



Adaptation to Sea Level Rise in Saco Bay: Building Resiliency

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In partnership with:
**SOUTHERN MAINE
REGIONAL PLANNING
COMMISSION**

Project Funding from:



Coastal Resiliency Project

Outreach, Education, and Partnership Development

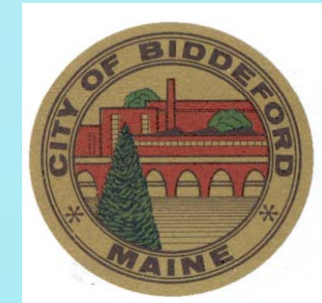
State Agencies – Regional Planning Commissions - Municipalities



Maine Coastal Program



DEPARTMENT OF CONSERVATION
MAINE
GEOLOGICAL SURVEY



Project Timeline – Year 3!

2007-2008 – Developing Hazard Resiliency Tools for Municipalities (*Pilot*)

- GIS data development to support efforts
- Initial outreach to Saco Bay communities
- Educational workshops on hazard data

2008-2009 – Enhancing Hazard Resiliency in Maine's Coastal Towns (Project)

- Continued educational workshops
- Meetings with Town officials
- Additional outreach (Kennebunk and York)

2009-2010 – Increasing Storm Hazard Resiliency in Selected Coastal Towns (Project)

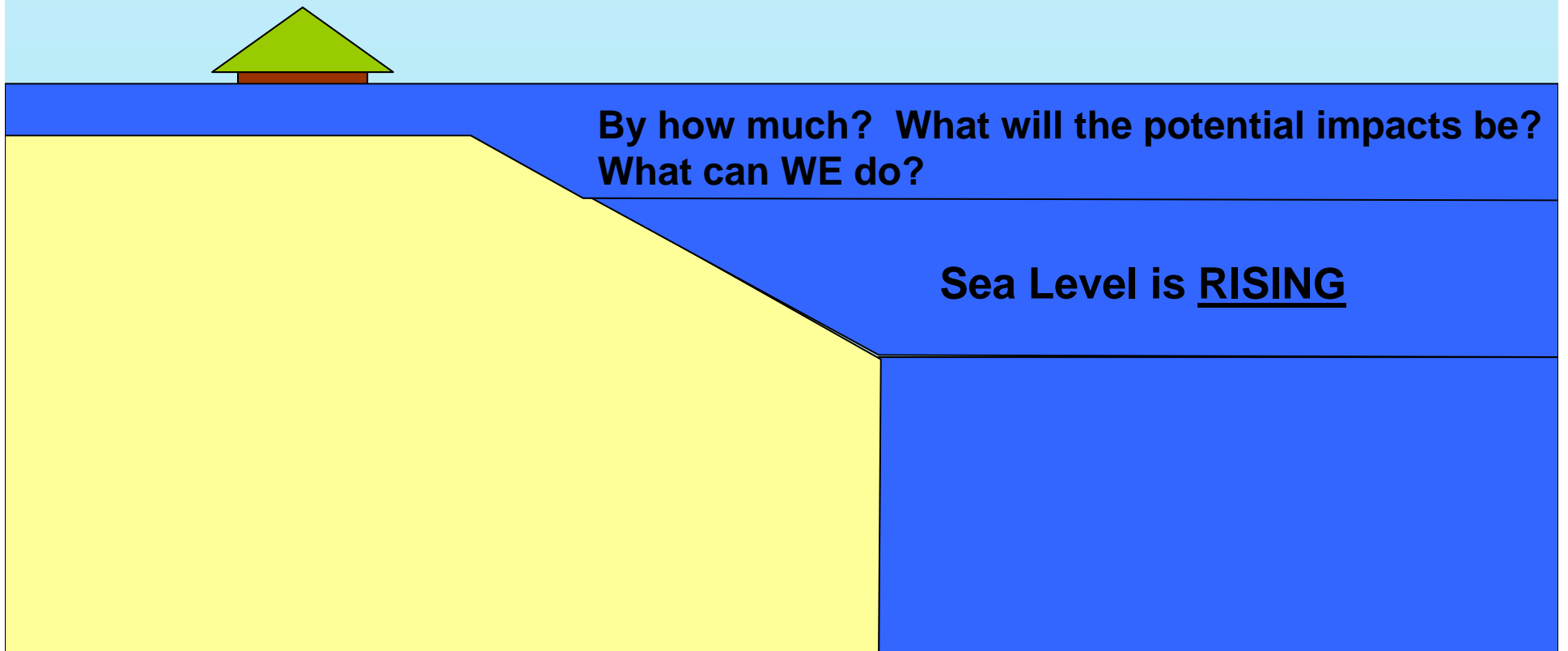
- Working on identification, adaptation, implementation
- SLAWG

Education – GIS Data and Tools

- Determining initial perspectives
- Education on Existing Hazards using Hazard Vulnerability Assessment Tools
- Identification of **Existing and Potential Future Hazards**
- Development of appropriate **Adaptation Techniques** for the **built and natural environments**
 - e.g., ordinances, tidal management improvements, capital improvements, etc.

