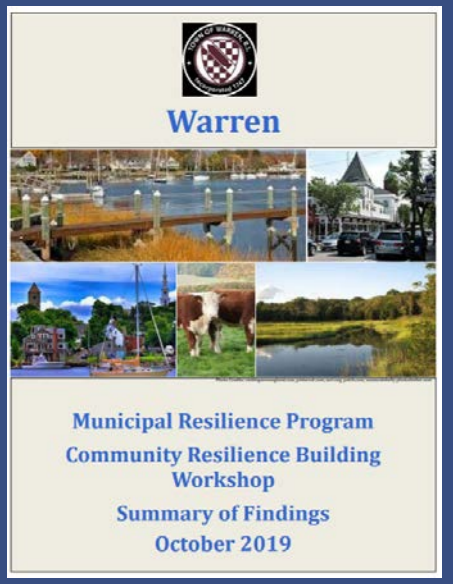


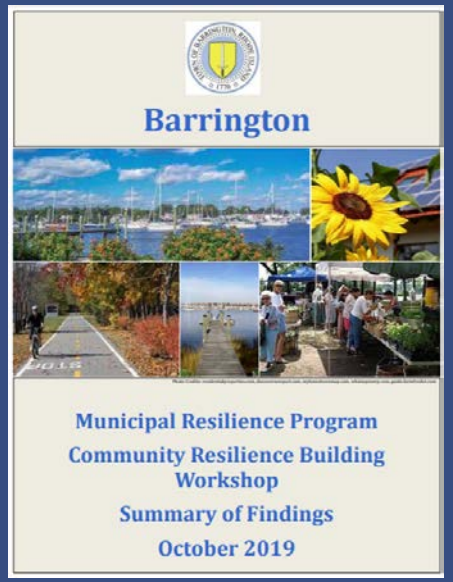
Take Action

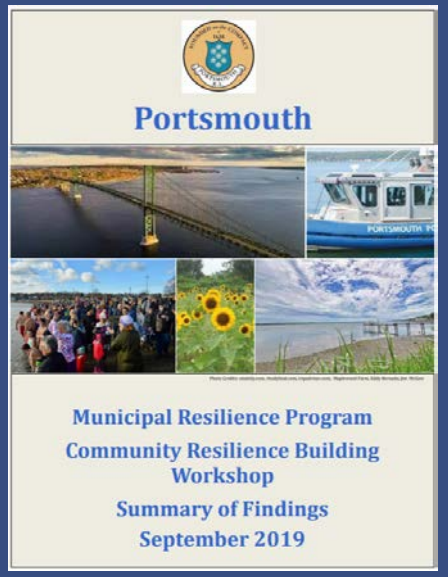


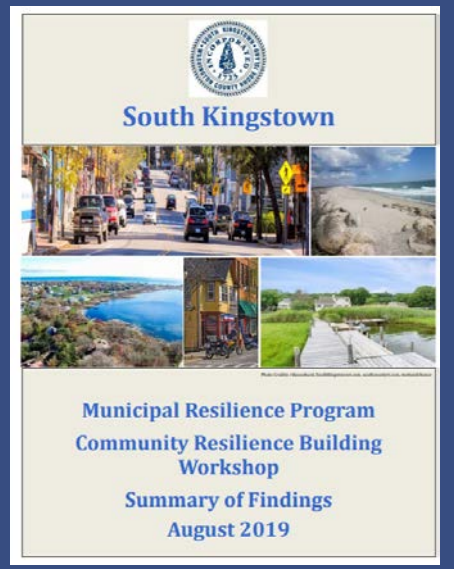
MAKE A PLAN
Municipalities Plan for Resilience

