Coastal Wetland Restoration and Planning: Tools for Tidal Restriction Avoidance and Removal

Webcast sponsored by EPA's Watershed Academy in partnership with the Coastal States Organization (CSO)

Thursday, June 11, 2020, 1:00pm – 3:00pm Eastern

Speakers:

- **Amanda Santoni**, U.S. Environmental Protection Agency
- **Mike Molnar**, Deputy Director, Coastal States Organization (CSO)
- **Kevin Lucey**, Habitat Coordinator, New Hampshire Department of Environmental Services-Coastal Program
- **Scott Jackson**, Extension Associate Professor, University of Massachusetts- Department of Environmental Conservation
- **Howard Schnabolk**, Marine Restoration Specialist, National Oceanographic and Atmospheric Administration
- **Mike Ruth PG,** Geologist, Federal Highway Administration

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Watershed Academy Webcast

- The slides for today's presentations are posted.
- A recording will be posted within the next month.

www.epa/gov/watershedacademy

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Webcast Logistics

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- Established in 1970 by appointed representatives from the nation's coastal states.
- Mission: Support the shared work and vision of the coastal states and territories for the protection, conservation, responsible use, and sustainable economic development of the nation's coastal resources.
- Vision: The nation's coastal areas are sustainably managed to balance economic and resource values and uses.

Learn more:

www.coastalstates.org

SUPPORTING HEALTHY COASTS & STRONG COASTAL COMMUNITIES

EPA Coastal Wetlands Initiative

Interagency Coastal Wetlands Workgroup

EPA works on the Coastal Wetlands Initiative in partnership with a number of federal agencies involved in coastal wetlands conservation on the Interagency Coastal Wetlands Workgroup (ICWWG)

US Army Corps of Engineers

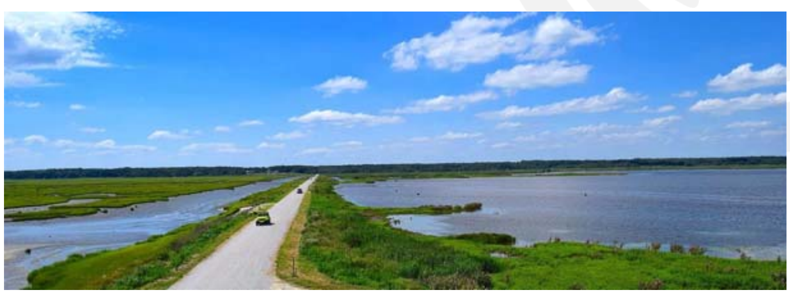
FHWA

NRCS

USGS

https://www.epa.gov/wetlands/coastal-wetlands

What is a Tidal Restriction?



A tidal restriction occurs when a structure or built landform limits or prevents tidal exchange between upstream and downstream habitats.

Types of Tidal Restrictions

1. Structures to protect lands by purposefully impeding movement of water:
   - Dikes, berms, dams, levees
2. Structures to move or drain water:
   - Ditches
   - Water control structures (e.g. weirs and tide gates)
3. Transportation structures over/ through tidal areas:
   - Bridges and culverts
   - Road and railroad causeways

Top Left: *Series of levees in south San Francisco Bay (Andrei Stanescu/iStock);* Top Right: *Mosquito Ditches at Assateague Island National Seashore (National Park Service);* Bottom Left: *Round Hill culvert in Dartmouth, MA (Lia McLaughlin/USFWS);* Bottom Right: *Undersized bridge on Parkers River in Barnstable, MA (Lia McLaughlin/USFWS)*

Types of Tools Available

- Identification and prioritization
  - Atlases/inventories
  - Direct assessment methods
  - Conservation and restoration planning
- Project planning and implementation
- Structure design and operation
- Funding

ID and Prioritization: Atlases, Inventories, and Assessments

Existing Atlases and Inventories

Method/ Resource	States
Direct survey	ME, NH, MA, FL, (Gulf), AL, MS, LA, TX
Model (transportation crossings only)	RI, CT, NY, NJ, DE, MD, VA
Related resource*	ME, VA, NC, SC, GA, FL (Atlantic), FL (Gulf), CA, OR, WA, AK

Example: NH Resilient Tidal Crossings and Tidal Crossing Assessment Protocol

*Related Resources were: synthesis of coastal wetland condition, AOP database, tide gate and levee inventory, and dam inventory

Resilient Tidal Crossings NH

Prioritizing
Tidal Stream Crossing Replacement
for
Community and Ecosystem
Resilience

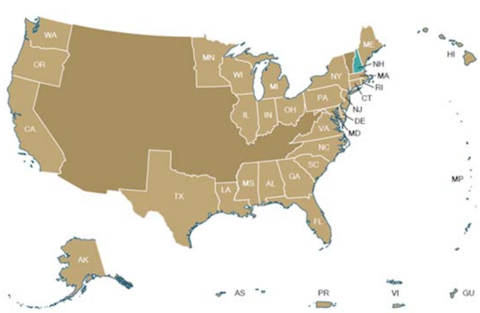
New Hampshire Department of Environmental Services

NHCP

NOAA – National Oceanic and Atmospheric Administration – U.S. Department of Commerce