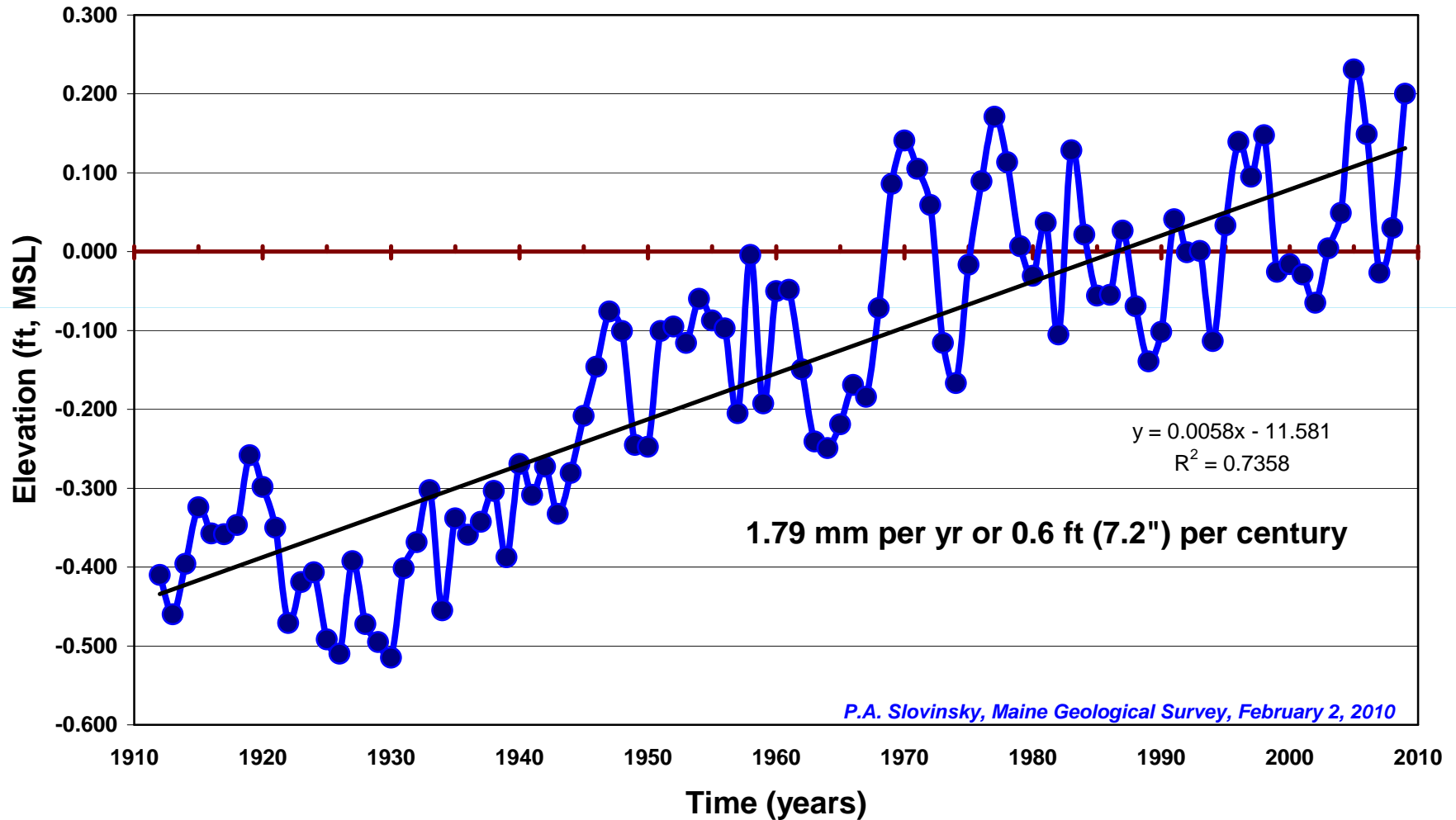
FOCUS ON SEA LEVEL IMPACTS

Framing the Problem



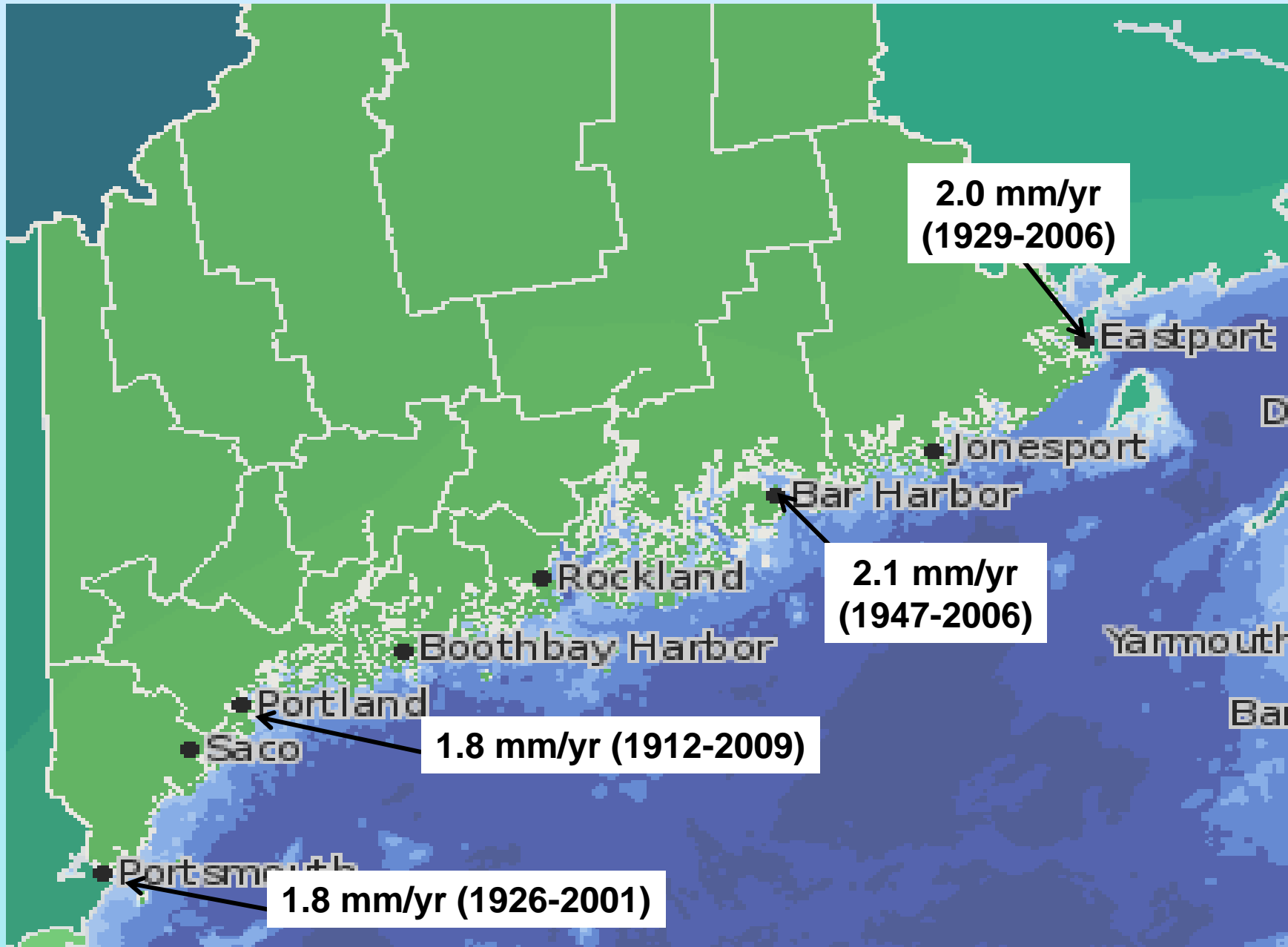
Sea Level, Portland, Maine

1912-2009



Portland Tide gauge = global ocean over last century **1.8 mm/yr** (IPCC, 2007).
In Maine, this is the fastest in past 3000 years

Documented Sea Level Rise

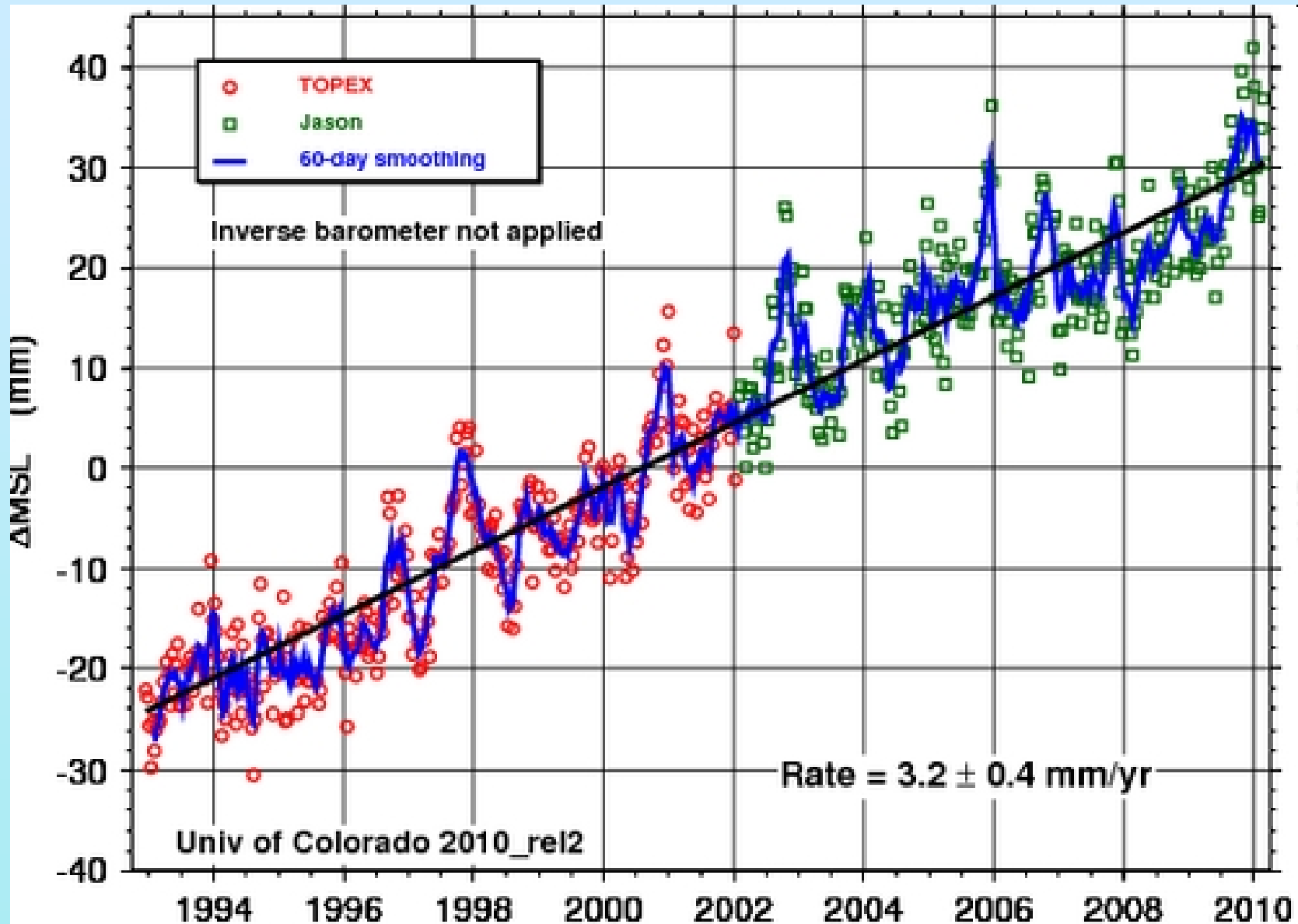


Data courtesy of NOAA CO-OPS

Measured Sea Level Changes in the Northeast

Station	Historic Rate (mm/yr)	R ²	50 yrs (")	100 yrs (")	Length of Record
Boston, MA.	↑ 2.7	0.8454	5.2	10.4	85 years
Seavey Island, ME	↑ 1.8	0.5879	3.5	7.1	58 years
Portland, ME	↑ 1.8	0.7364	3.6	7.2	94 years
Bar Harbor, ME	↑ 2.1	0.7145	4.1	8.3	58 years
Eastport, ME	↑ 2.0	0.7493	4.0	8.1	76 years
Saint John, NB	↑ 2.9	0.7529	5.8	11.6	70 years
Yarmouth, NS	↑ 2.9	0.7268	5.7	11.5	37 years
Halifax, NS	↑ 3.2	0.9246	6.3	12.6	106 years

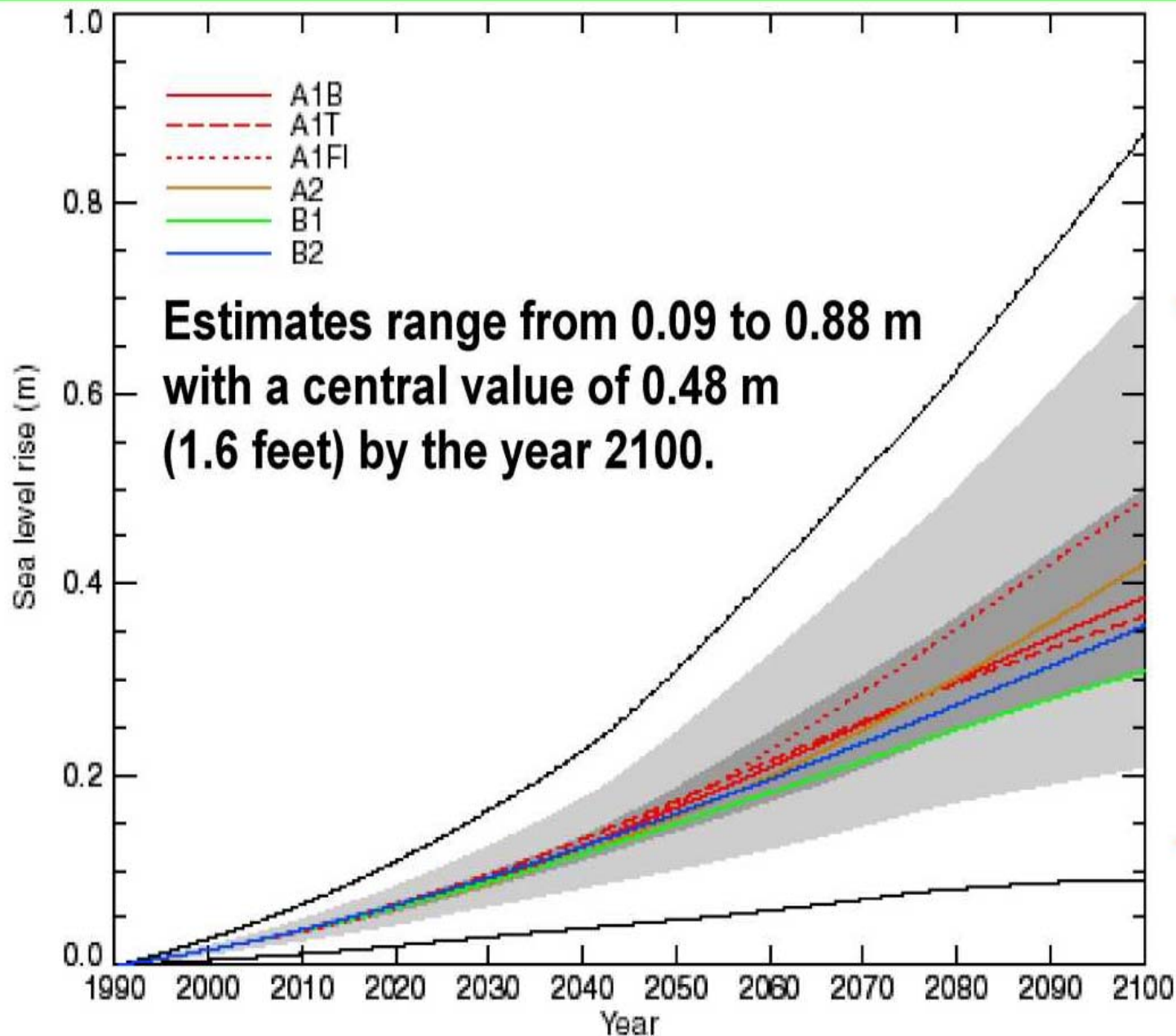
Based on *measurements*, about 7-8" (0.6-0.7 feet) of sea level rise has occurred along the Maine coast.



