

Assessing ecological integrity of salt marshes in the Northeast

A project of the North Atlantic Landscape Conservation Cooperative



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Designing Sustainable Landscapes (DSL) assesses the capability of current and potential future landscapes to provide integral ecosystems and suitable habitat for a suite of representative species, and provides guidance for strategic habitat conservation.

Landscapes are modeled in the present, and projected into the future (70 years in 10-year timesteps).

Change, including urban growth, climate change, sea level rise, and succession/disturbance.

Assessment of ecological integrity (“coarse filter”) and habitat for representative species.

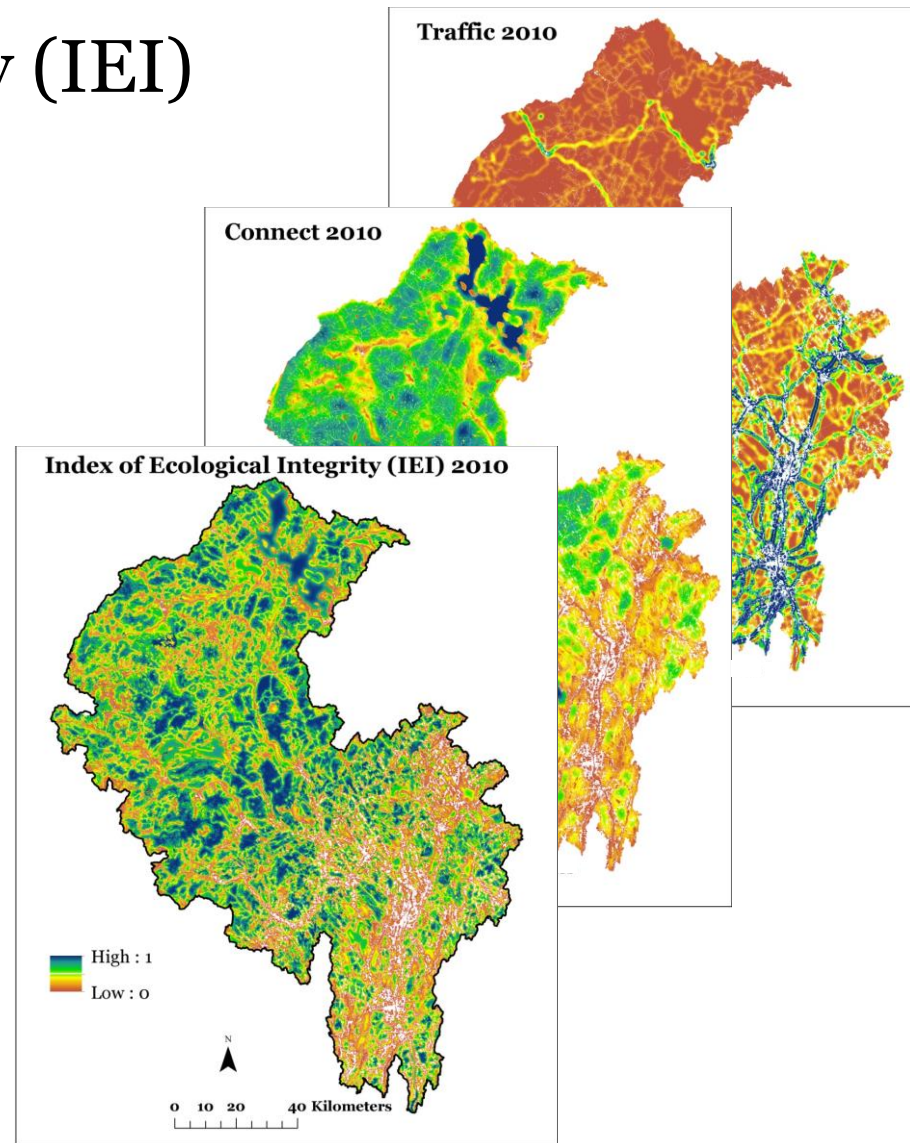
Design of landscape-based conservation strategies.

Index of Ecological Integrity (IEI)

Ecological integrity: the capability of an area to sustain biodiversity and ecosystem processes over the short and long term, especially in the face of disturbance and stress.

Metrics: Road traffic, Microclimate alterations, Watershed road salt, Edge predators, Similarity, Connectedness, ...and 15 others.

Metrics are combined in a weighted linear combination specific to each ecological system, resulting in IEI.



2009-2010: Under an EPA WPD grant, UMass/Amherst, MA CZM, and MA DEP convened a group to scope out a number of new metrics that apply to coastal systems.

Criteria: must be reasonably important to integrity, and must be feasible to model at broad scales.

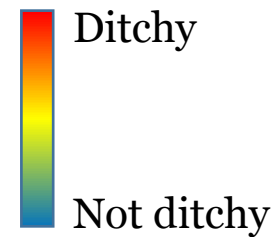
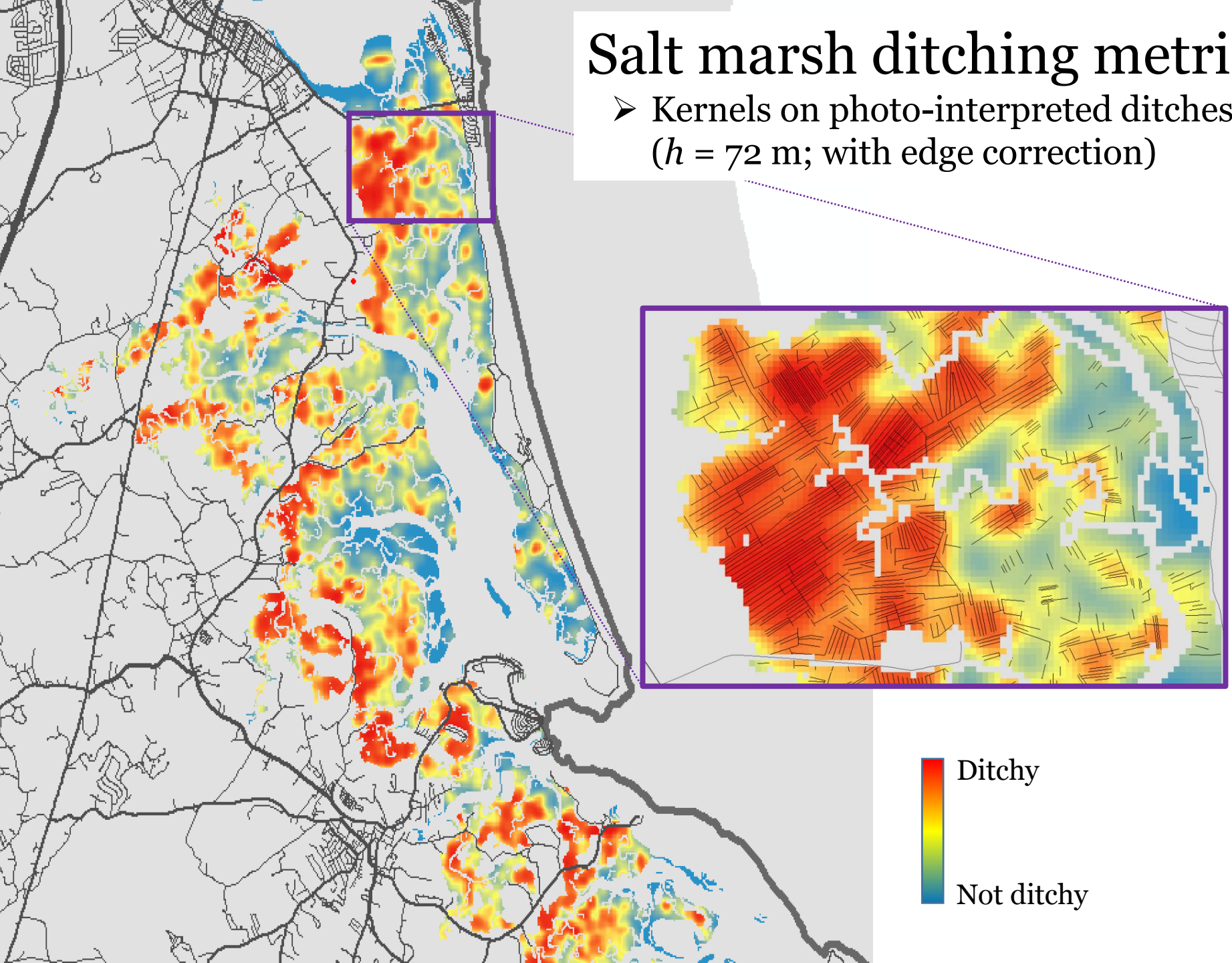
Two metrics apply to salt marshes:

- **Salt marsh ditching:** loss of open water habitat as a legacy of mosquito control ditches in salt marshes.
- **Tidal restrictions:** loss of tidal effects and saltwater input due to undersized culverts, bridges, and tidegates (applied to freshwater systems too).

2015: can we apply these metrics to the northeast (VA to ME)?

Salt marsh ditching metric

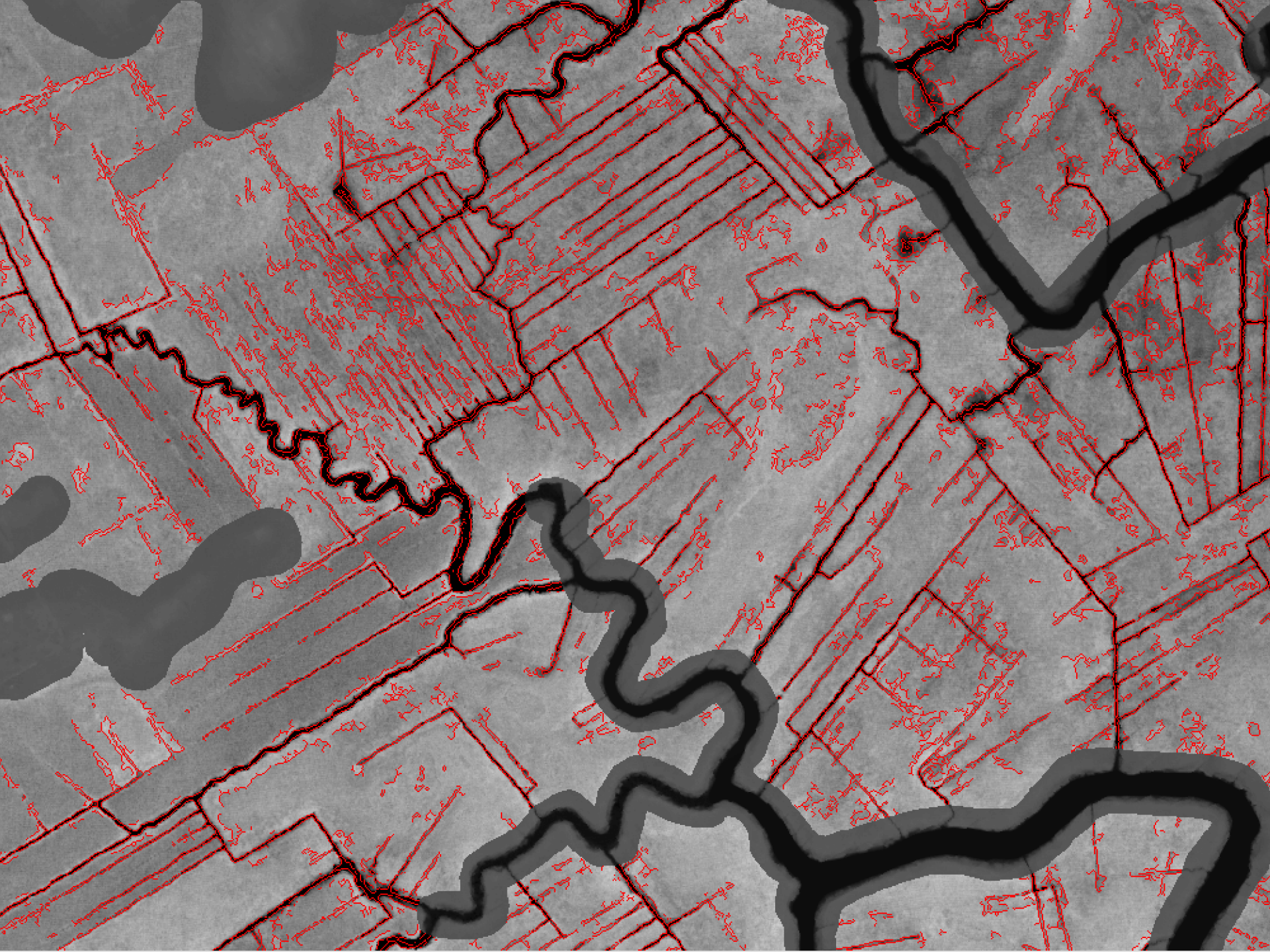
- Kernels on photo-interpreted ditches ($h = 72$ m; with edge correction)