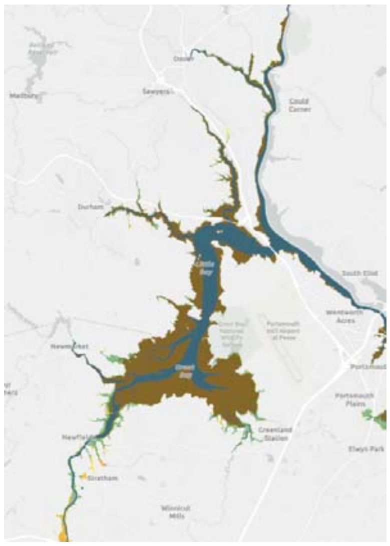
The Nature Conservancy
New Hampshire

New Hampshire Coastal Zone

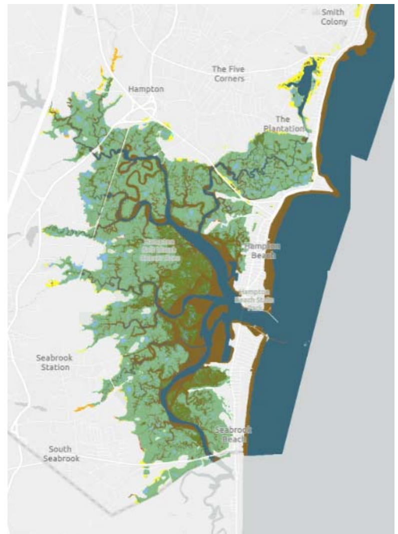


NEW HAMPSHIRE HAS
235 MILES
OF COASTLINE

New Hampshire Coastal Zone



Great Bay Estuary



Hampton Seabrook Estuary

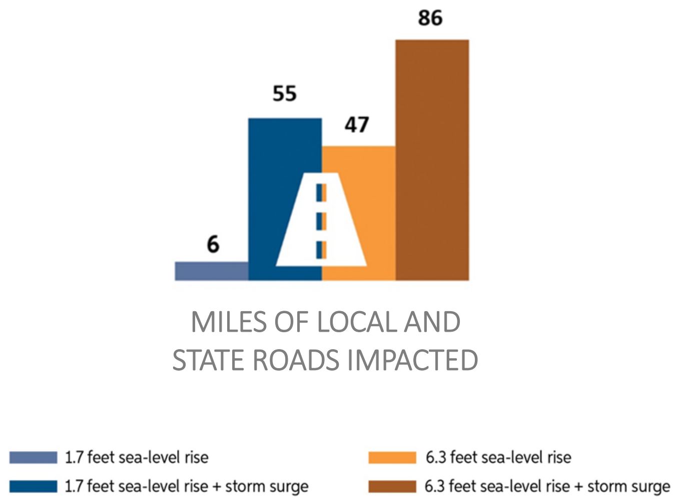
New Hampshire Coastal Zone

420,000+ PEOPLE
LIVE IN A NEW HAMPSHIRE
COASTAL ZONE COUNTY

$$$$$$$$$$
$$$$$$$$$

OVER $19 BILLION OF
N.H.'S G.D.P. COMES FROM
COASTAL ZONE COUNTIES

New Hampshire Coastal Zone

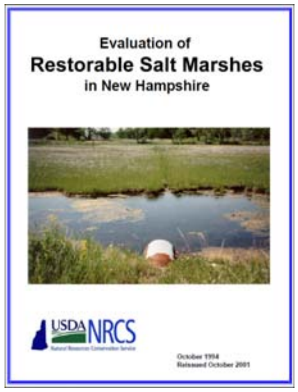


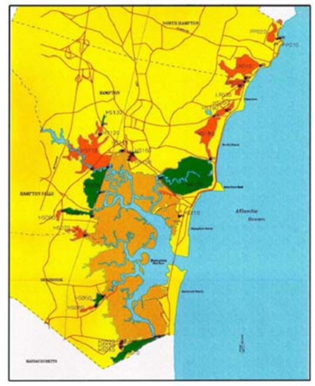
Agenda

- Assessment Protocol Development
- Data Analysis and Site Prioritization
- Advancing Highest Priority Projects
- Policy

Why Tidal Crossings?

30 Years of Community Based Restoration at Tidal Crossings





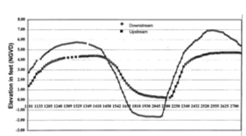
15 Pro-Active Tidal Restriction Removal Projects since 1994;

Restoring Tidal Hydrology to 635 Acres of Salt Marsh

Why Tidal Crossings?

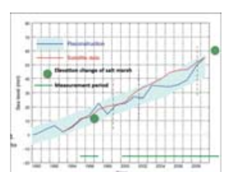
Complex Systems and Decision Making

Dynamic, Bi-Directional Flow



Salt Marsh Condition and Health

Rising Sea Level Effect on Salt Marsh



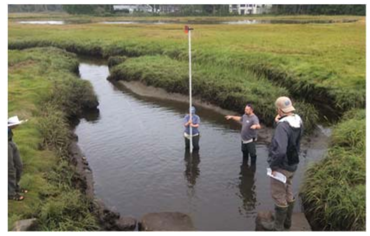
Increased Storm Intensity

Operations & Maintenance

Low Lying Infrastructure

NH Tidal Protocol Development

Local Advisory Committee



NH Tidal Protocol Development

Regional Coordination

NH Tidal Protocol Development

Management Objective	*Management Objective Standard*
Crossing Condition	*Crossing is in good condition*
Tidal Restriction	*Crossing does not restrict tidal flow*
Tidal Aquatic Organism Passage	*Crossing does not impede fish or other aquatic organism passage*
Salt Marsh Migration	*Crossing will not impede upstream salt marsh migration*
Vegetation	*Crossing has no noticeable effect on upstream versus downstream marsh vegetation*
Infrastructure Risk	*Crossing is climate-ready: it is not vulnerable to inundation currently and with 1.7 feet of sea level rise (i.e. 2050 high emissions projection)*
Adverse Impacts	*Restoring full tidal range at the crossing will not adversely affect upstream infrastructure*

NH Tidal Crossing Assessment Protocol


New Hampshire's Tidal Crossing Assessment Protocol

Authors: Peter Steckler[1], Kevin Lucey[2], David Burdick[3], Joanne Glode[1], Shea Flanagan[1]

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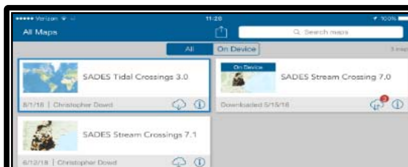
pstecklerr@tnc.org, jglode@tnc.org, shea.flanagan@tnc.org

[2]New Hampshire Department of Environmental Services Coastal Program, 222 International Drive – Suite 175, Portsmouth, NH Kevin.Lucey@des.nh.gov

[3]University of New Hampshire, Jackson Estuarine Laboratory, 85 Adams Point Road, Durham, NH
david.burdick@unh.edu

July 14, 2017

NH SADES
New Hampshire Statewide Asset Data Exchange System



- ✓ provides a common set of collection and training standards.
- ✓ assists partners in reaching a common data collection goal.
- ✓ provides a central cloud repository where all asset data is stored and accessible to all partners at any time. https://www.nhsades.com/

https://www.nature.org/content/dam/tnc/nature/en/documents/nh-tidal-crossing-assessment-protocol.pdf

INFRASTRUCTURE SCORES

1. Structure Condition
2. Inundation Risk To Roadway
3. Inundation Risk To Crossing Structure
4. Inundation Risk To Low-Lying Development

ECOLOGICAL SCORES

5. Tidal Range Ratio
6. Crossing Ratio
7. Erosion Classification

} 8. Tidal Restriction Overall Score

9. Tidal Aquatic Organism Passage Evaluation
10. Salt Marsh Migration Potential Watershed
11. Salt Marsh Migration Potential Evaluation Unit
12. Vegetation Evaluation

COMBINED SCORES

13. Overall Infrastructure Score
14. Overall Ecological Score
15. Overall Combined Score

Scoring & Prioritization

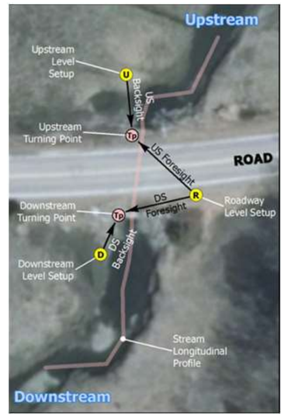
SCORE	SCORING CHARACTERIZATION	RECOMMENDED ACTION
1	- good structure condition - no tidal restriction - allows organism passage - low salt marsh migration potential - vegetation unaffected by crossing - low flood risk - many adverse impacts	Low Replacement Priority
2		
3		
4		
5	- poor structure condition - severe tidal restriction - reduced organism passage - high salt marsh migration potential - vegetation affected by crossing - high flood risk - few adverse impacts	High Replacement Priority