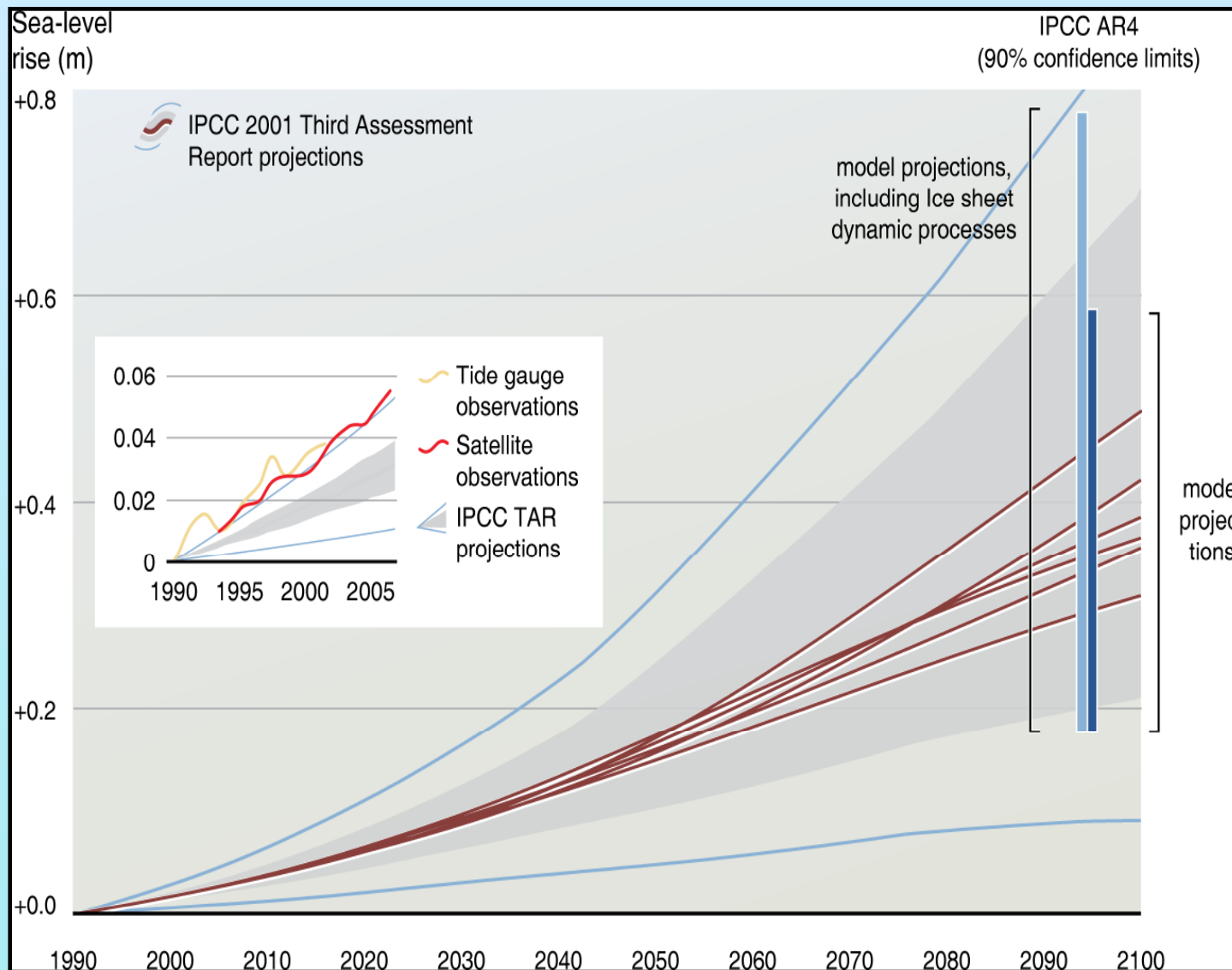
Satellite altimetry (1992-2010) = global sea level 3.2 ± 0.4 mm/yr

Portland during same time period = 1.9 mm/yr

<http://sealevel.colorado.edu/>



IPCC 3rd Assessment (Tech. Summary of Working Group I Report, Fig. 24, p. 74., 2001)



Hugo Ahlenius, United Nations Environment Programme, 2007

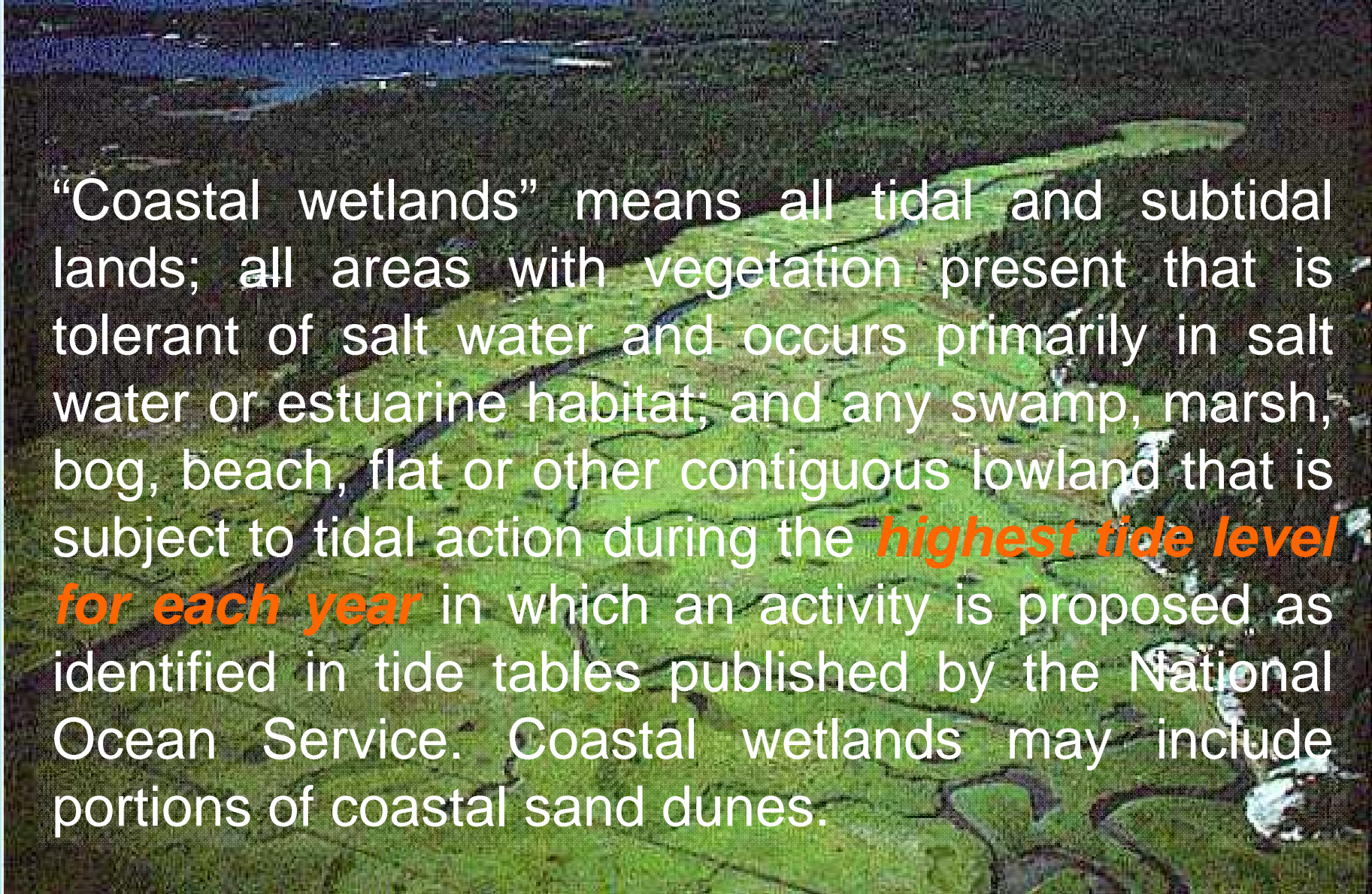
<http://maps.grida.no/go/graphic/projected-sea-level-rise-for-the-21st-century>

Coastal Sand Dune Rules (Chapter 355 NRPA)



In the coastal sand dune system, Maine is planning for **2 feet of sea level rise over the next 100 years**, which is generally a “middle-of-the road” prediction for global sea level rise.