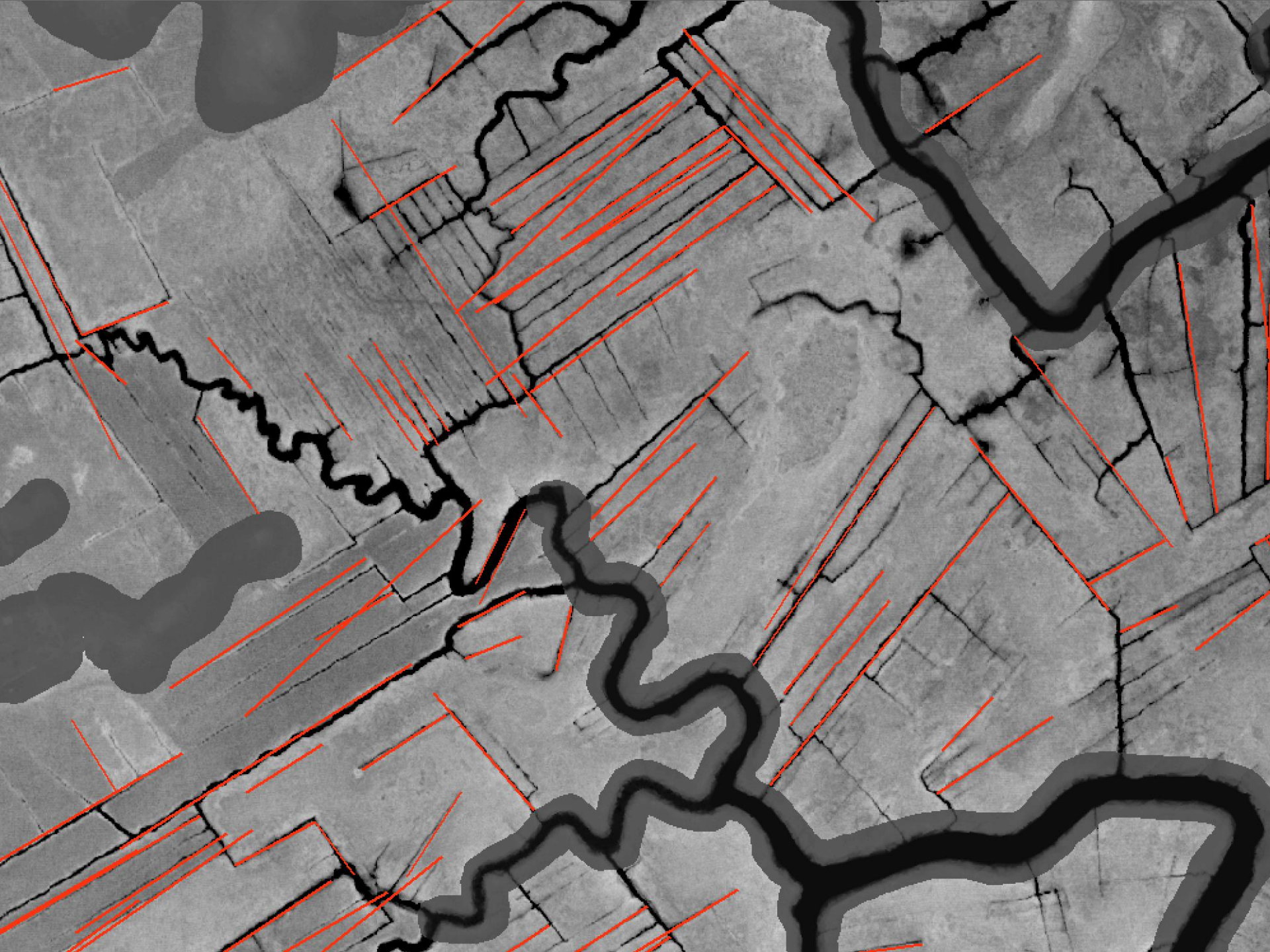






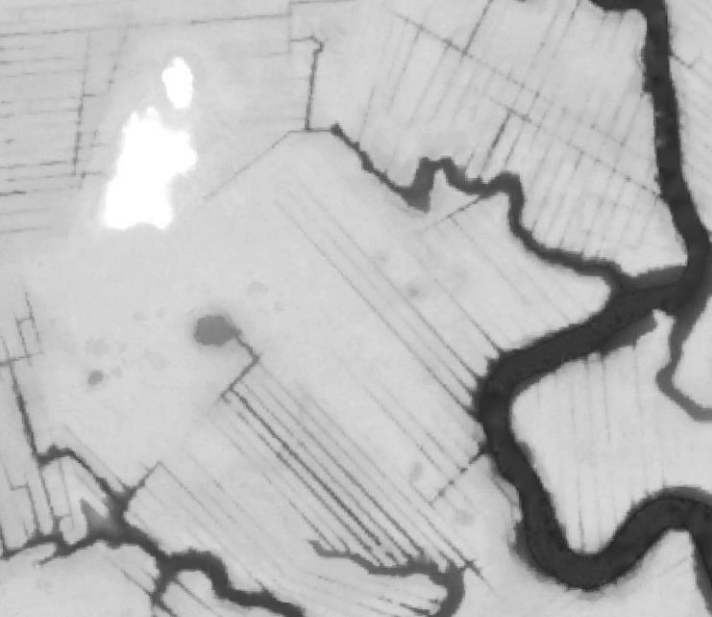




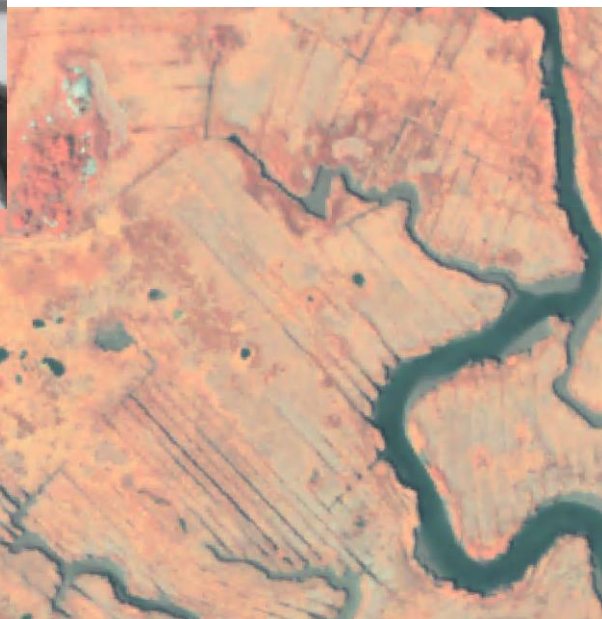


Comparison of ditching metric results

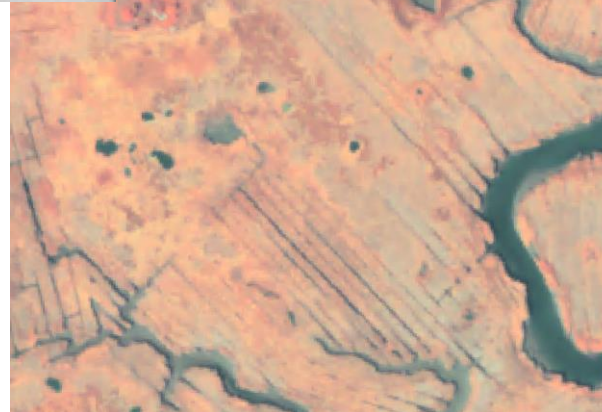
- 9 tiles (1.5 km²)
- Comparison of ditching metric from PI with...
- **1 m ditches:**
mean $r = 0.74$ (0.60 – 0.93)
- **3 m ditches (CoNED):**
mean $r = 0.52$ (0.08 – 0.85)