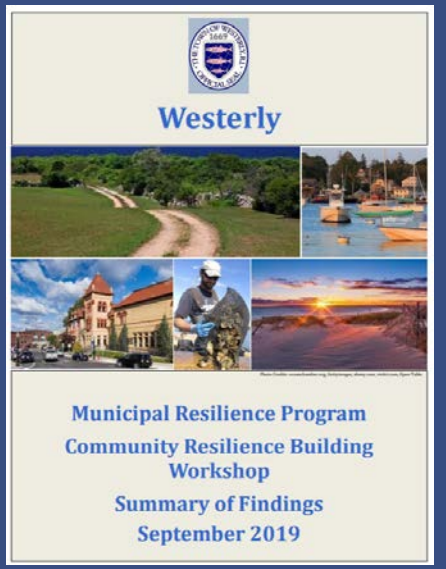
https://www.riib.org/mrp











MAKE A PLAN - Business Tools

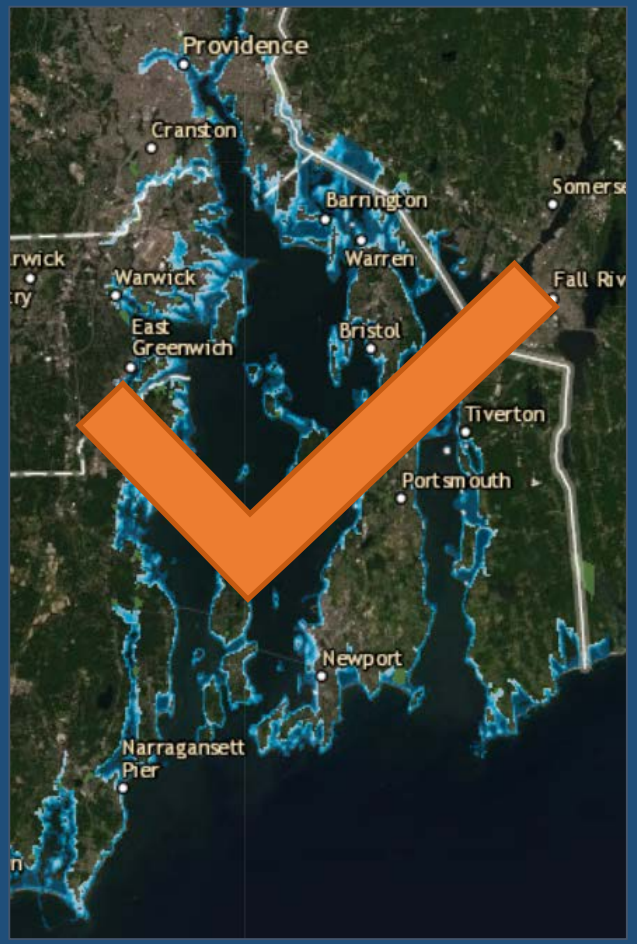
http://climatechange.ri.gov/businesses/small-biz.php

Printable Guides

Small Business Resilience Project (less than 50 employees)

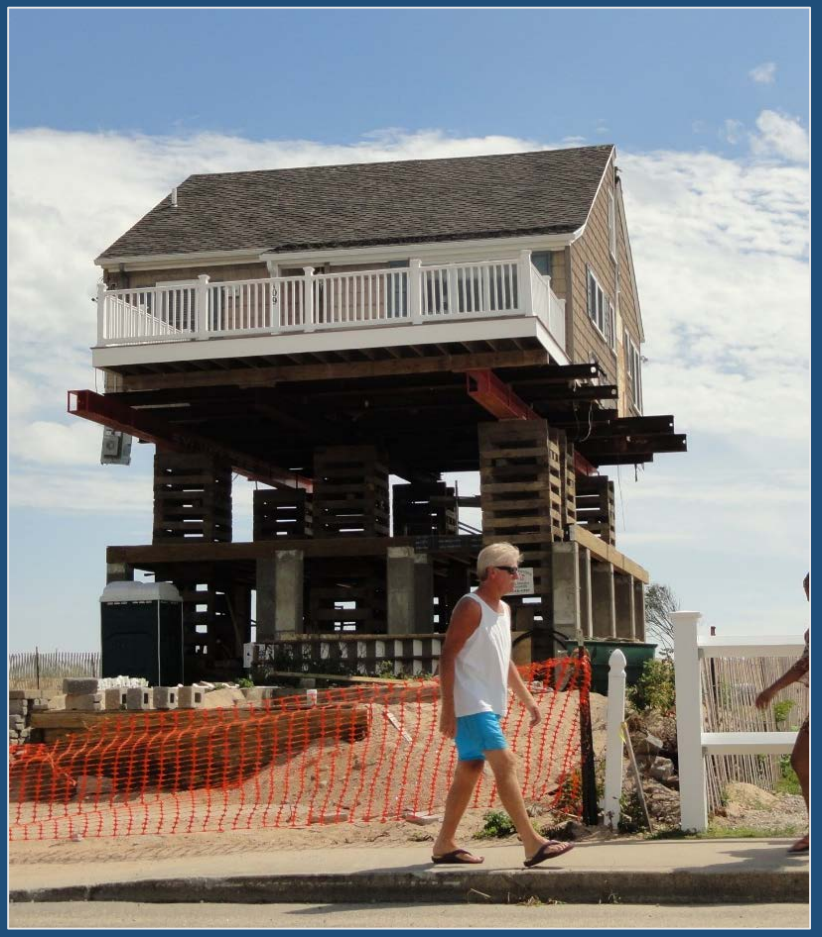
- Restaurant/Food Guide
- Retail Guide
- Lodging & Accommodations Guide
- Water-Dependent Guide
- Manufacturing Guide
- Service Provider Guide
- Construction Guide
- Real Estate / Property Management Guide