SCORE ≥ 3 indicate a cause for concern

Longitudinal Profile

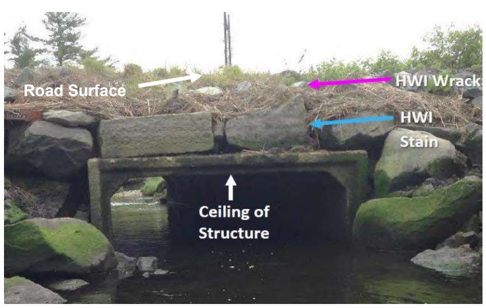


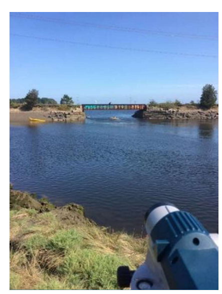
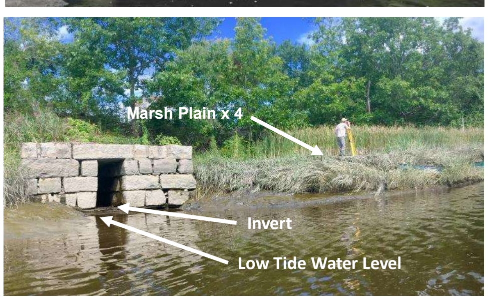




LONGITUDINAL PROFILE
Distance
Height
Substrate
Feature Code

Crossing Cross Section

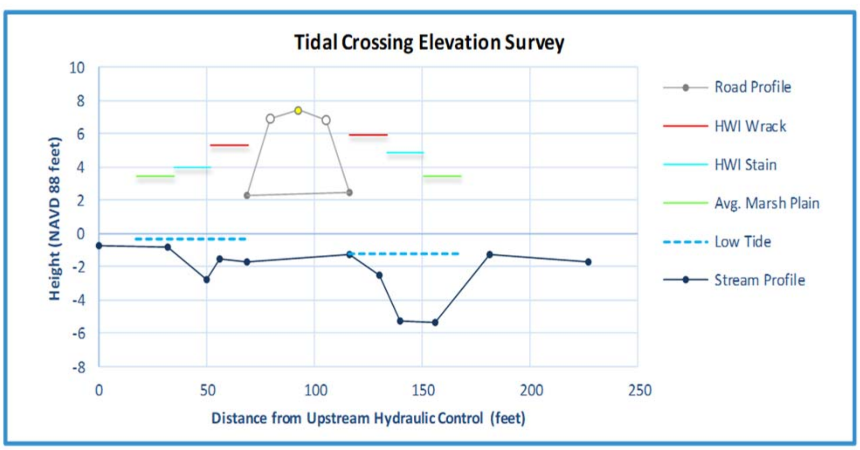


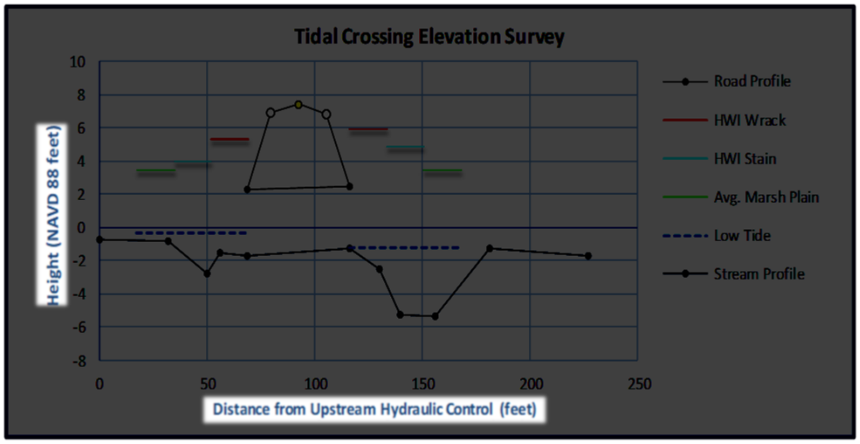
CROSS SECTION
Road Surface
High Water Indicator (HWI) Wrack
High Water Indicator (HWI) Stain
Ceiling of the Structure
Invert
Salt Marsh Plain
Low Tide Water Level

High Water Indicators

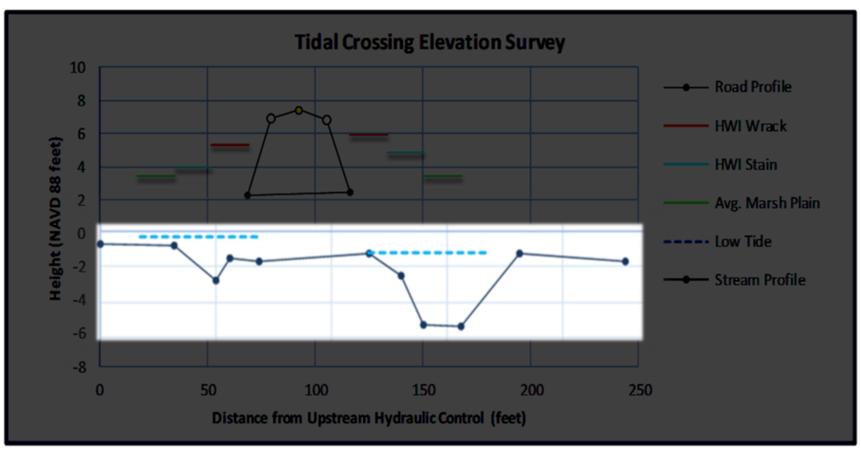
Tidal Crossing Elevation Survey



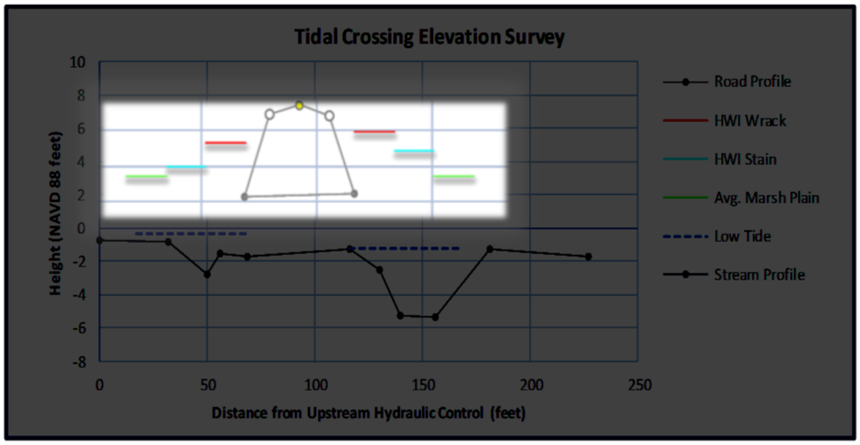
Tidal Crossing Elevation Survey



Tidal Crossing Elevation Survey



Tidal Crossing Elevation Survey



Evaluation Criteria - Tidal Restriction

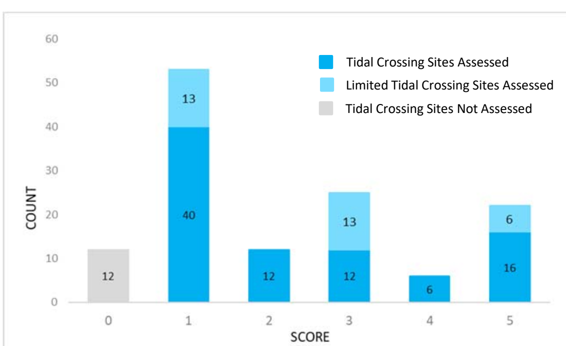
	Components of tidal restriction overall score			Tidal Restriction Overall
	Tidal Range Ratio	**Crossing Ratio***	**Erosion Classification***	
Assessment Parameters	MHHW	Channel Width	Channel Width	rolled up score of three tidal restriction component scores
	MLLW	Structure Width	Scour Pool Width	