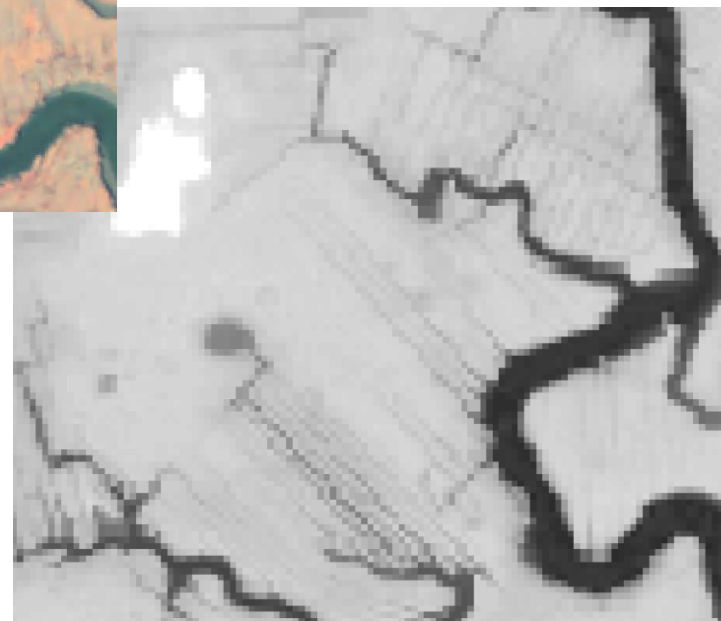
1 m LiDAR (MA only)



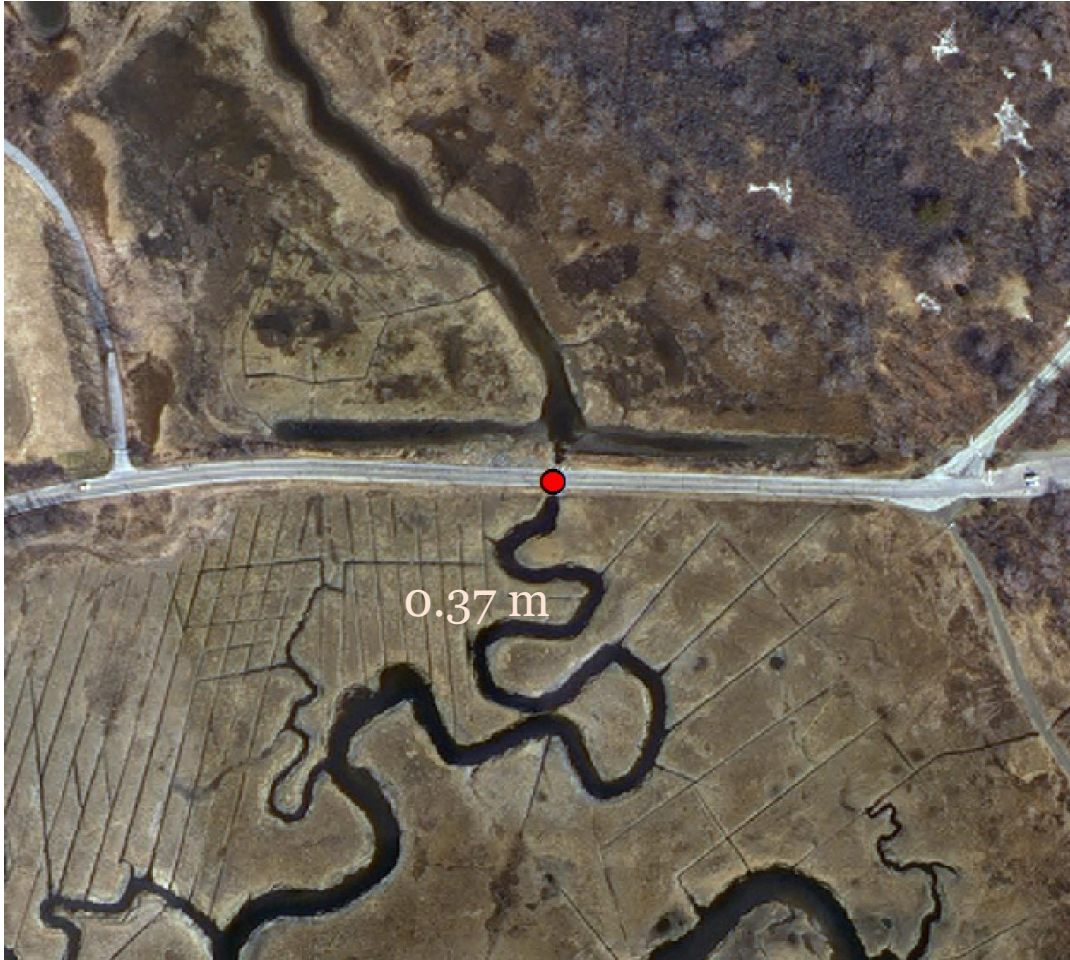
3 m LiDAR (CoNED)