Coastal wetlands



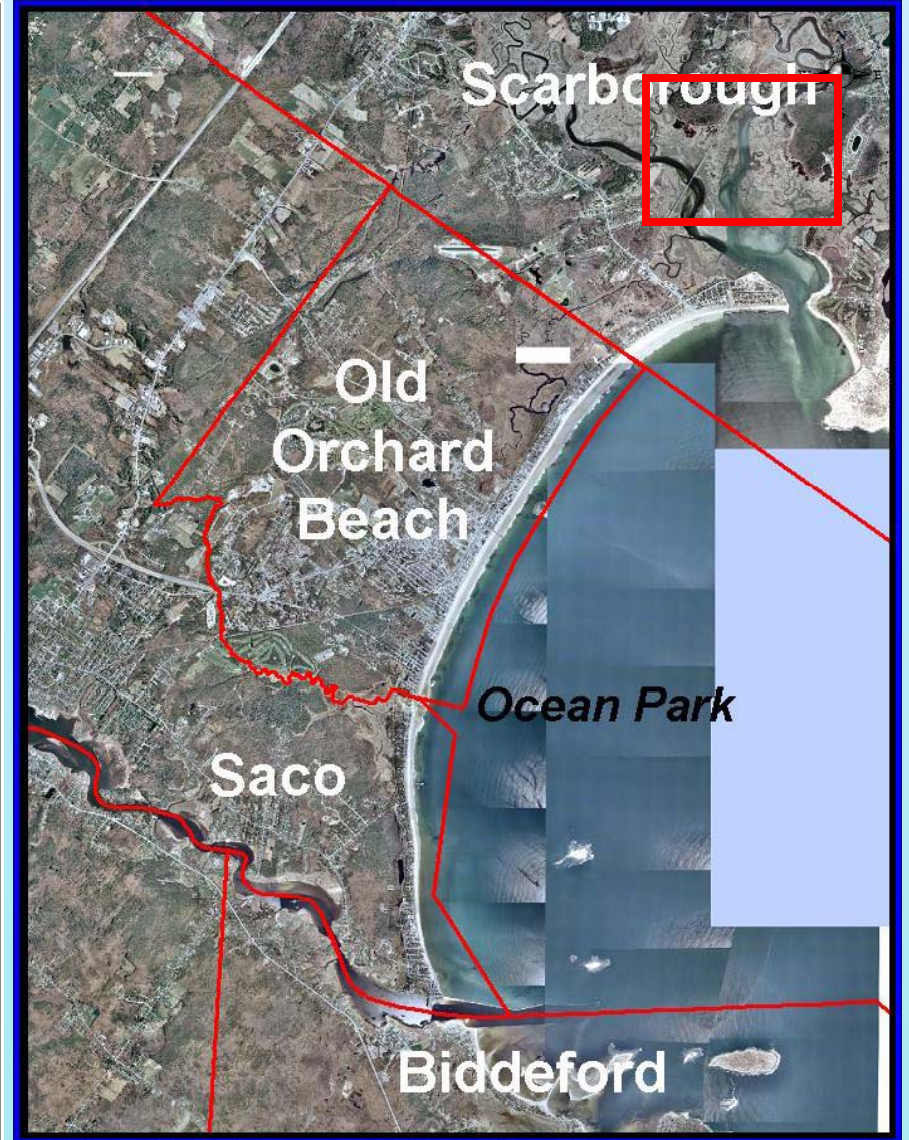
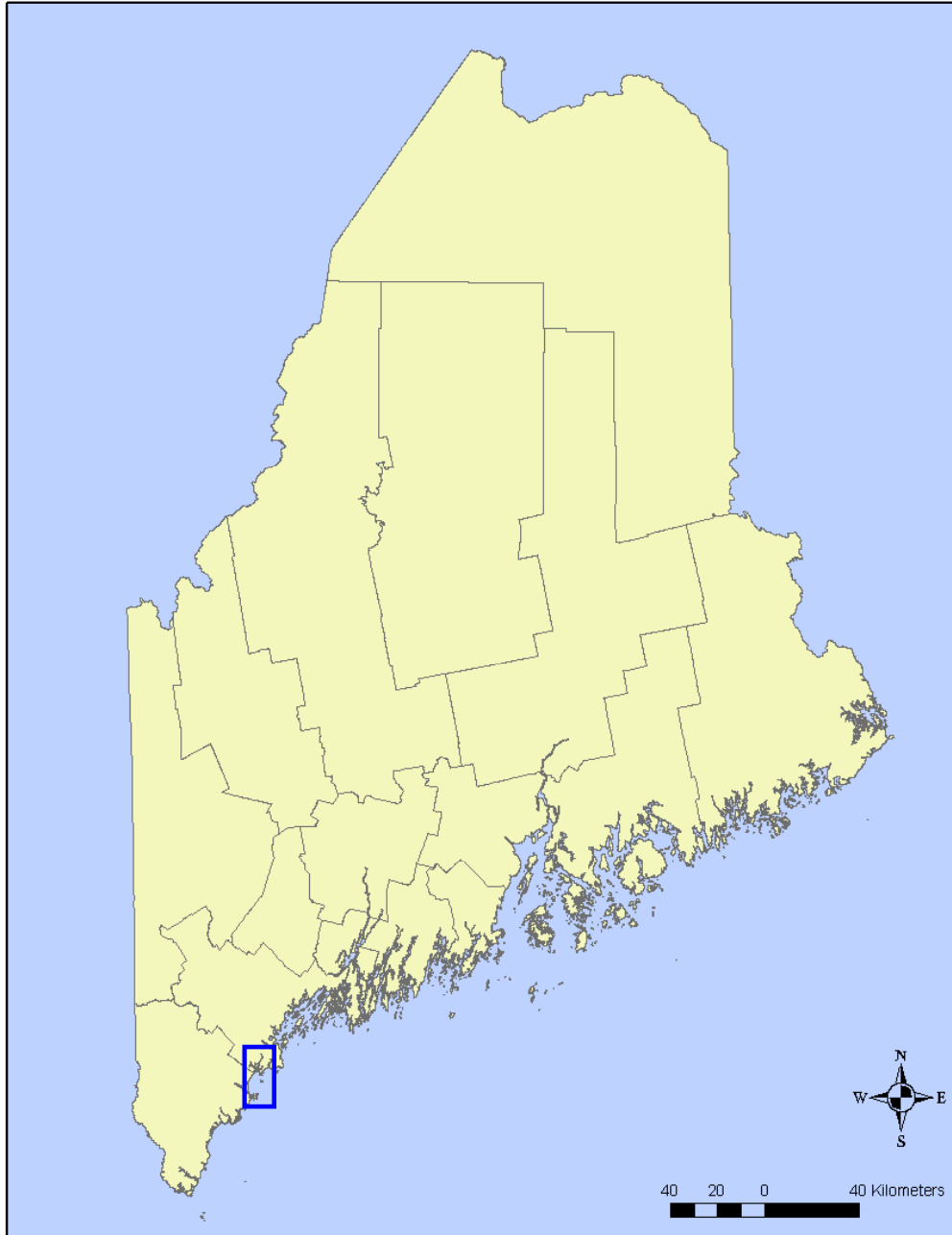
“Coastal wetlands” means all tidal and subtidal lands; all areas with vegetation present that is tolerant of salt water and occurs primarily in salt water or estuarine habitat; and any swamp, marsh, bog, beach, flat or other contiguous lowland that is subject to tidal action during the **highest tide level for each year** in which an activity is proposed as identified in tide tables published by the National Ocean Service. Coastal wetlands may include portions of coastal sand dunes.

Using the Sea Level Rise Inundation Tool

Steps:

- 1) Demonstrate accuracy of **LIDAR** in representing ground conditions.
- 2) Demonstrate accuracy in simulating **existing conditions** using **tidal elevations** to define marsh habitats and inundation
- 3) Simulate **potential impacts of sea level** rise on:
 - a) Existing infrastructure
 - b) Marsh habitat
- 4) Identify at-risk areas
- 5) Identify adaptation strategies

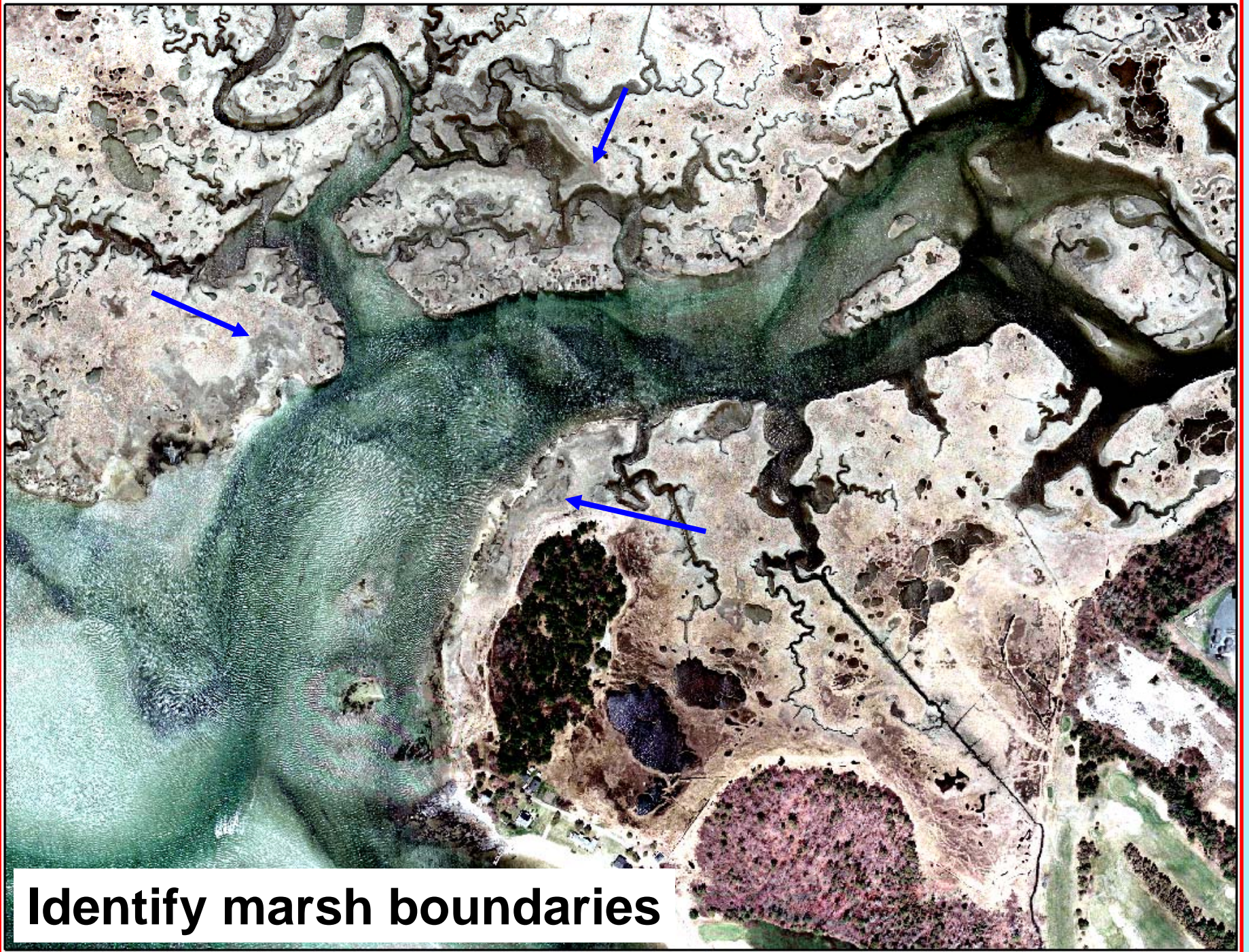
Saco Bay – Hazards and Habitats



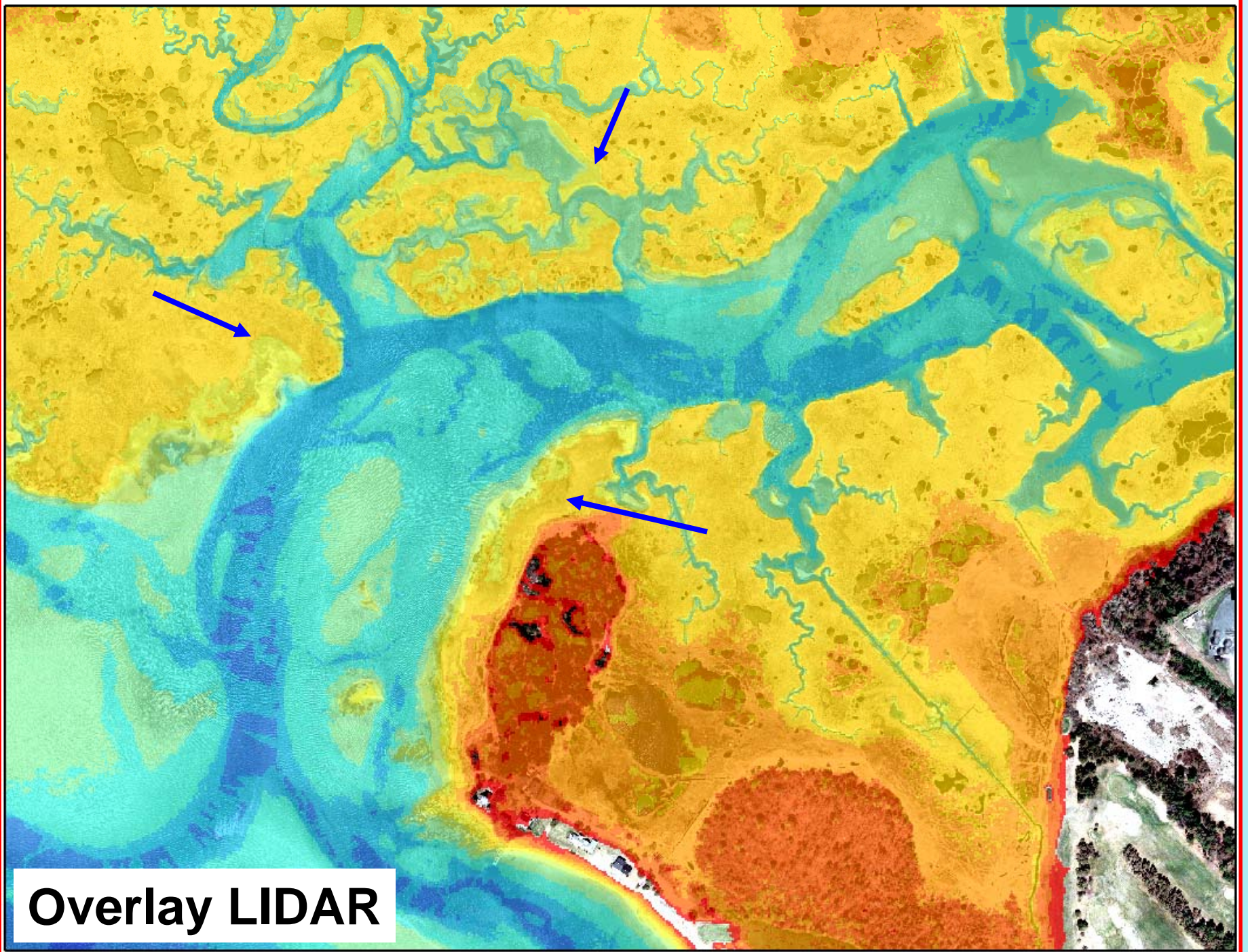
Marsh Habitats
Scarborough River, Scarborough