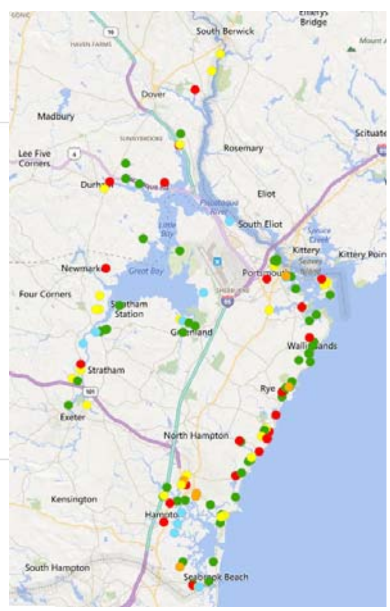
*adapted from Purinton and Mountain (1996)

Tidal Range Ratio

Evaluation Score	Evaluation Criteria
1	No downstream invert perch at low tide; stream grade through the crossing matches that of the natural system (upstream tidal range is >90% of downstream tidal range), or crossings with limited tidal influence (downstream natural community is brackish or fresher) have no downstream perch and low tide water depth at crossing inverts is six inches or greater
2	Tidal range upstream is between 80 and 90 percent of downstream range
3	Tidal range upstream is between 70 and 80 percent of downstream range, or crossings with limited tidal influence (downstream natural community is brackish or fresher) have no downstream perch and low tide water depth at one or both crossing inverts is less than six inches
4	Tidal range upstream is between 50 and 70 percent of downstream range
5	Downstream invert is perched at high tide, or tidal range upstream is less than 50 percent of downstream range, or crossings with limited tidal influence (downstream natural community is brackish or fresher) have a downstream perch

Tidal Range Ratio

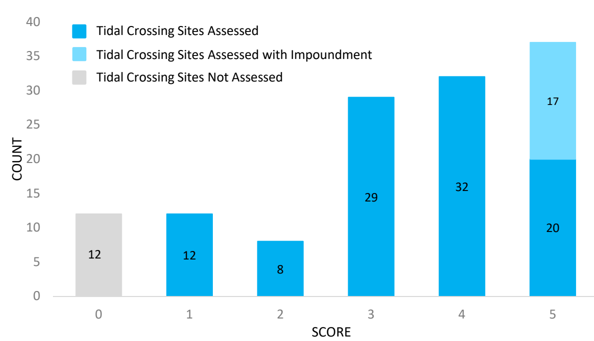




Crossing Ratio

Evaluation Score		Evaluation Criteria
Upstream	Downstream	
	0	Crossing outlets to subtidal conditions (i.e. no measurable downstream channel)
1	1	Channel Width < Opening Width
2	2	Channel Width ≥ 1 and < 1.2 times opening width
3	3	Channel Width ≥ 1.2 and <2.5 times Opening Width
4	4	Channel Width ≥2.5 and <5 times Opening Width
5	5	Channel Width ≥5 times Opening Width, or for the upstream side only, crossing structure permanently impounds water and no channel feature is present.

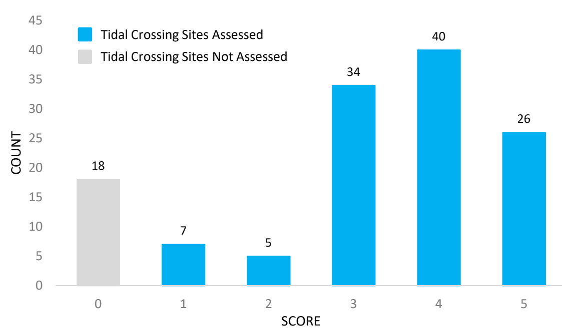
Crossing Ratio



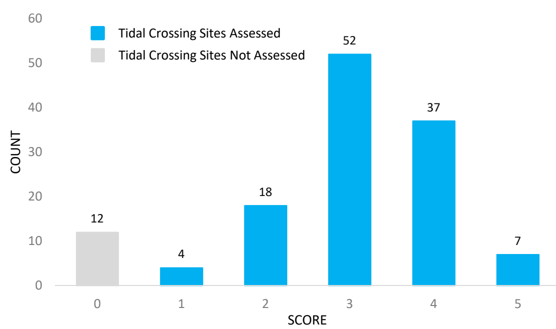
Erosion Classification

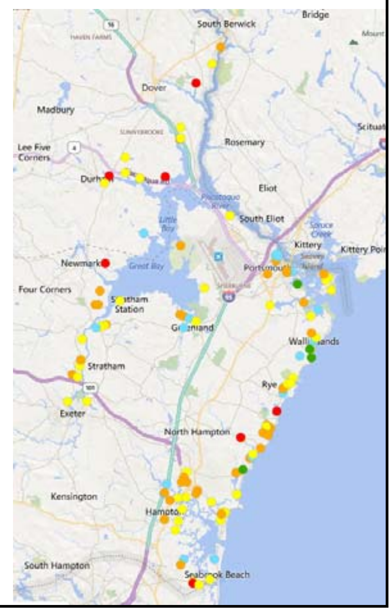
Evaluation Score		Evaluation Criteria
Upstream	Downstream	
0	0	For upstream only: if the crossing serves as an impoundment resulting in no detectable scour pool For downstream only: if the crossing outlets directly to subtidal conditions resulting in no detectable scour pool
1	1	Unrestricted/ No Pooling (erosion classification <=1)
2	2	Flow Detained/ Slight Erosion (>1, <=1.2, pool width is up to 20% wider than channel)
3	3	Minor Pooling/ Erosion Present (>1.2, <=2, pool width is between 20 and 100% wider than channel)
4	4	Significant Pooling/Erosion Present (>2, <=3, pool width is two to three times wider than channel)
5	5	Major Pooling/ Major Erosion Present (>3, pool width is more than three times as wide as channel)