1 m NAIP imagery



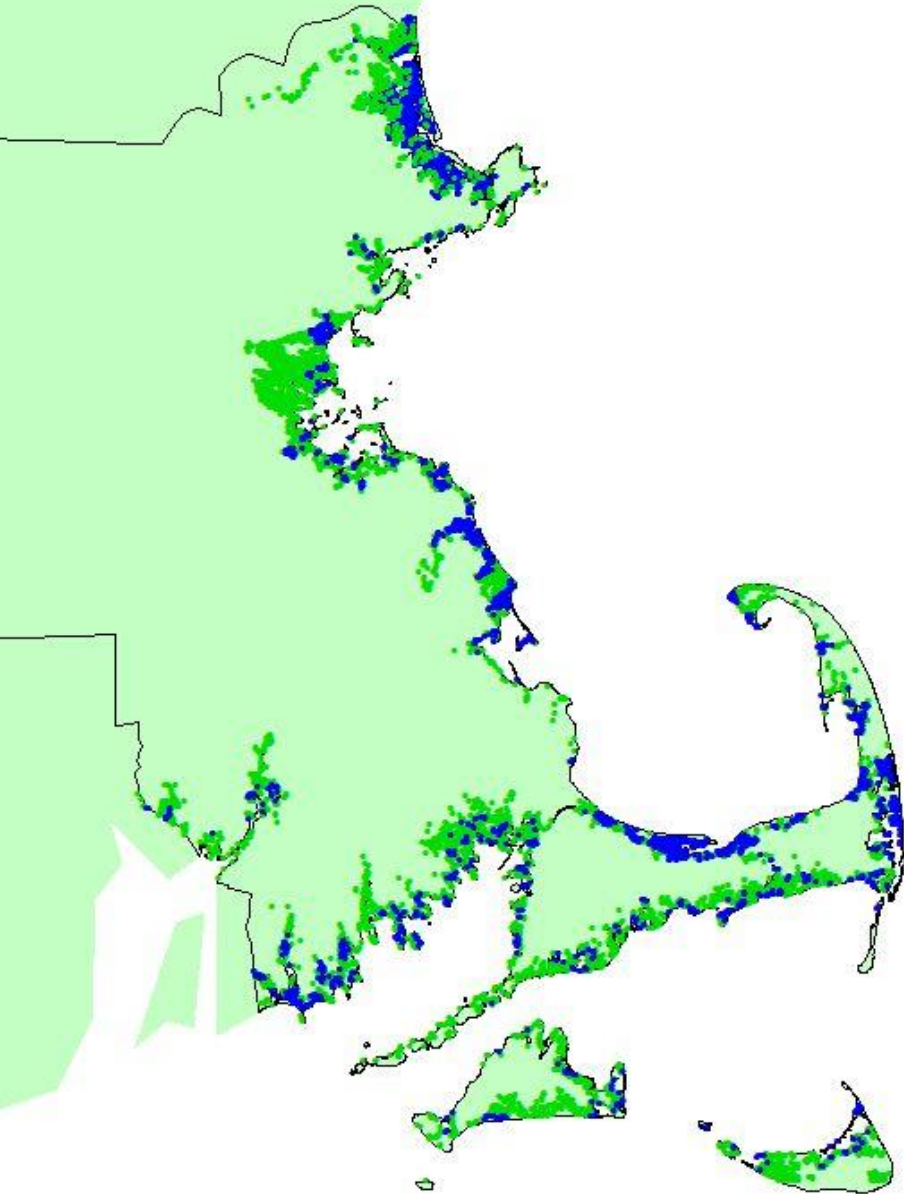
Tidal restrictions



Have 75 measured restrictions from MA CZM/DEP. Each records Δ spring high tide (m).

Potential tidal restrictions modeled at all road-stream and railroad-stream crossings in coastal area. We don't have data for tide gates.

Modeling potential salt marshes



Logistic regression:

marsh vs. upland

= elevation + tide range + dummy

$P < 0.001$

correct classification rate = 91%

	marsh	upland
marsh	2259	296
upland	149	2406

2500 random points in each

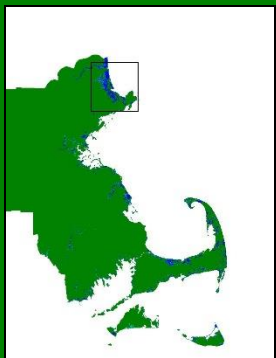
- Upland
- Salt marsh

A map showing potential tides in a coastal region. The map is color-coded: dark blue for the deepest areas, transitioning through light blue and green to yellow and orange for shallower areas. The coastline is irregular, with many inlets and bays. The text on the right explains that the values range from 0 to 1, representing the probability of salt marsh presence, with asterisks indicating areas that are deeper.