“Groundtruthing”





Identify marsh boundaries



Overlay LIDAR



Identify using tidal elevation ranges

High Marsh = Above MHW and below HAT

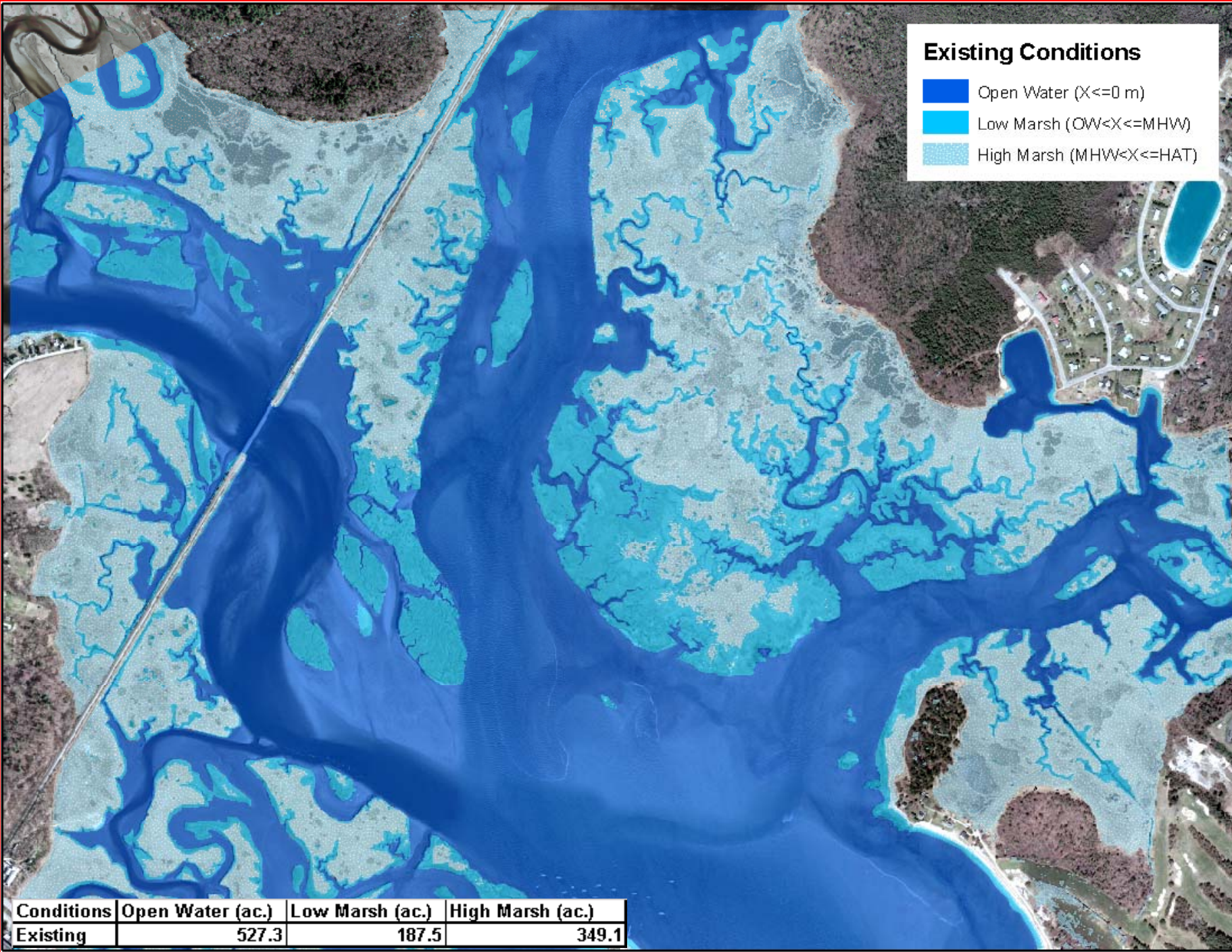
Low Marsh = Above MLW and below MHW

Open Water = Below MLW

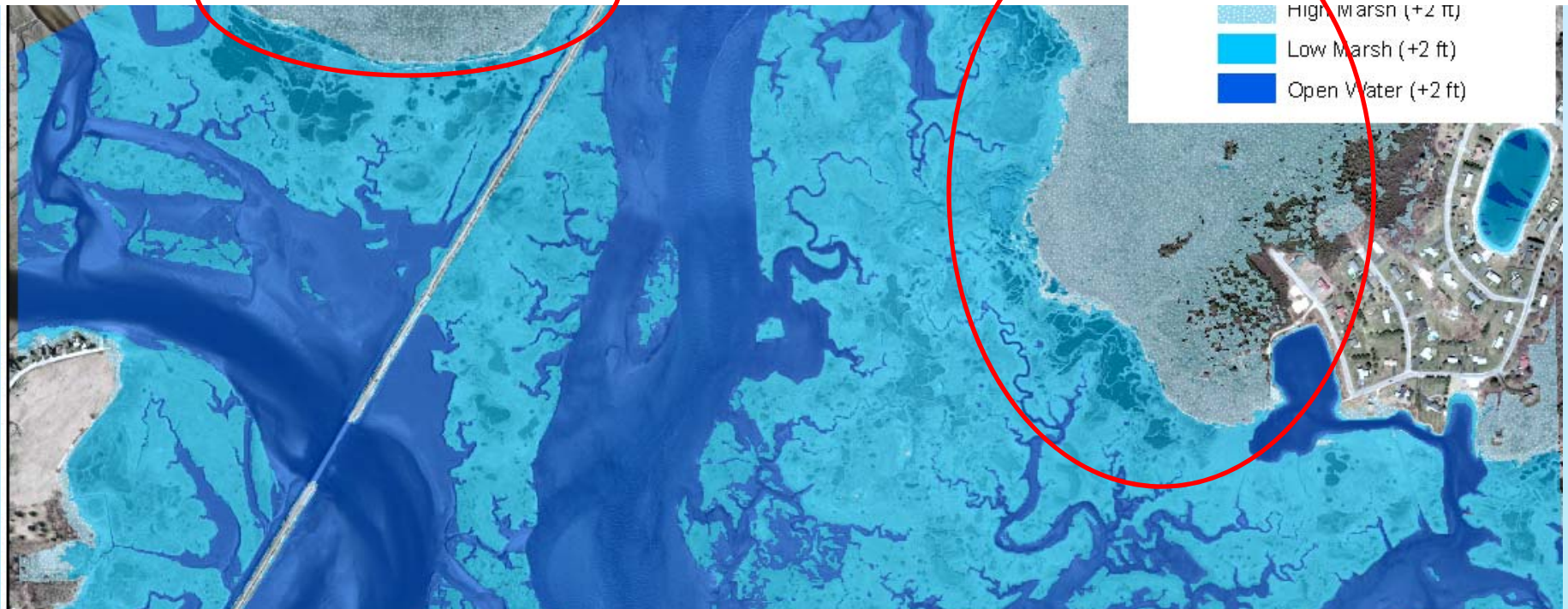


Use #1: Simulate Existing Conditions in Marshes