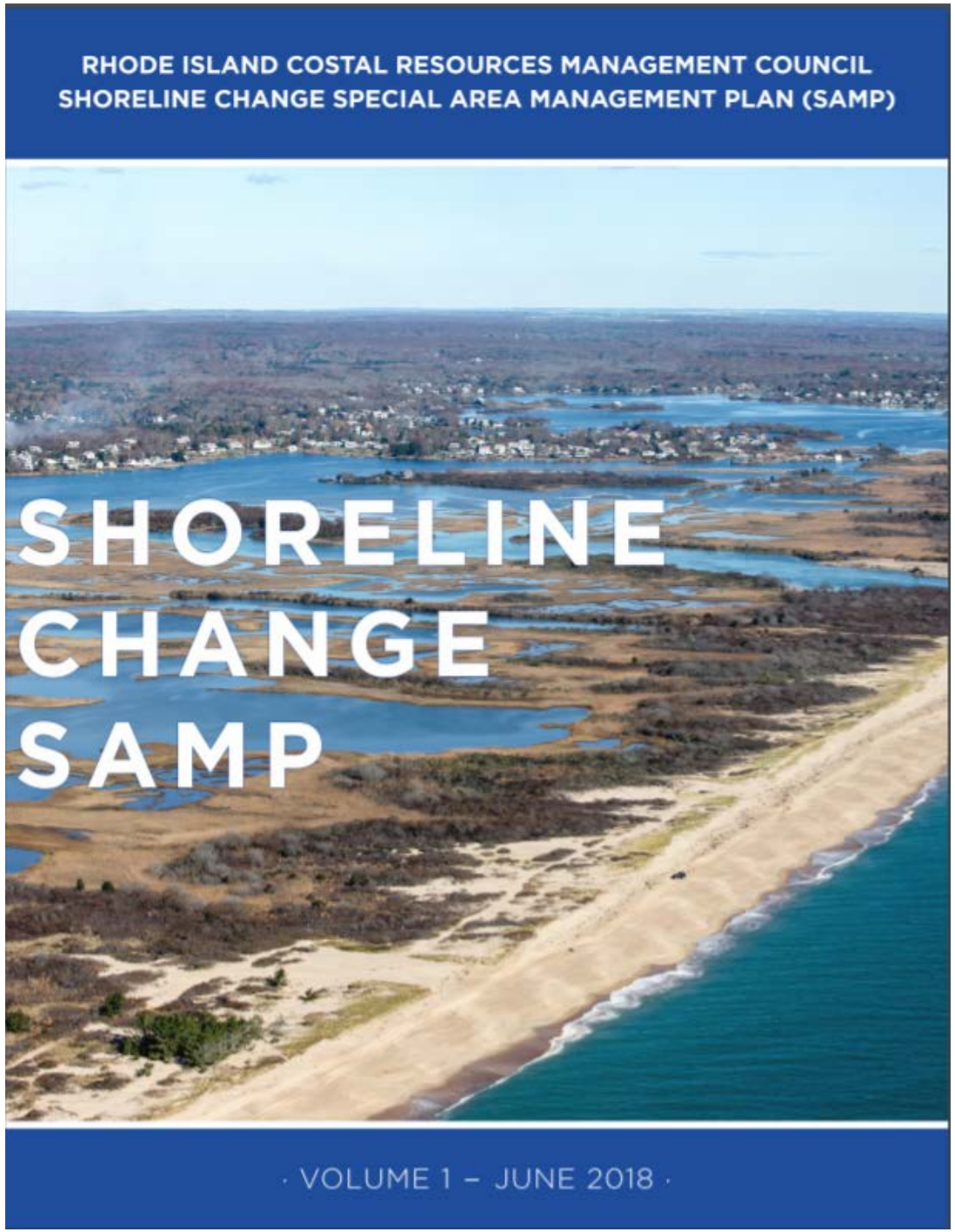
Know Your Risk



Make a Plan

Take Action



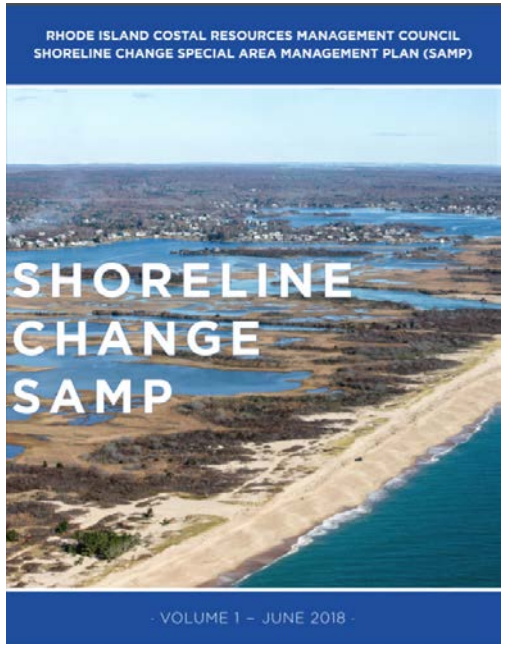


Chapter 7: Adaptation Strategies and Techniques for Coastal Properties

CRMC Coastal Resources Management Council

The University of Rhode Island Graduate School of Oceanography — CRC Coastal Resources Center