Tides_{potential}

ranges from 0~1
 $\approx P(\text{salt marsh}^*)$

* or deeper



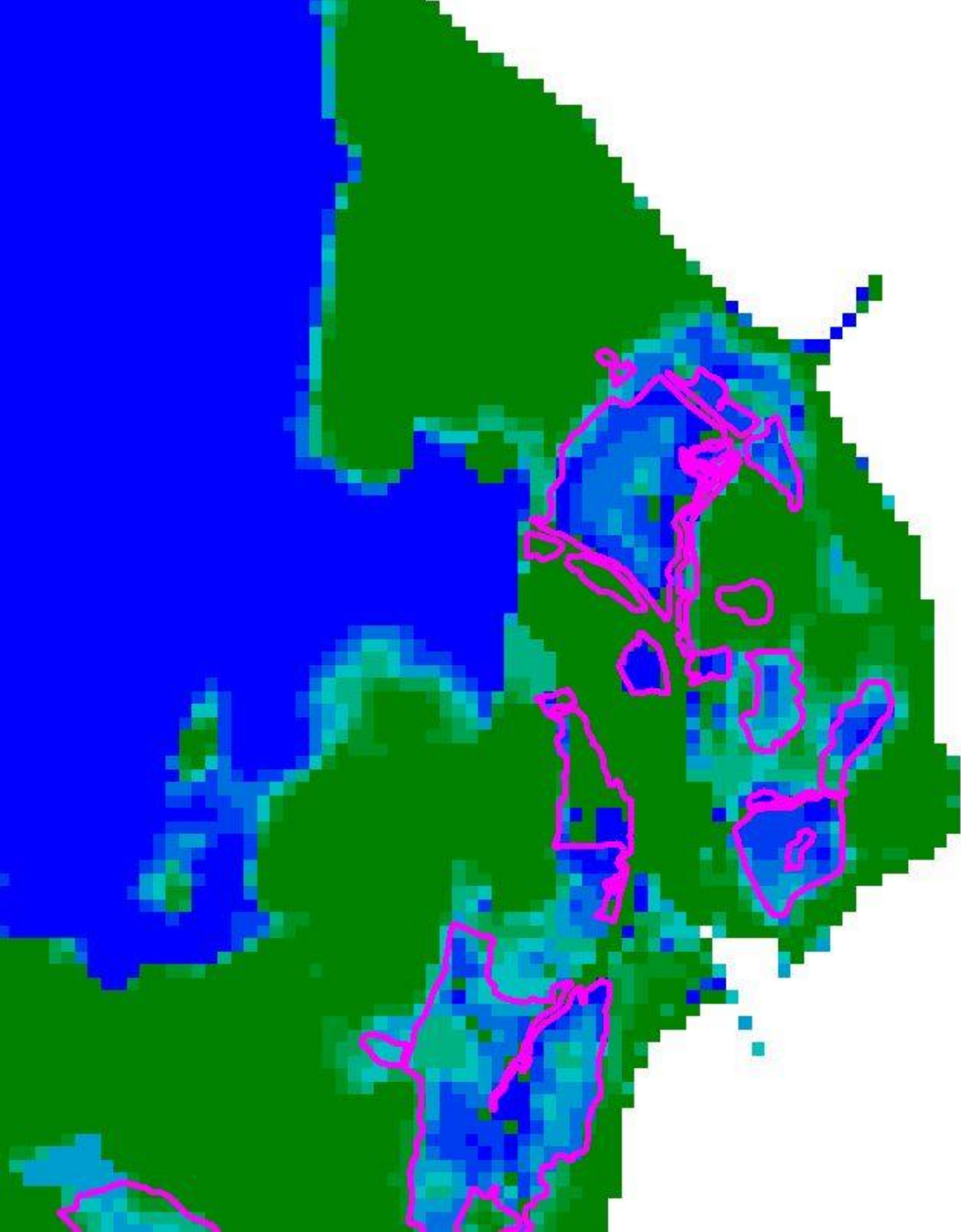



Tides_{potential}

ranges from 0~1
 $\approx P(\text{salt marsh}^*)$

* or deeper

 DEP salt marsh



 DEP salt marsh



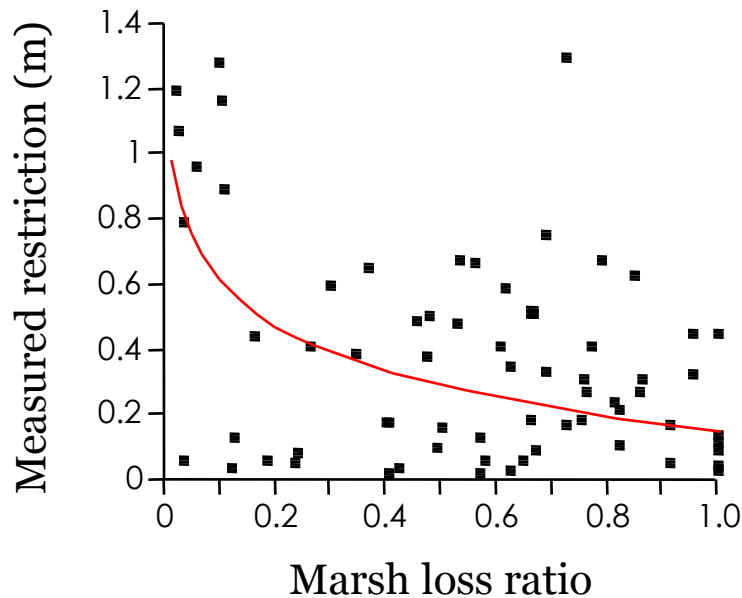
Estimating severity of unsurveyed tidal restrictions

Marsh loss ratio =

$$\frac{\text{area of observed salt marsh (DEP wetlands)}}{\text{area of potential salt marsh (tides}_{\text{potential}} > 0.5)} \quad \text{above each restriction}$$

...Assumption: tidal restrictions are sole cause of salt marsh loss

Estimating severity of unsurveyed tidal restrictions



*restriction height = $\ln(\text{marsh loss ratio})$,
weighted by predicted marsh size*