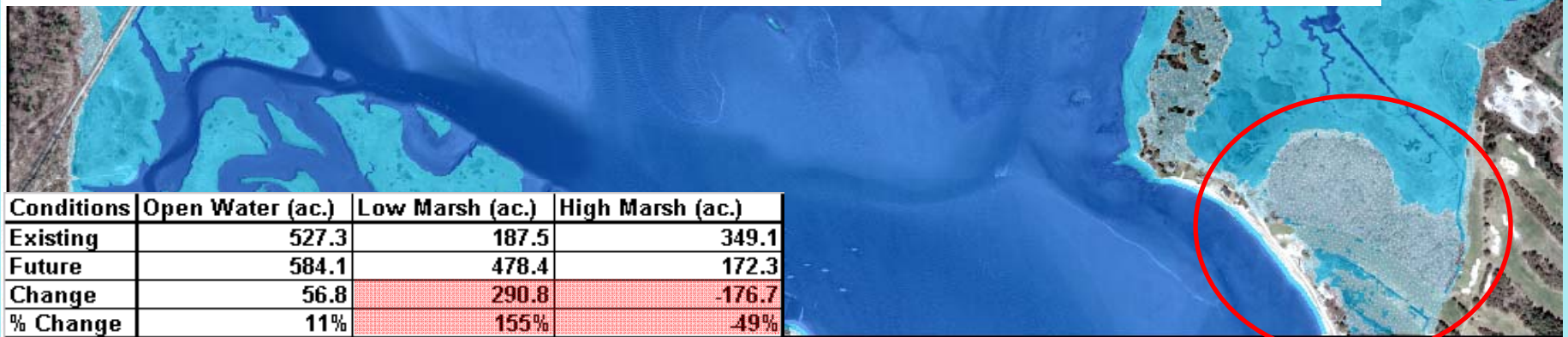




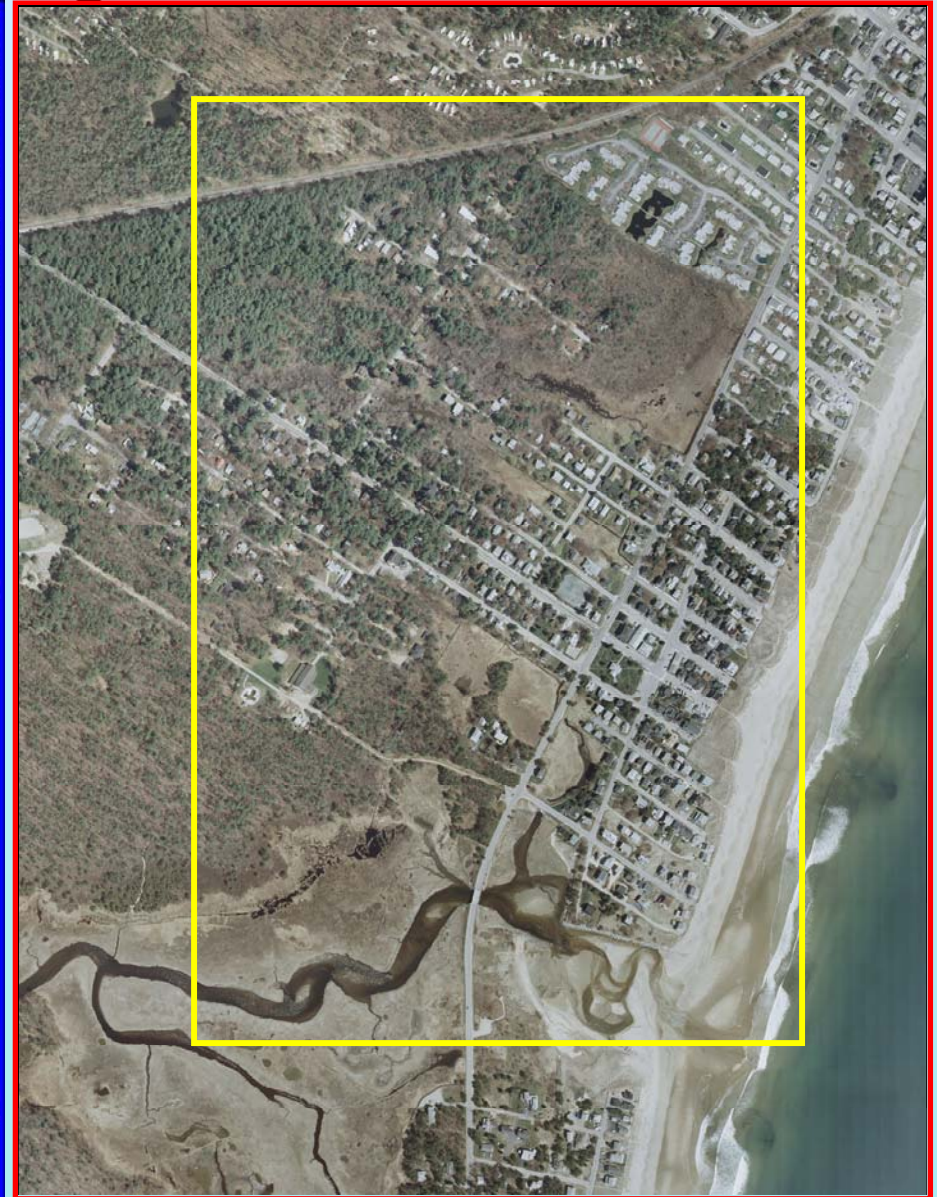
Use #2: Simulate Potential Future Marsh Conditions



Use #3: Identify low-lying uplands for marsh transgression

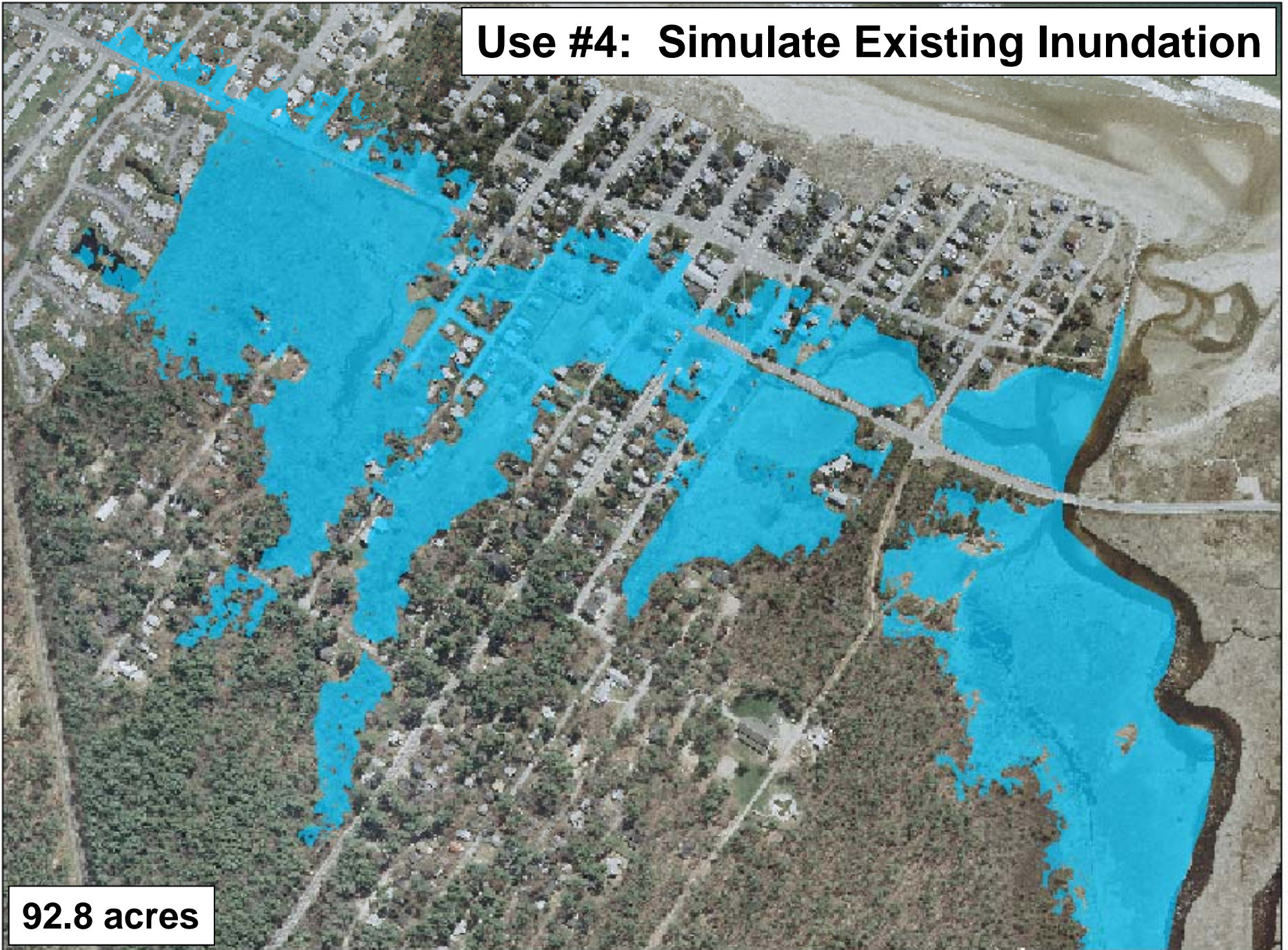


Simulation of Existing Conditions



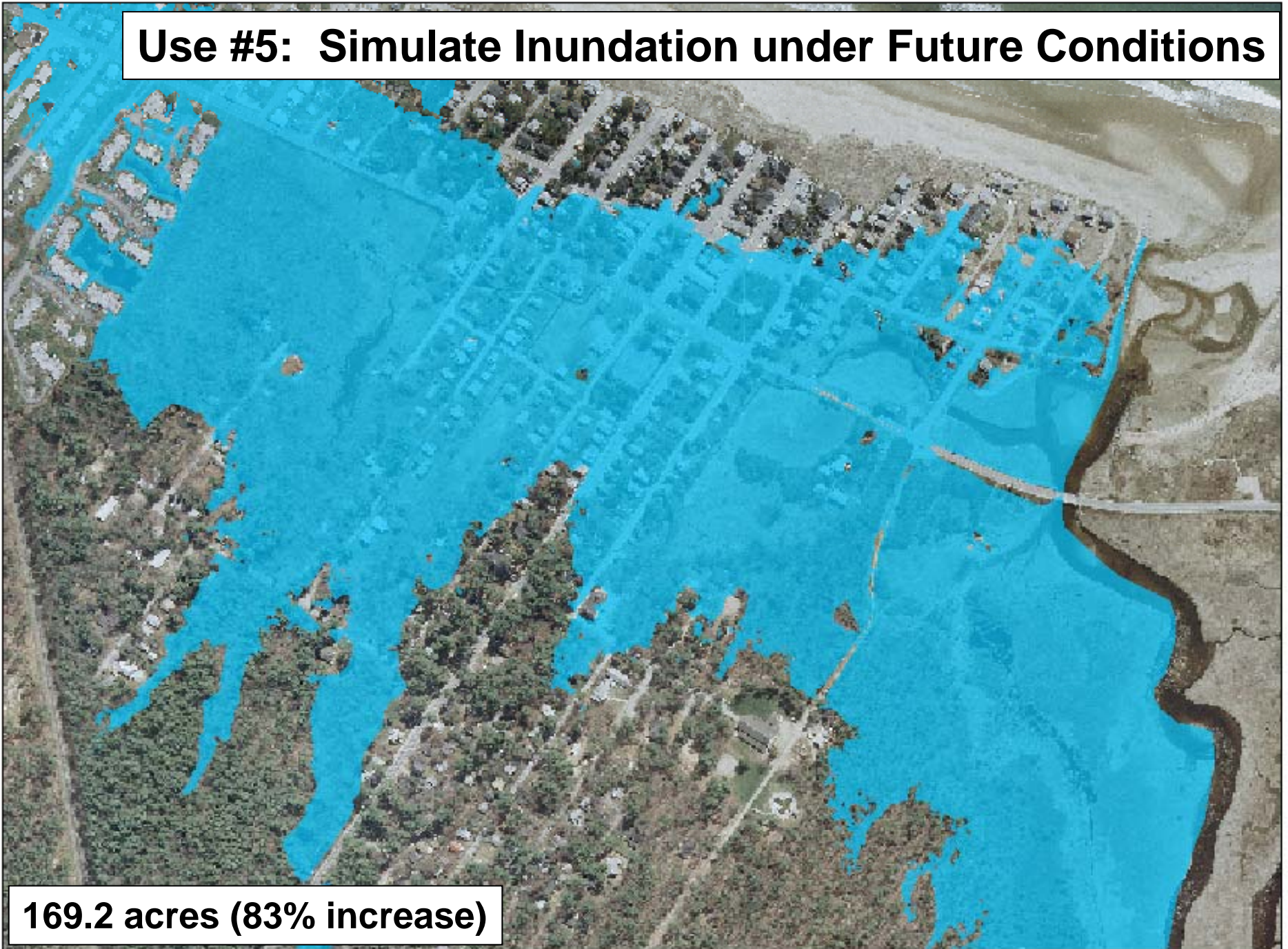
**Flooding and Inundation
Ocean Park, Old Orchard Beach**