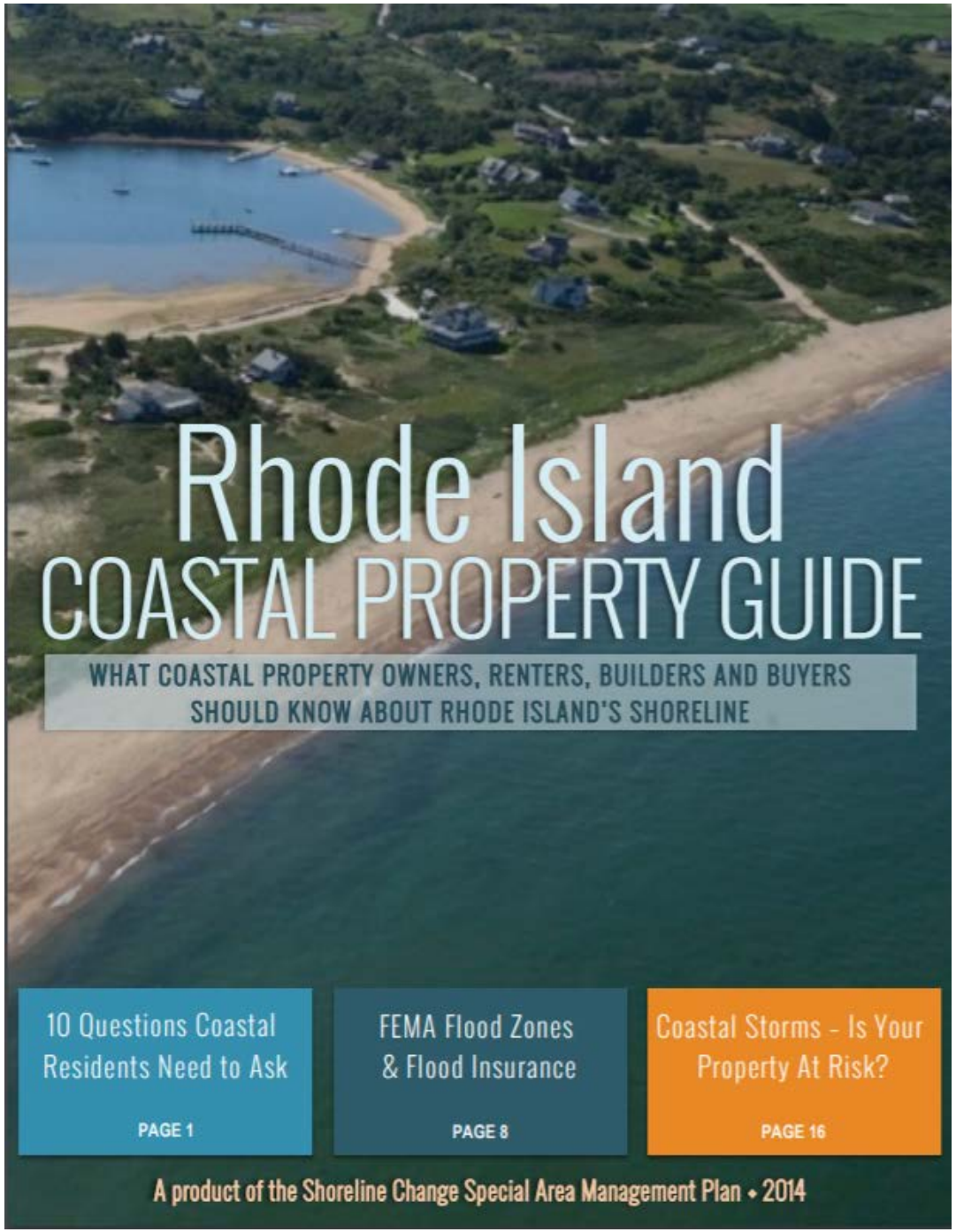
Sea Grant Rhode Island



Chapter 7: Adaptation Strategies and Techniques for Coastal Properties

Table 1. Summary table of coastal property adaptation tools and techniques

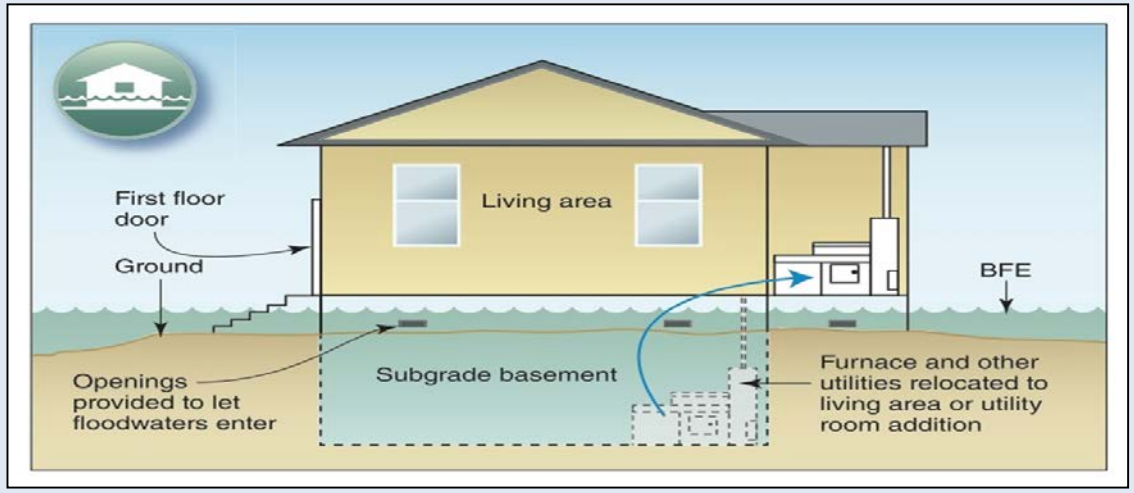
Strategy	*Existing or New Construction*	*Protection, Accommodation or Retreat*	*Site or Structure*
Site selection	New	Accommodation or Retreat	Site or structure
Distance inland	Existing or new	Retreat	Site or structure
Elevation	Existing or new	Accommodation	Site or structure
Terrain management			
Site grading	New	Accommodation	Site
Site layout	New	Accommodation	Site
Drainage	Existing or new	Accommodation	Site or structure
Natural or nature-based measures			
Coastal bank protection	Existing or new	Protection	Site
Living breakwaters	Existing or new	Protection	Site
Dune restoration	Existing or new	Protection	Site
Beach nourishment	Existing or new	Protection	Site
Coastal wetland or enhancement	Existing or new	Protection	Site