$n = 67$

$P < 0.001$

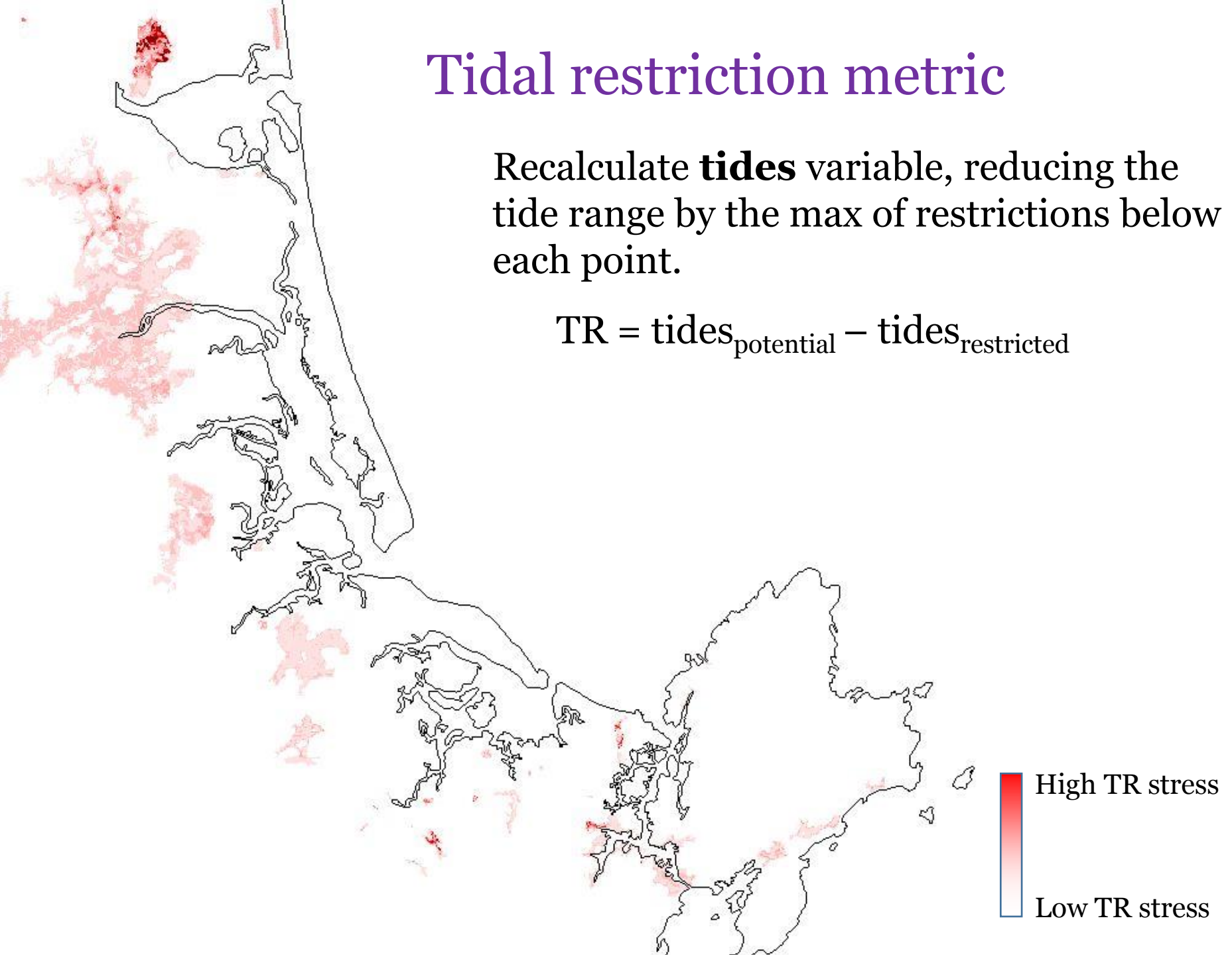
$r^2 = 0.364$

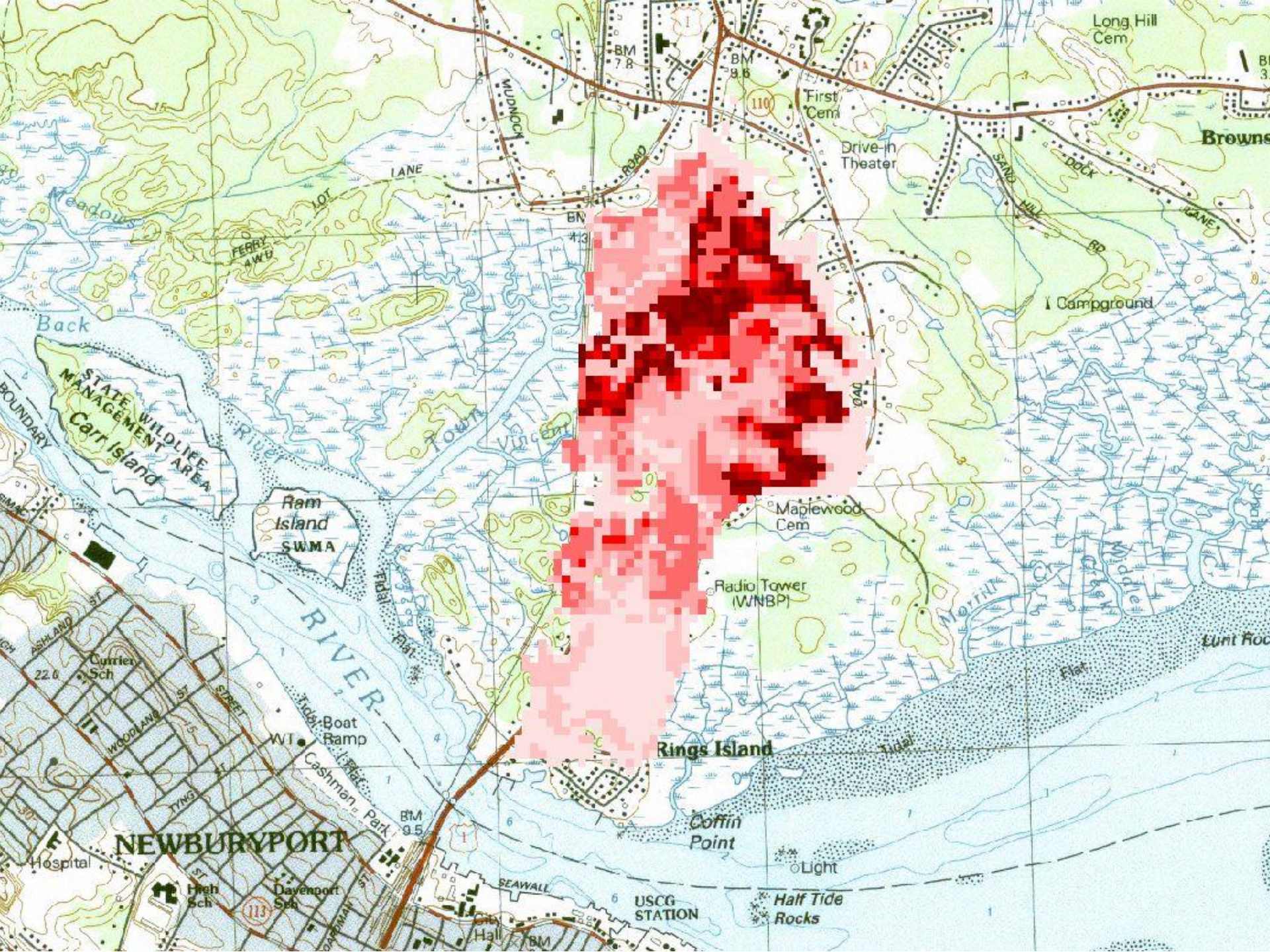
Applied to 1,528 potential tidal restrictions, giving us an estimate of the Δ (in m) for each potential restriction.

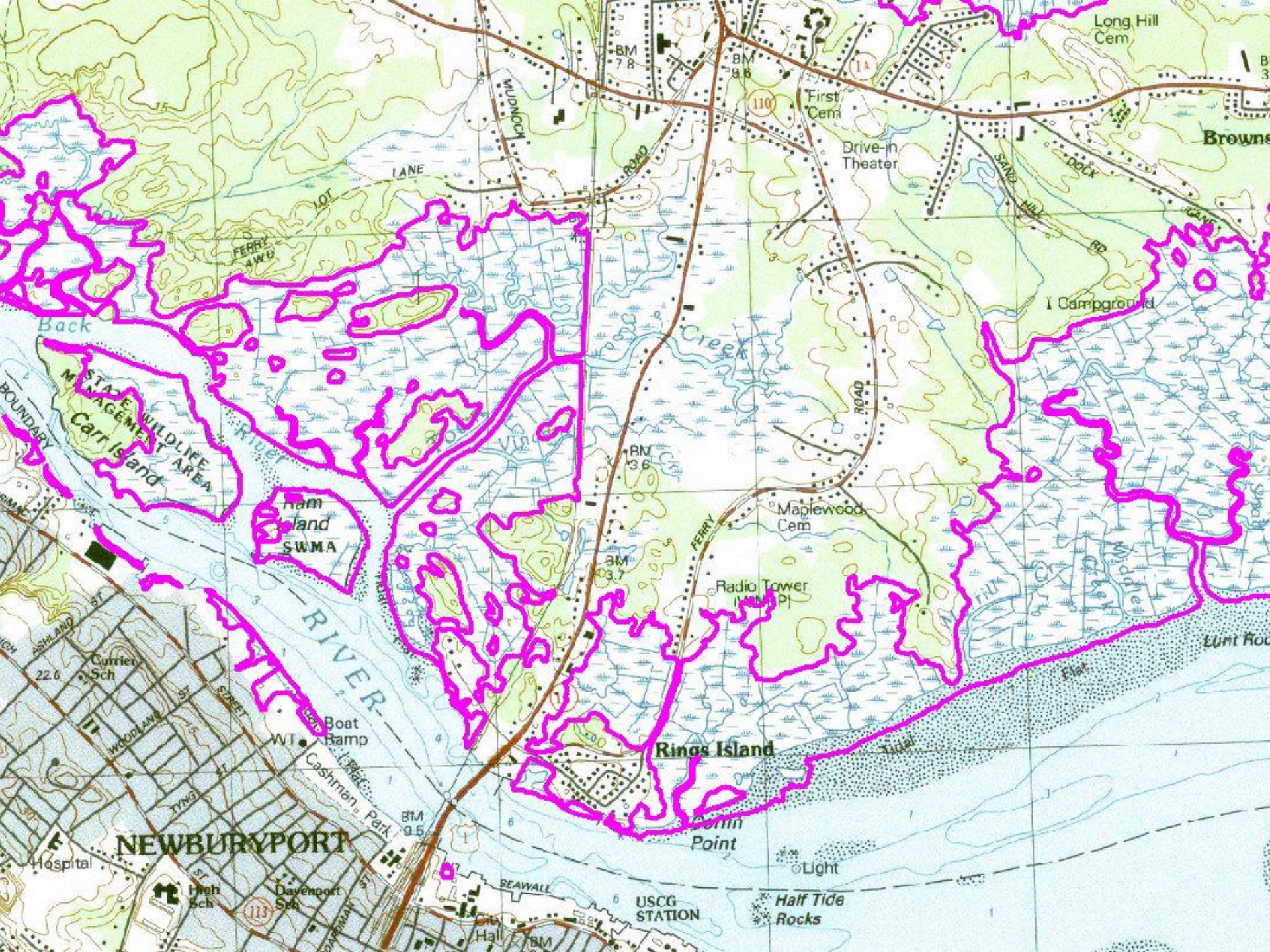
Tidal restriction metric

Recalculate **tides** variable, reducing the tide range by the max of restrictions below each point.