Use #4: Simulate Existing Inundation



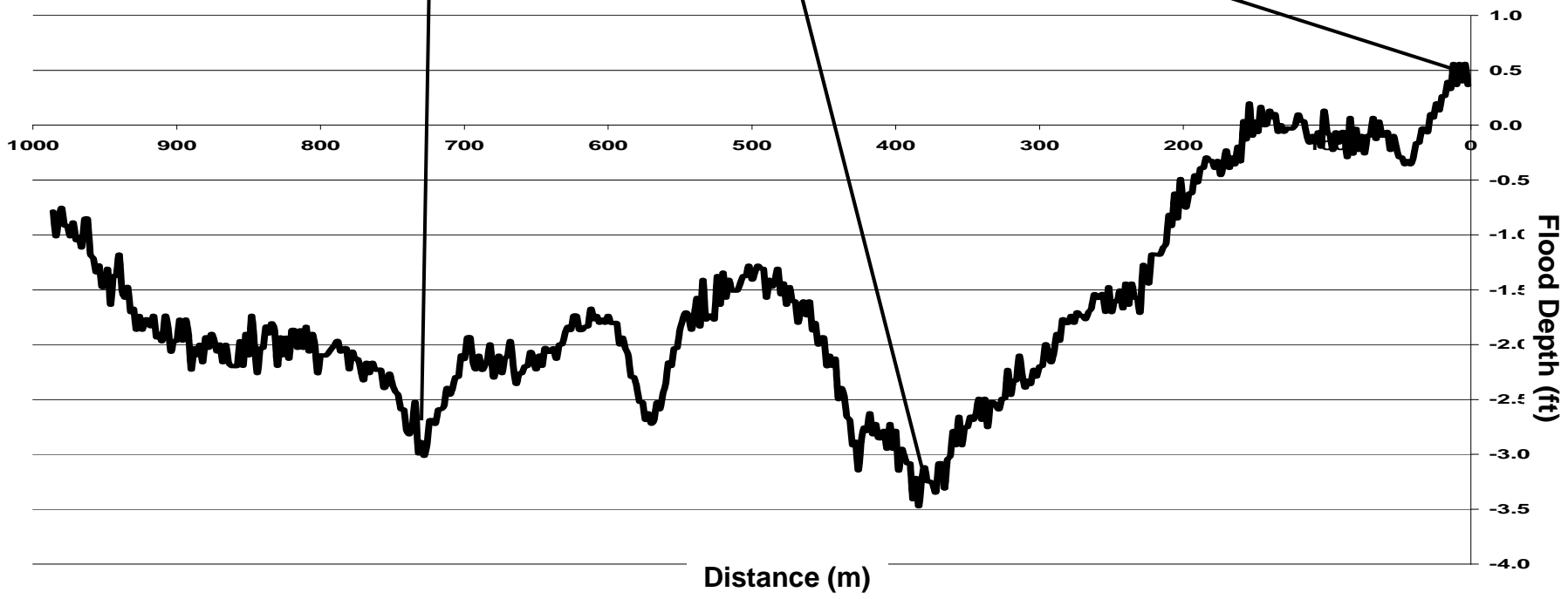
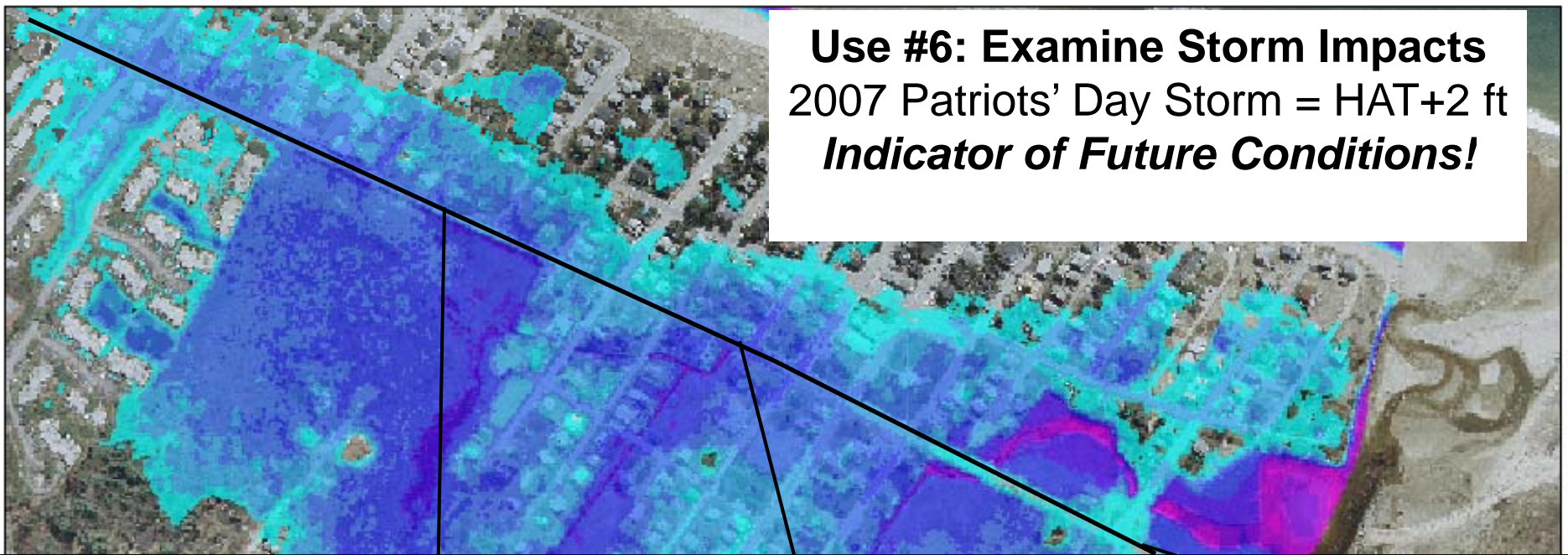
92.8 acres

Use #5: Simulate Inundation under Future Conditions



169.2 acres (83% increase)

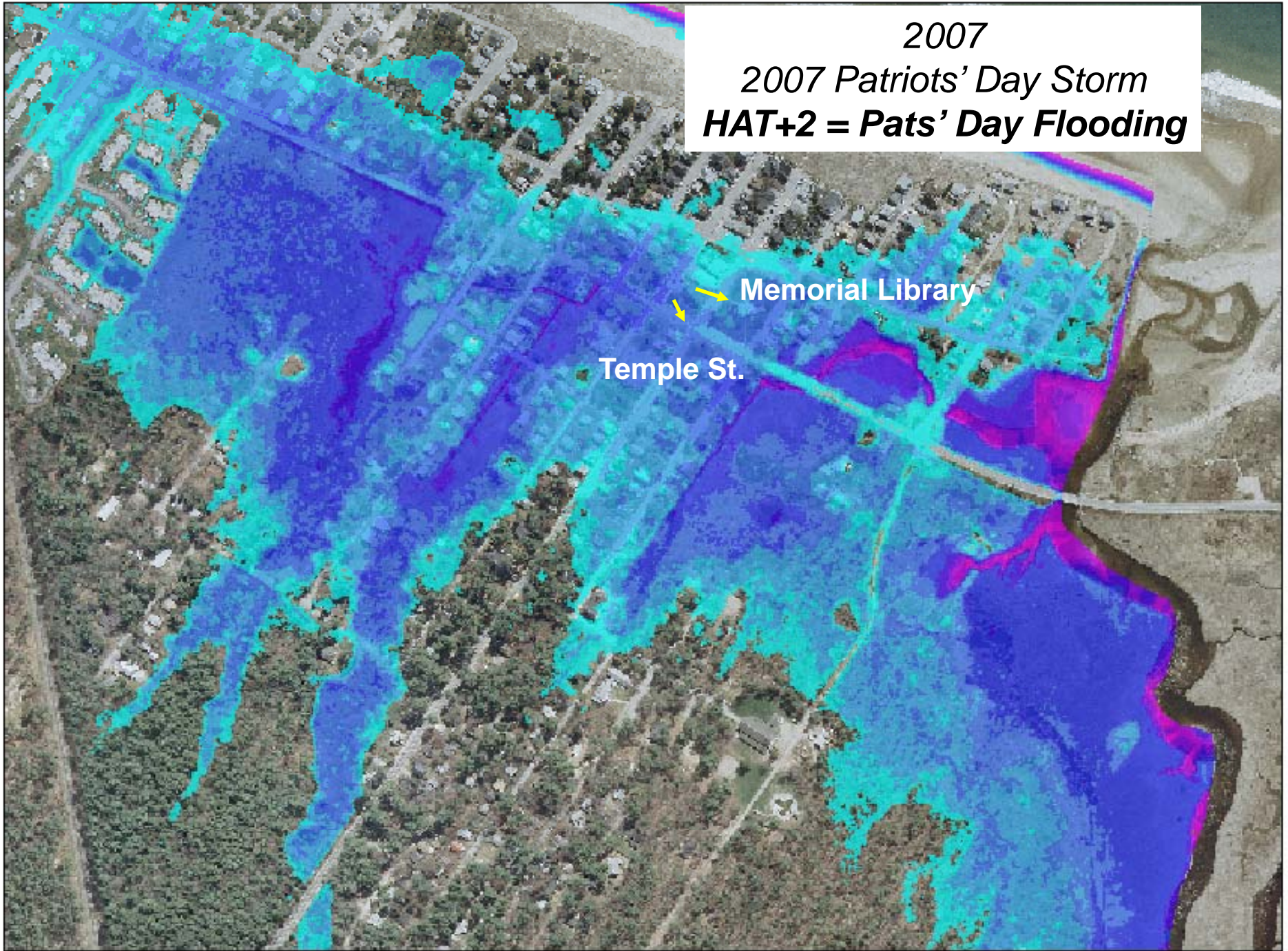
Use #6: Examine Storm Impacts
2007 Patriots' Day Storm = HAT+2 ft
Indicator of Future Conditions!



2007
2007 Patriots' Day Storm
HAT+2 = Pats' Day Flooding

Memorial Library

Temple St.





**Memorial Library
2-3 feet flooding**



**Temple St.
2-3 feet flooding**

2007
2007 Patriots' Day Storm
HAT+2 = Pats' Day Flooding









Memorial Library

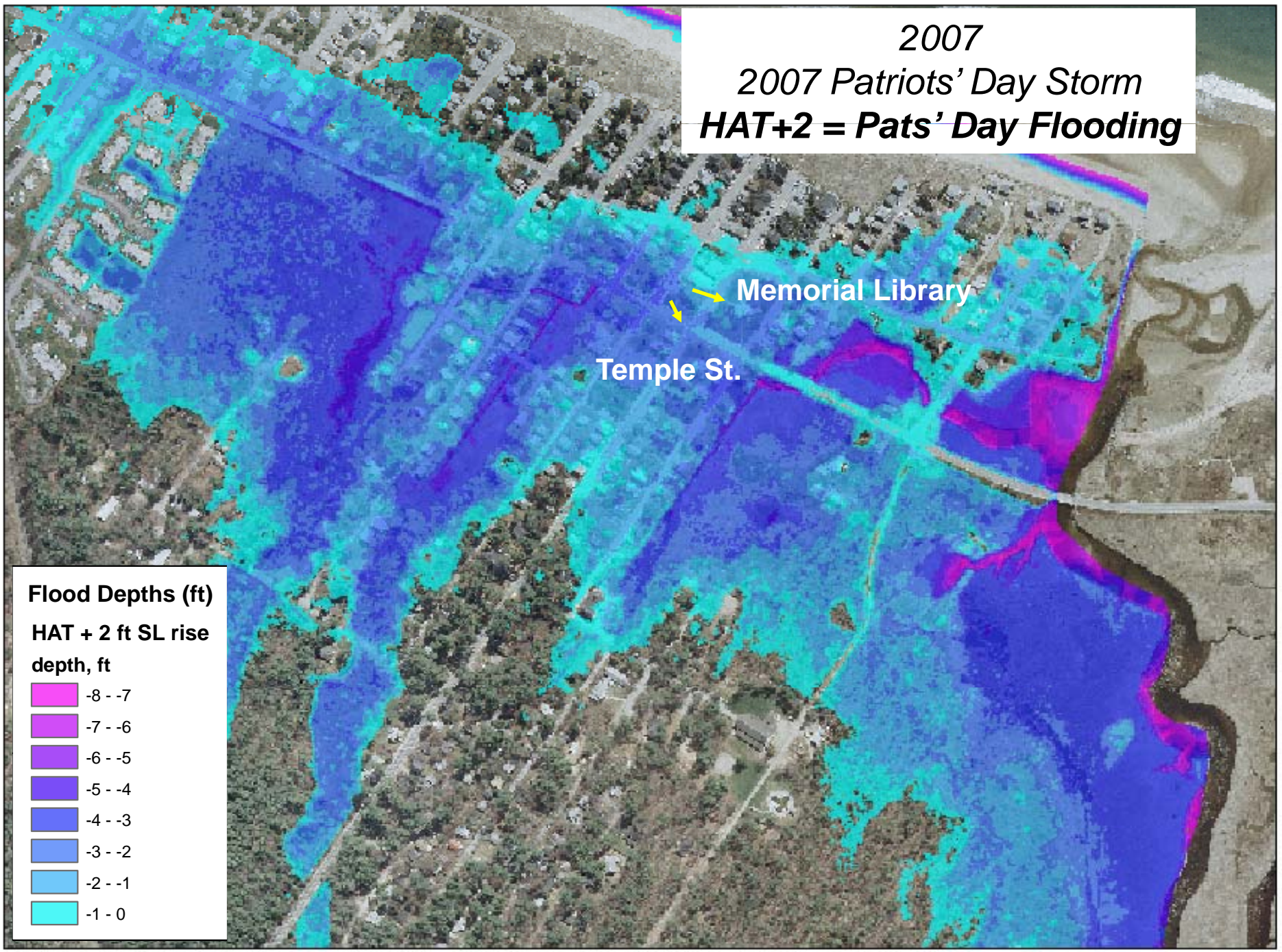
Temple St.