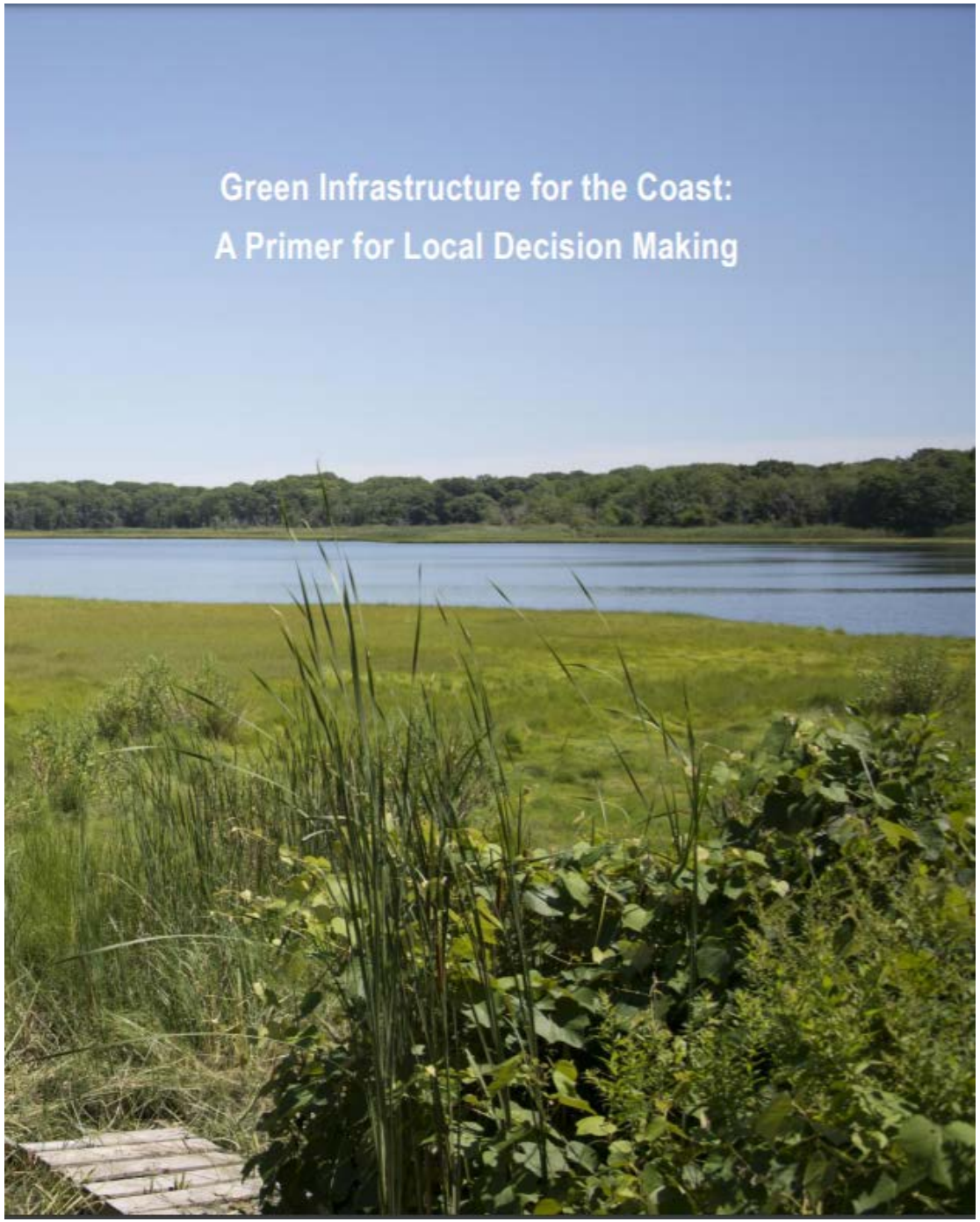
10 Questions Coastal Residents Should Ask About Coastal Property

Accommodating Flood Waters

Methods for allowing flood water to enter and exit a structure while minimizing damage are commonly used to accommodate flood waters. Examples: Elevating a structure, installing flood vents and raising utilities and electrical system components.