Erosion Classification

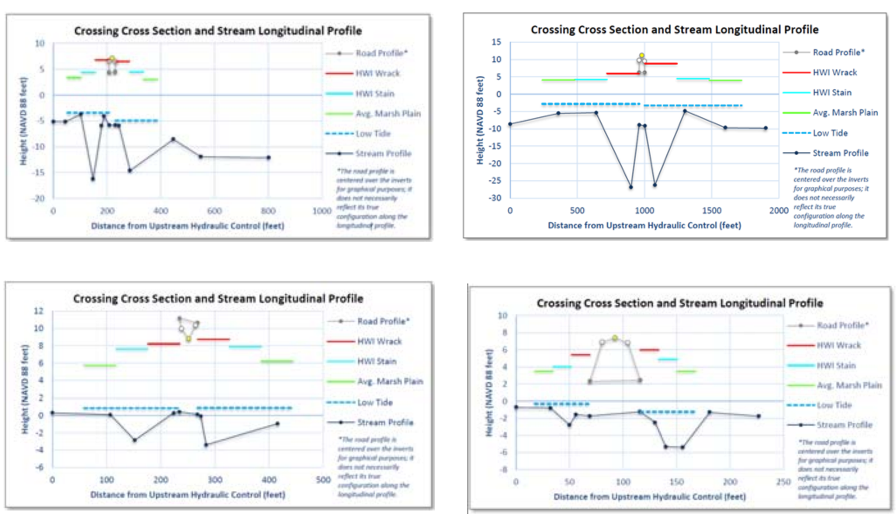


Tidal Restriction Overall

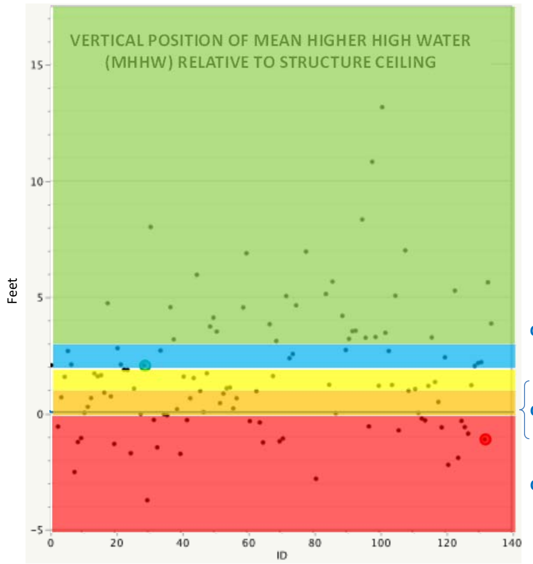




Tidal Restriction: Scour Pool Depth



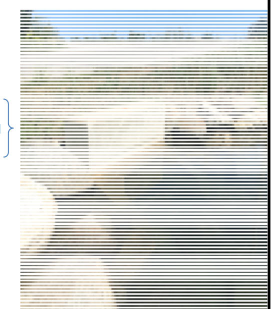
Inundation Risk to the Crossing Structure



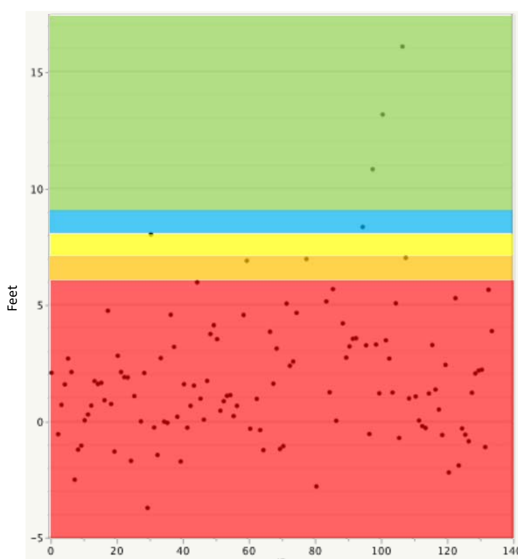
CEILING > HWI STAIN

CEILING = HWI STAIN

CEILING < HWI STAIN

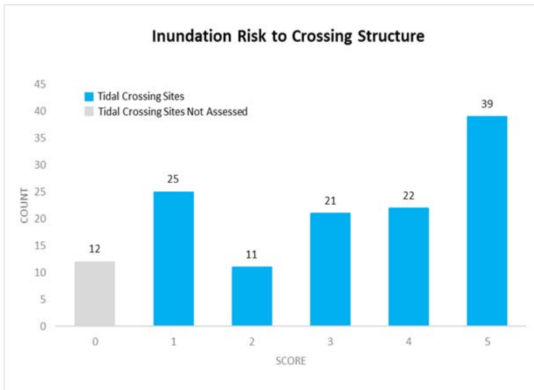


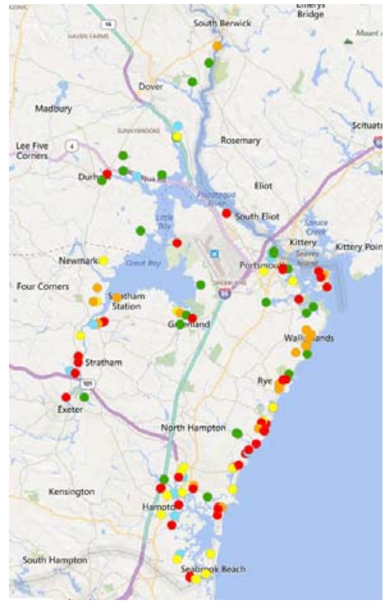
Inundation Risk to the Crossing Structure



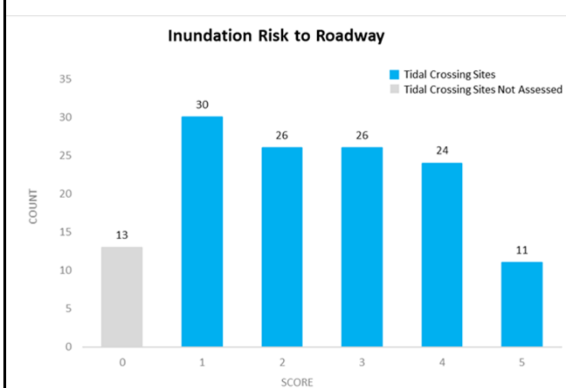
6' of sea level rise will inundate 93% of tidal crossings at MHHW