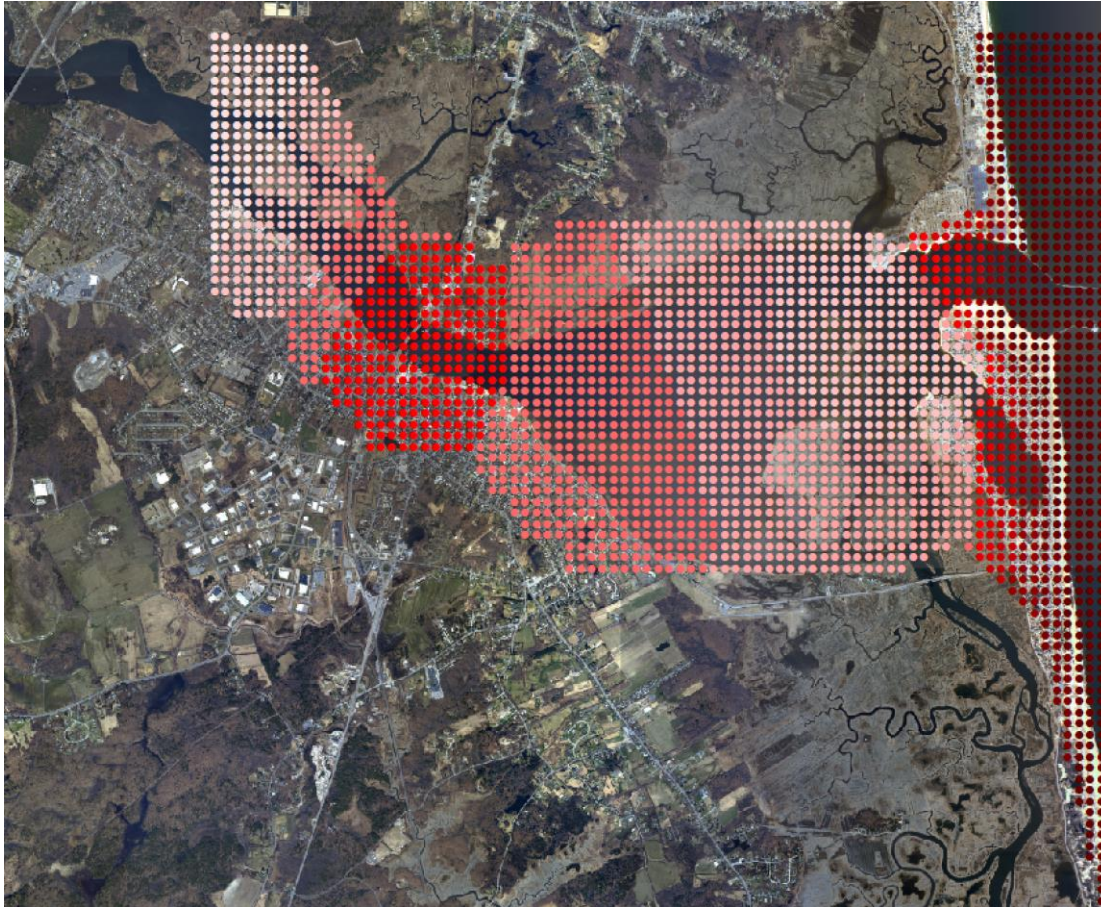
$$TR = \text{tides}_{\text{potential}} - \text{tides}_{\text{restricted}}$$







Tide ranges from NOAA's VDatum



VDatum doesn't go very far inland, so we're forced to extrapolate upflow (bathtub assumption).

Designing Sustainable Landscapes:

www.umass.edu/landeco/research/nalcc/nalcc.html

CAPS (existing MA results):

www.umasscaps.org

UMass Landscape Ecology Lab

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Assessment of Landscape Changes in the North Atlantic Landscape Conservation Cooperative: Decision-Support Tools for Conservation

The overall purpose of this project (known colloquially as the **Designing Sustainable Landscapes** project, or DSL for short) is to assess the capability of current and potential future landscapes within the extent of the North Atlantic Landscape Conservation Cooperative (NALCC) to provide integral ecosystems and suitable habitat for a suite of representative species, and provide guidance for strategic habitat conservation. To meet this goal, we are developing a Landscape Change, Assessment and Design (LCAD) model for the NALCC, as described in the documents below.

Phase one of this project, which began in December 2010 and was completed June 2012, focused on developing the overall modeling framework for simulating landscape change and assessing the ecological consequences of those changes (i.e., landscape change and assessment), and piloting the model in three study landscapes: 1) Kennebec River watershed in Maine, 2) middle Connecticut River watershed in Massachusetts, New Hampshire and Vermont, and 3) combined Pocomoke and Nanticoke River watersheds in Maryland and Delaware.

Phase two of this project, which began in July 2012 and will continue through June 2014, will focus on extending the landscape modeling to the entire Northeast (13 states), modeling an additional 20 representative species, expanding the ecological integrity assessment, coupling the landscape change model with a third party sea level rise model, improving the vegetation succession modeling, and developing an approach for integrating the results of the landscape change assessment into decision support for landscape design.

This project website provides links to recent presentations, results of phase 1 including a report and accompanying data for each of the pilot watersheds, detailed working technical reports, and an online manager survey to provide feedback.

Quicklinks

- NALCC
- FRAGSTATS
- CAPS
- HABIT@
- RMLands
- Vernal pools
- Fire
- Shortcourses

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Conservation Assessment and Prioritization System (CAPS)

Home About CAPS Data & Maps Documents & Reports Applications

The Conservation Assessment and Prioritization System (CAPS) is an ecosystem-based (coarse-filter) approach for assessing the ecological integrity of lands and waters and subsequently identifying and prioritizing land for habitat and biodiversity conservation. We define ecological integrity as the ability of an area to support biodiversity and the ecosystem processes necessary to sustain biodiversity over the long term. CAPS is a computer software program and an approach to prioritizing land for conservation based on the assessment of ecological integrity for various ecological communities (e.g., forest, shrub swamp, headwater stream) within an area.

CAPS combines principles of landscape ecology and conservation biology with the capacity of modern computers to compile spatial data and characterize landscape patterns. This process results in a final Index of Ecological Integrity (IEI) for each point in the landscape based on models constructed separately for each ecological community.

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Data needs

- 1 m DEM for northeast (ditches)
- Complete 3 m CoNED (tidal restrictions)
- Samples of field-measured tidal restrictions (tidal restrictions)