*** Courtesy of FEMA *Homeowner's Guide to Retrofitting****



10 Guiding Questions on Coastal Green Infrastructure

SHORELINE ADAPTATION, INVENTORY AND DESIGN

Marine Affairs Institute

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CRC

SAVE THE BAY®
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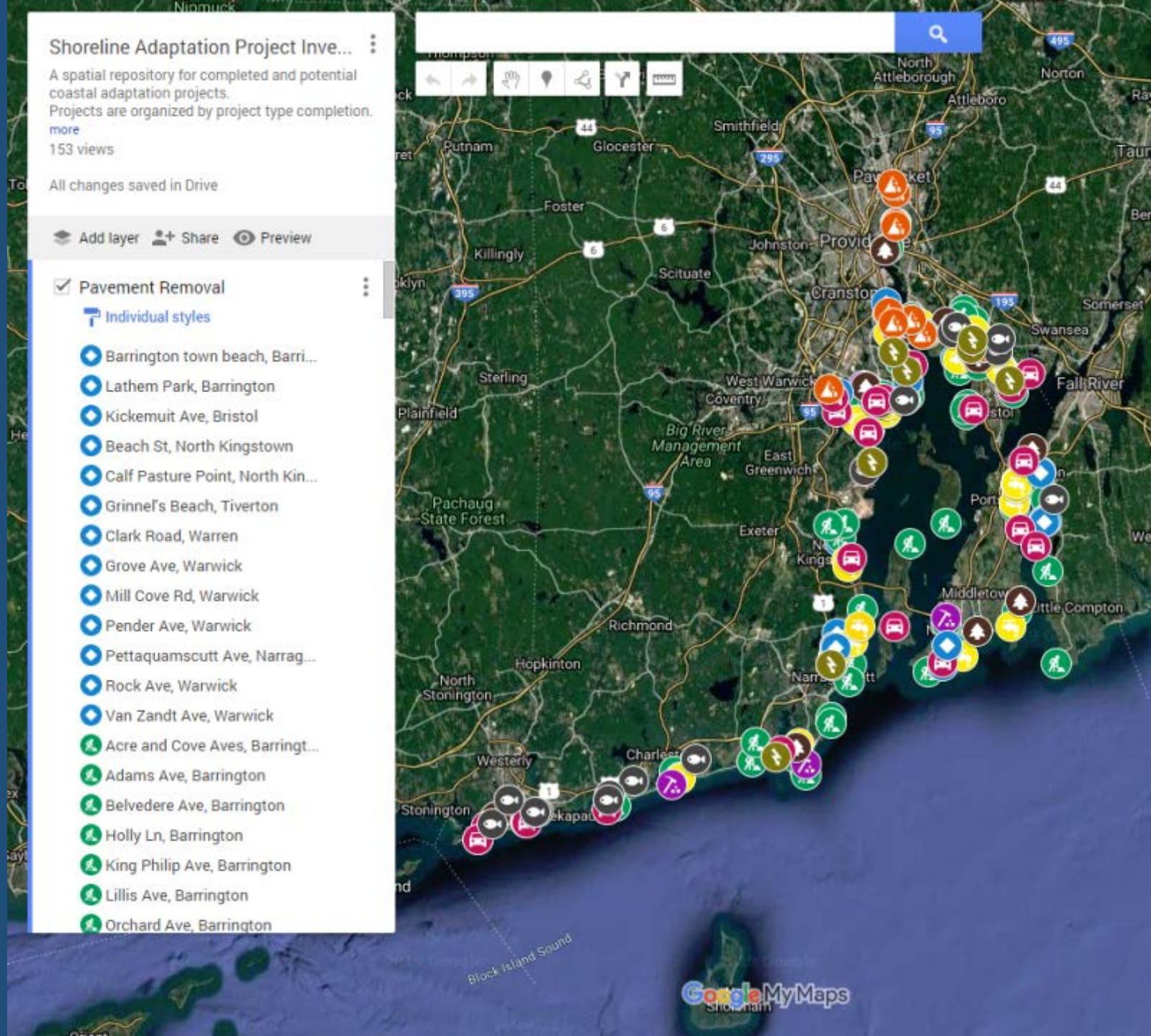
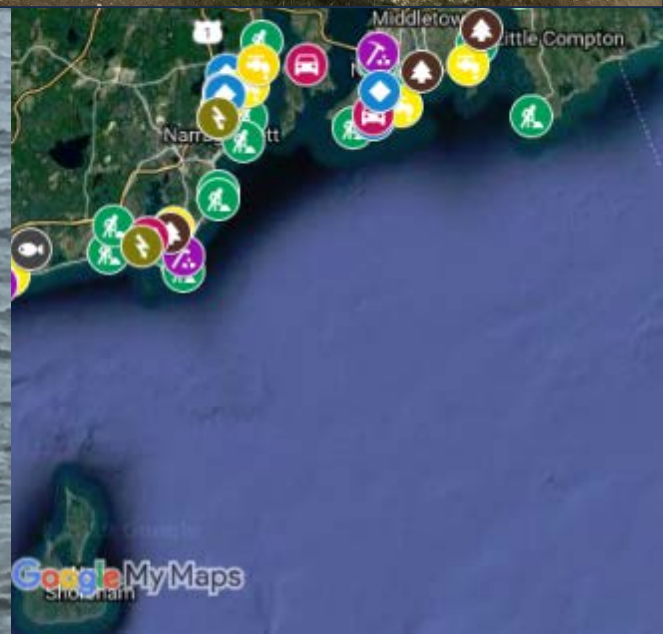
CRMC
COASTAL RESOURCES MANAGEMENT COUNCIL