Inundation Risk to the Crossing Structure

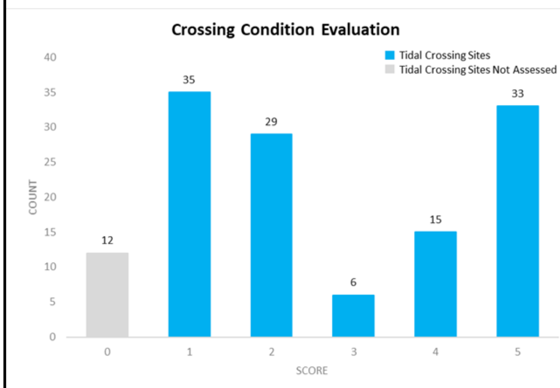


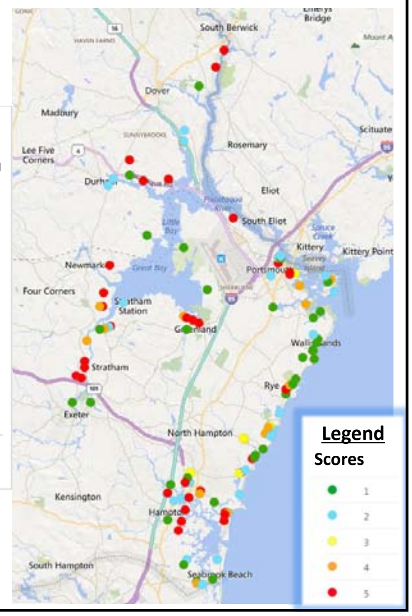


Inundation Risk to the Roadway

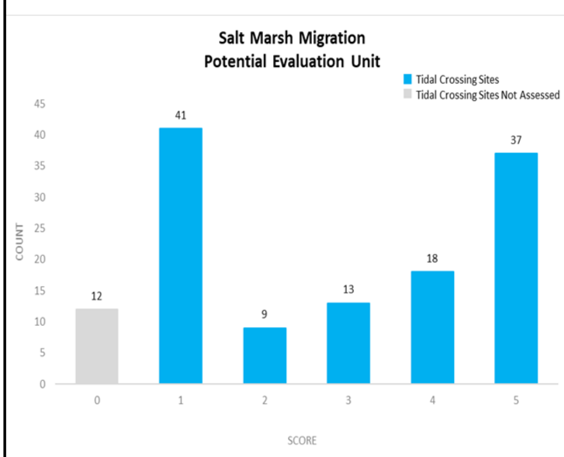


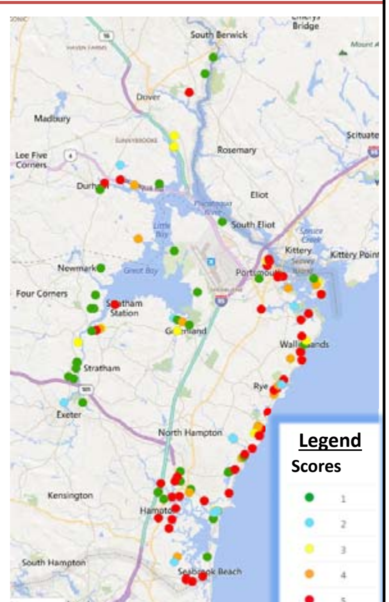
Structure Condition





Salt Marsh Migration Potential





Data Sharing

Final Report with Summary Sheets and static maps for 132 assessed Tidal Crossings

https://www.des.nh.gov/

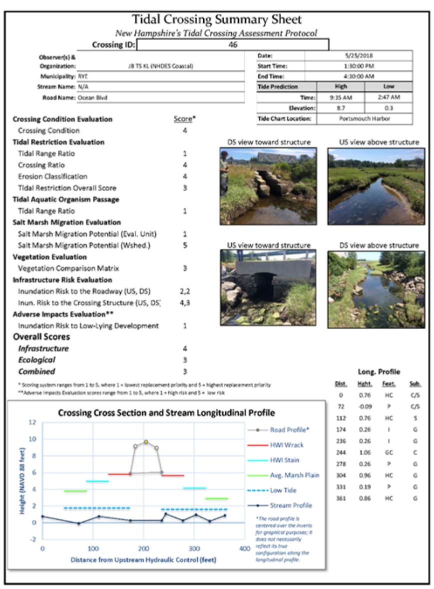
Abridged Tidal Crossing Assessment scores available for display and download on NH Coastal Viewer

http://www.nhcoastalviewer.org/

Complete Tidal Crossing Assessment dataset available for display and download through SADES

https://www.nhsades.com/

Data Sharing



Tidal Crossing Summary Sheet

New Hampshire's Tidal Crossing Assessment Protocol

Crossing ID: 46

Observer(s) & Organization:	JB TS KL (NHDES Coastal)
Municipality:	RYE
Stream Name:	N/A
Road Name:	Ocean Blvd

Date:	5/25/2018	
Start Time:	1:30:00 PM	
End Time:	4:30:00 AM	
Tide Prediction	High	Low
Time:	9:35 AM	2:47 AM
Elevation:	8.7	0.3
Tide Chart Location:	Portsmouth Harbor	

	Score*
Crossing Condition Evaluation	
Crossing Condition	4
Tidal Restriction Evaluation	
Tidal Range Ratio	1
Crossing Ratio	4
Erosion Classification	4
Tidal Restriction Overall Score	3
Tidal Aquatic Organism Passage	
Tidal Range Ratio	1
Salt Marsh Migration Evaluation	
Salt Marsh Migration Potential (Eval. Unit)	1
Salt Marsh Migration Potential (Wshed.)	5
Vegetation Evaluation	
Vegetation Comparison Matrix	3
Infrastructure Risk Evaluation	
Inundation Risk to the Roadway (US, DS)	2,2
Inun. Risk to the Crossing Structure (US, DS)	4,3
Adverse Impacts Evaluation**	
Inundation Risk to Low-Lying Development	1
Overall Scores	
Infrastructure	4
Ecological	3
Combined	3

* Scoring system ranges from 1 to 5, where 1 = lowest replacement priority and 5 = highest replacement priority

**Adverse Impacts Evaluation scores range from 1 to 5, where 1 = high risk and 5 = low risk

DS view toward structure

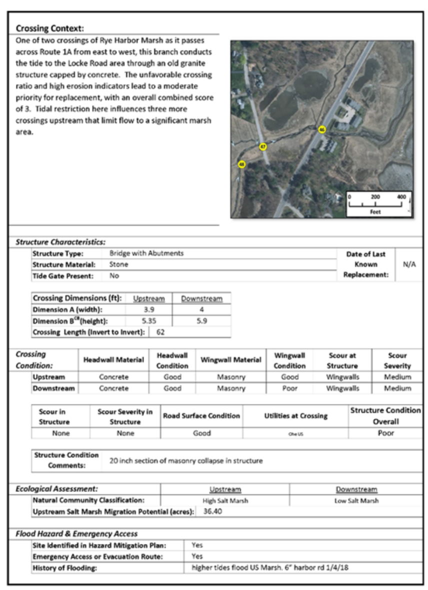
US view above structure

US view toward structure

DS view above structure

Long. Profile

Dist.	Hght.	Feat.	Sub.
0	0.76	HC	C/S
72	-0.09	P	C/S
112	0.76	HC	S
174	0.26	I	G
236	0.26	I	G
244	1.06	GC	C
278	0.26	P	G
304	0.96	HC	G
331	0.19	P	G
361	0.86	HC	G



Crossing Context:

One of two crossings of Rye Harbor Marsh as it passes across Route 1A from east to west, this branch conducts the tide to the Locke Road area through an old granite structure capped by concrete. The unfavorable crossing ratio and high erosion indicators lead to a moderate priority for replacement, with an overall combined score of 3. Tidal restriction here influences three more crossings upstream that limit flow to a significant marsh area.

Structure Characteristics:

Structure Type:	Bridge with Abutments	Date of Last Known Replacement:	N/A
Structure Material:	Stone		
Tide Gate Present:	No		

Crossing Dimensions (ft):	Upstream	Downstream
Dimension A (width):	3.9	4
Dimension B (height):	5.35	5.9
Crossing Length (Invert to Invert):	62	

Crossing Condition:	Headwall Material	Headwall Condition	Wingwall Material	Wingwall Condition	Scour at Structure	Scour Severity
Upstream	Concrete	Good	Masonry	Good	Wingwalls	Medium
Downstream	Concrete	Good	Masonry	Poor	Wingwalls	Medium

Scour in Structure	Scour Severity in Structure	Road Surface Condition	Utilities at Crossing	Structure Condition Overall
None	None	Good	Ohe US	Poor

Structure Condition Comments: 20 inch section of masonry collapse in structure

Ecological Assessment:	Upstream	Downstream
Natural Community Classification:	High Salt Marsh	Low Salt Marsh
Upstream Salt Marsh Migration Potential (acres):	36.40	