Flood Depths (ft)

HAT + 2 ft SL rise

depth, ft

-  -8 - -7
-  -7 - -6
-  -6 - -5
-  -5 - -4
-  -4 - -3
-  -3 - -2
-  -2 - -1
-  -1 - 0



Show Visualization Techniques (CanVis2.3)



Memorial Library

Visualization Techniques (CanVis2.3)



Temple Street

Simulation of Mapped Flood Conditions



Use #8: Simulate impacts to static floodplains



Existing A-zone (9 ft)



Future A-zone (11 ft)

Regional Adaptation Techniques

Adaptation Techniques

Wetland Restoration

Open Space Designation/Acquisition

“Future” Flood or Wetland Areas



Adaptation Techniques

*Tidal Flow Control
New locations?*



Emergency Access Rerouting Stormwater Improvements



April 16, 2007, approximately 10:00 am

Images courtesy of Bill Edwards, www.maineoastimages.com and NOAA NWS

Adaptation Techniques



Elevation and siting

Adaptation Techniques

*Sea Level Rise as
Future requirement?*



Adaptation Techniques



Dune Restoration

Adaptation Techniques

Selective Structure Improvement



Adaptation Techniques

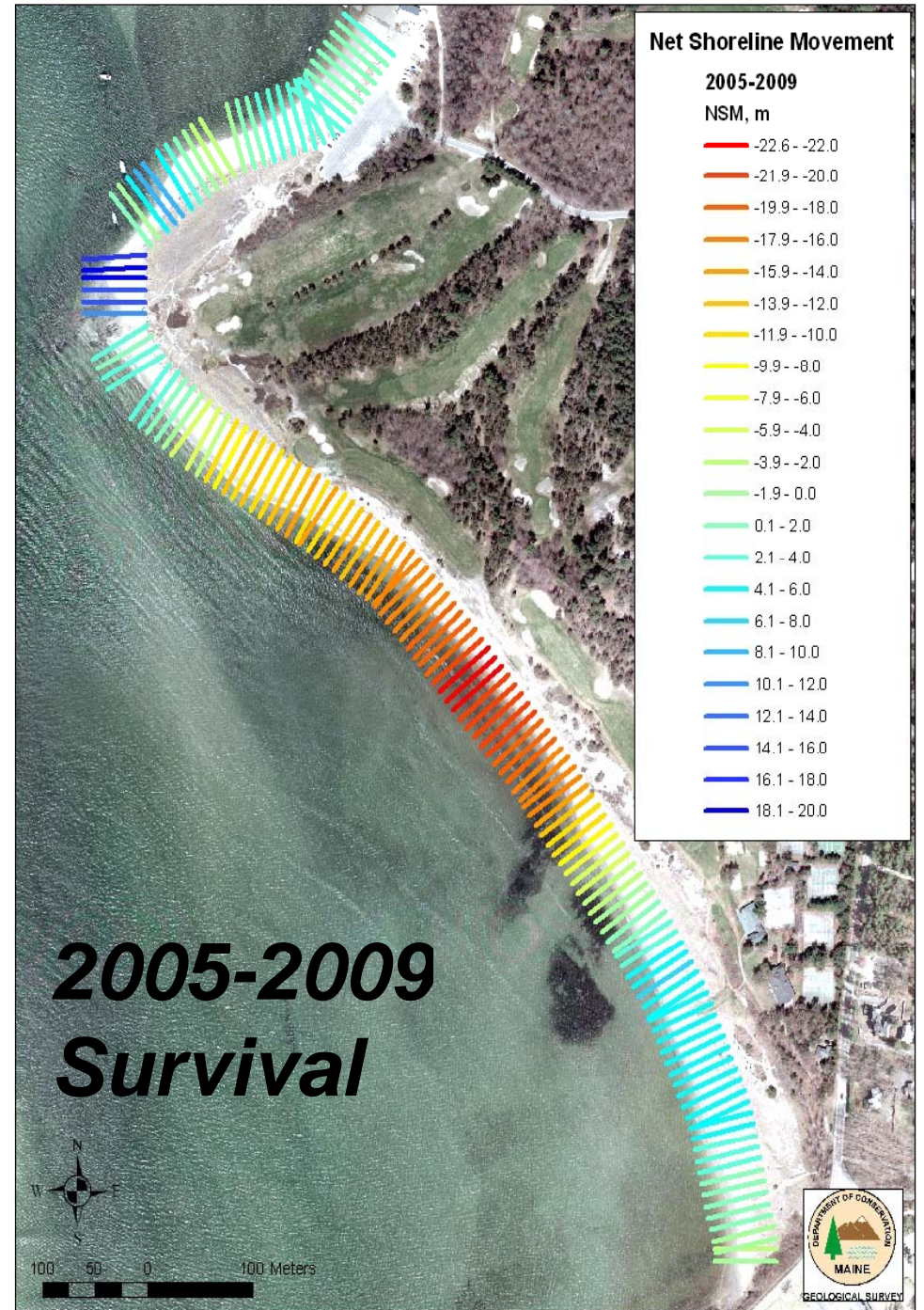


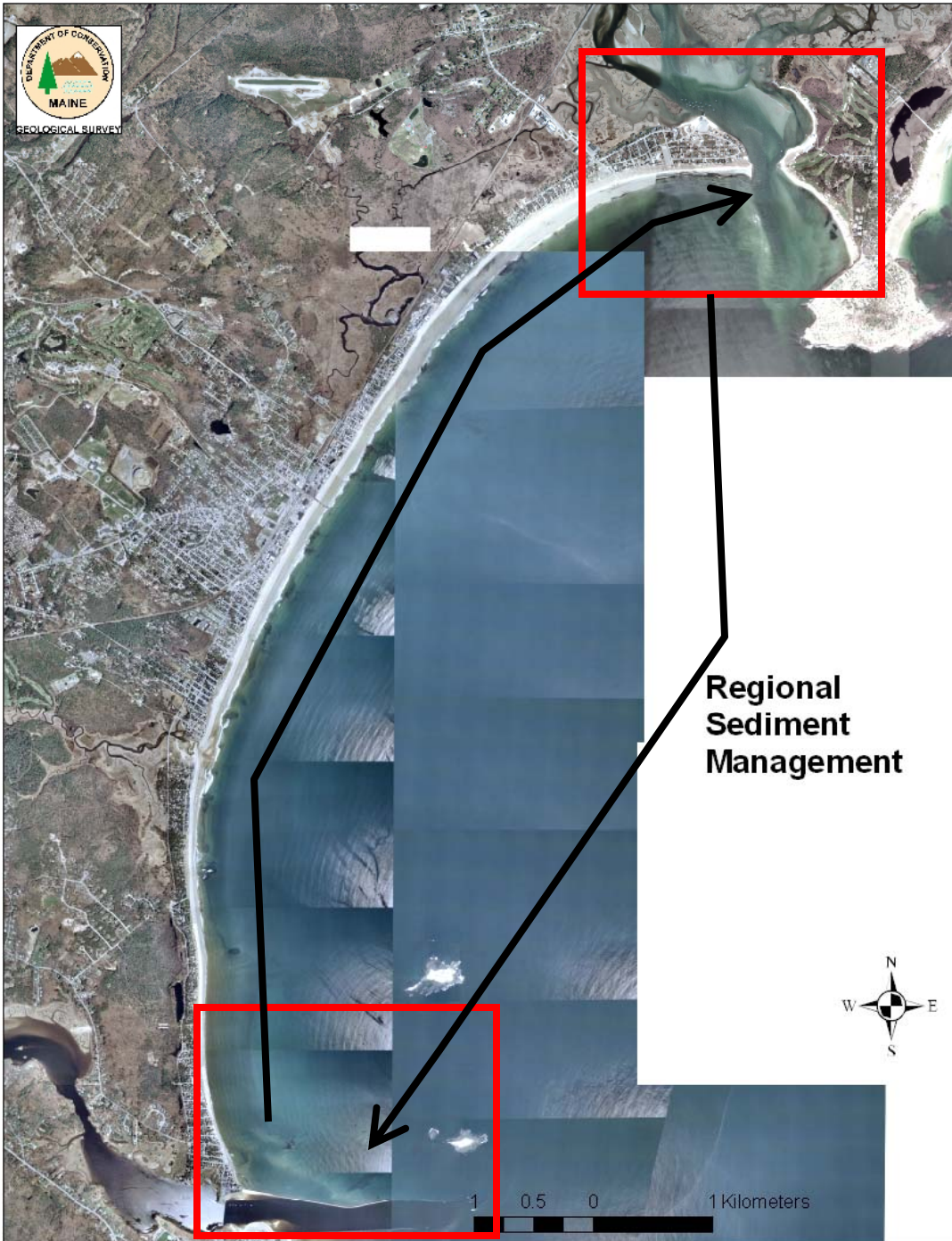
Utility Relocation



Sediment Management

- **Within the
Community
(intra)**
- **Within the
Region (inter)**





Regional, inter-community
management of sediment can be undertaken.

Potential Uses:

- *Beach Nourishment*
- *Dune Restoration*
- *Upland uses*

Sea Level Adaptation Working Group (SLAWG)

- Comment on regional federal/state beach nourishment/erosion control
- Identify infrastructure vulnerable to storms and sea level rise such as culverts, storm drains, bridges or tide gates;
- Use regional approaches to plan for improvements
- Recommend standardizing of floodplain management standards and building code interpretations across jurisdictions
- Recommend standardizing of ordinance review standards affecting the shorelands adjacent to Saco Bay;
- Standardize review/controls for water activities across jurisdictions for structures/activities affected by sea level rise
- Provide non-binding comments on various applications for development review affecting Saco Bay

JT....tell us more about SLAWG!