PROJECT INVENTORY

- Pavement Removal
- Stormwater Management
- Structure Removal
- Natural Feature Restoration
- Road Relocation / Limit Vehicle Access
- Bank Re-Grading / Stabilization
- Culvert Redesign
- Utility Removal / Relocation

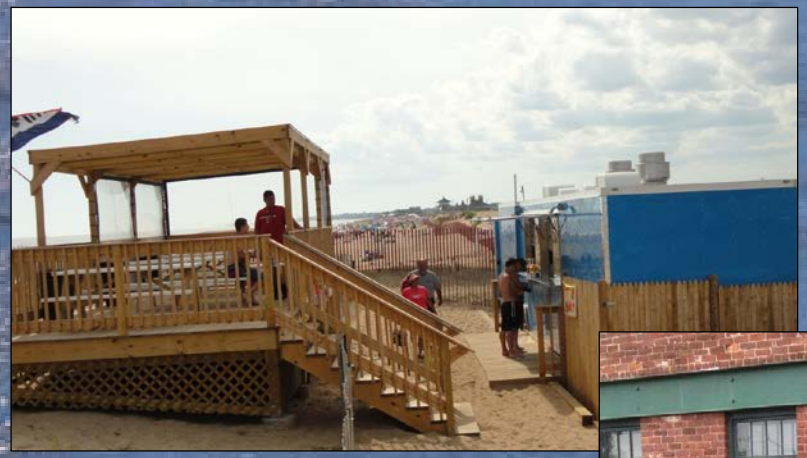


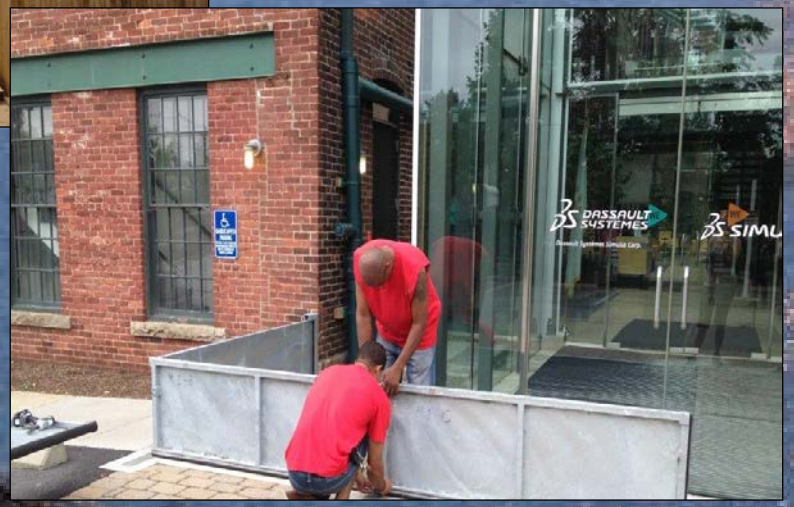

CRMC


Middletown
Little Compton
Google MyMaps

COASTAL RESILIENCE IN RHODE ISLAND

Introduction to STORMTOOLS & RI Adaptation in Progress





December 9, 2020
RI Rivers Council

Teresa A. Crean, AICP
University of Rhode Island Coastal Resources Center / RI Sea Grant

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