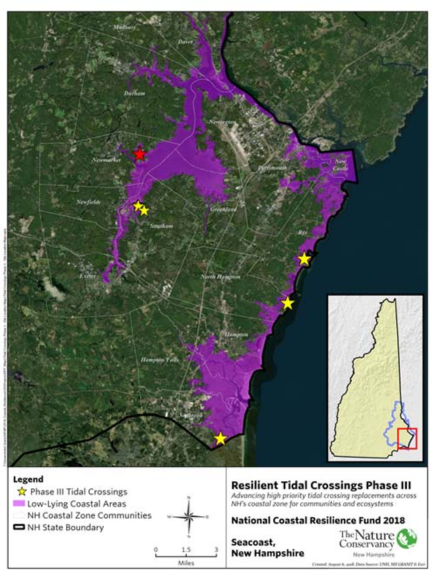
Flood Hazard & Emergency Access

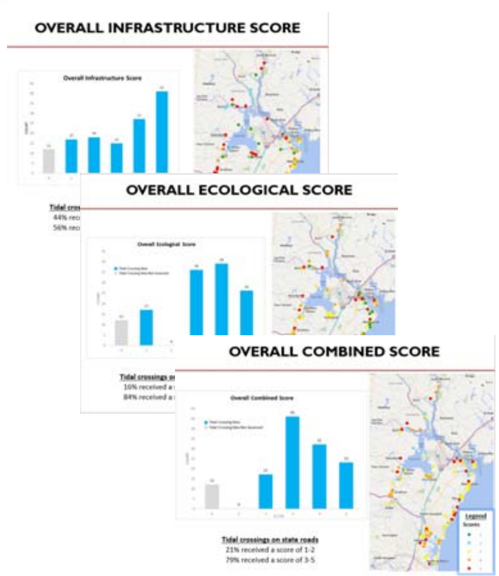
Site Identified in Hazard Mitigation Plan:	Yes
Emergency Access or Evacuation Route:	Yes
History of Flooding:	higher tides flood US Marsh. 6" harbor rd 1/4/18

NFWF Coastal Resilience Funded Project (Resilient Tidal Crossings Phase III)

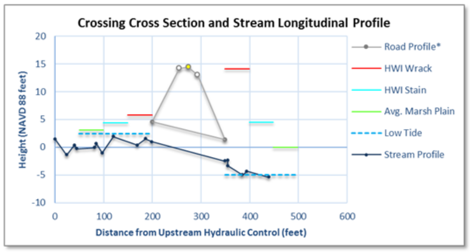
- **PROJECT DESCRIPTION**
  - → Complete full engineering and design plans for **<u>four to five</u>** high-priority tidal crossings across New Hampshire’s coastal zone.
  - → Project will work closely with local partners and coastal resource managers to deign **<u>projects that will enhance resilience for coastal communities and ecosystems</u>**.
- $200,000 for engineering

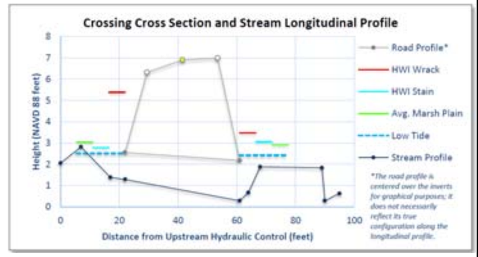
NFWF Coastal Resilience Funded Project (Resilient Tidal Crossings Phase III)

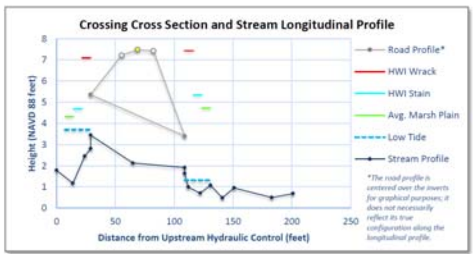


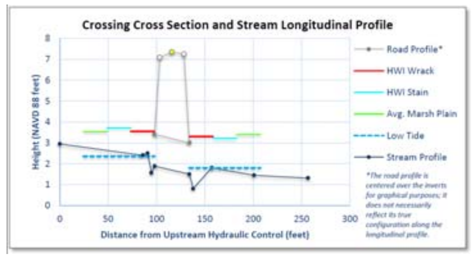


NFWF Coastal Resilience Funded Project (Resilient Tidal Crossings Phase III)









NHDES Stream Crossing Policy

Structure type requirements are based upon contributing watershed area and waterbody type.

Tier 1	Tier 2	Tier 3	Tier 4
≤200 acres	>200 - <640 acres	greater than 640 acres	Tidal Watercourse




New tidal stream crossings rules (Tier IV) became effective on December 15, 2019

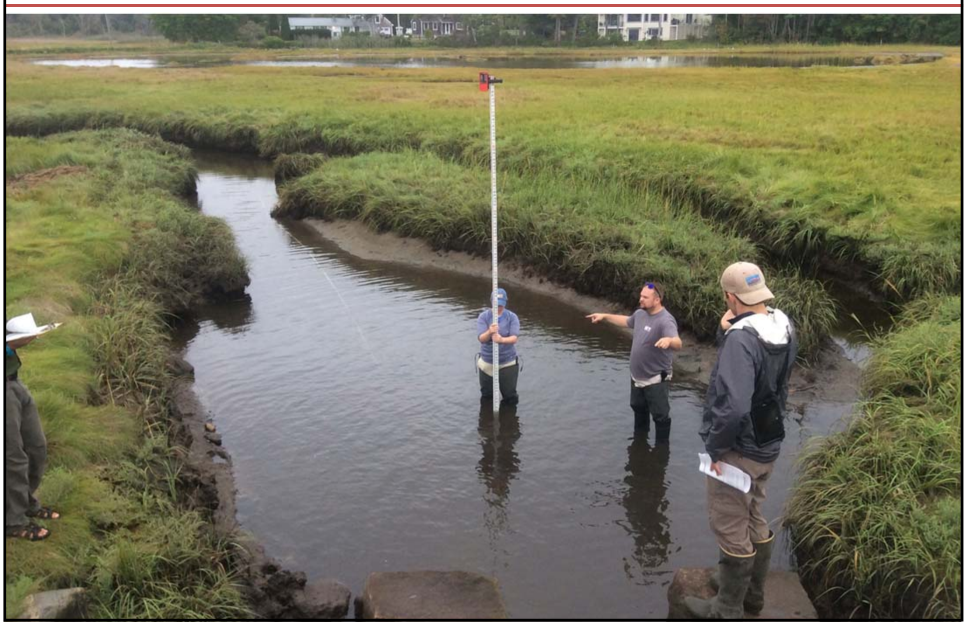
NHDES Tidal Stream Crossing Policy

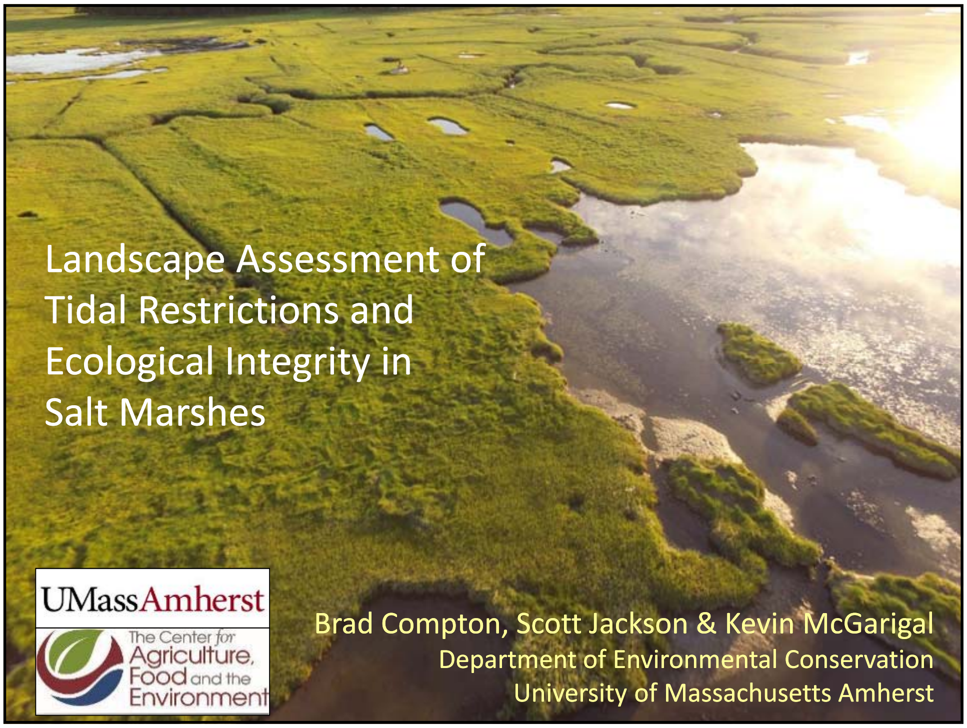
ENV-WT 904.07 Tier 4 Stream Crossing Regulatory Design Criteria

Shall be a designed :

- Of sufficient size to accommodate the 100-Year 24-hour design storm.
- To prevent a restriction of tidal flows
- To account for channel morphology
- To consider sea level rise.

Questions?





Landscape Assessment of Tidal Restrictions and Ecological Integrity in Salt Marshes

Brad Compton, Scott Jackson & Kevin McGarigal
Department of Environmental Conservation
University of Massachusetts Amherst

Conservation Assessment & Prioritization System (CAPS)

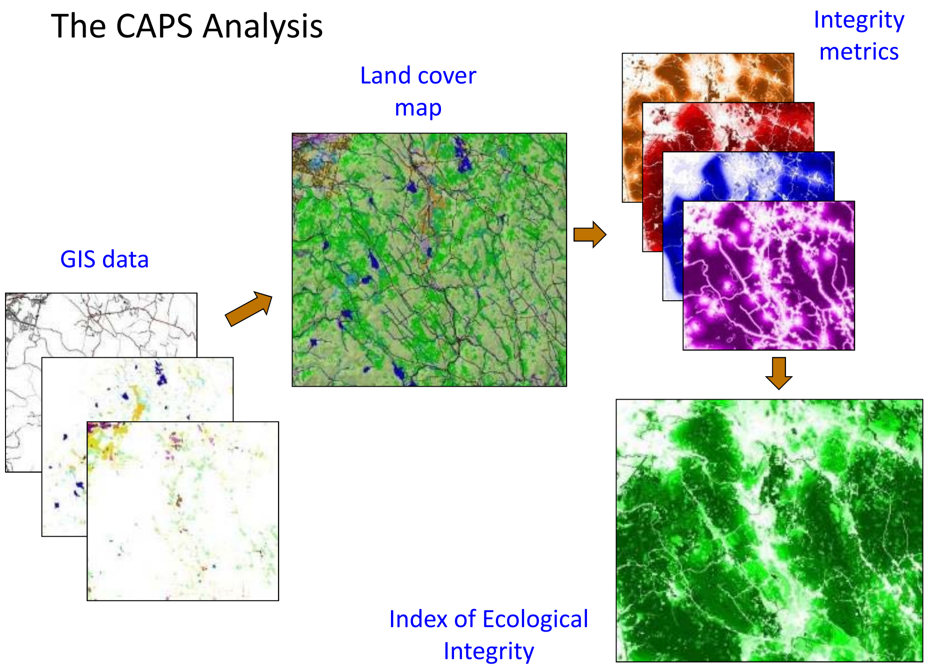
Assessing ecological integrity and supporting decision-making for land conservation, habitat management, project review & permitting to protect biodiversity

Landscape Ecology Lab

http://www.umasscaps.org

Ecological Community Approach

The CAPS Analysis



CAPS Integrity Metrics

Stressor metrics

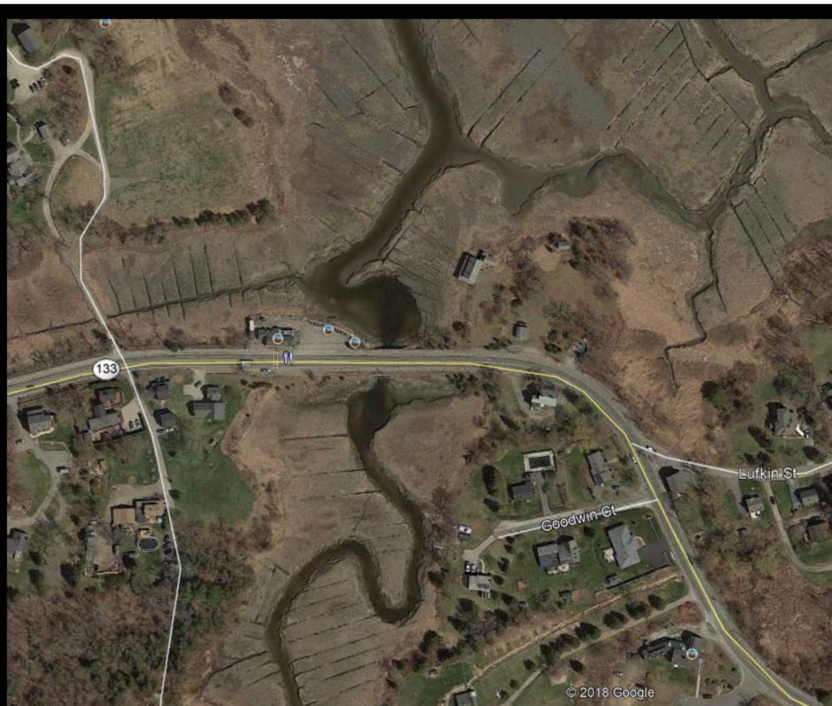
- Road Traffic
- Habitat loss
- Microclimatic alterations
- Mowing & plowing intensity
- Domestic predators
- Edge predators
- Non-native invasive plants
- Non-native invasive earthworms
- Wetland buffer insults
- Tidal restrictions
- Salt marsh ditching
- Coastal structures
- Beach pedestrian traffic
- Beach ORVs
- Boat traffic intensity

Watershed-based stressor metrics

- Road salt
- Road sediment
- Phosphorus enrichment
- Nitrogen enrichment
- Dam intensity
- Watershed habitat loss
- Imperviousness
- Hydrological alterations

Resiliency metrics

- Similarity
- Connectedness
- Aquatic connectedness



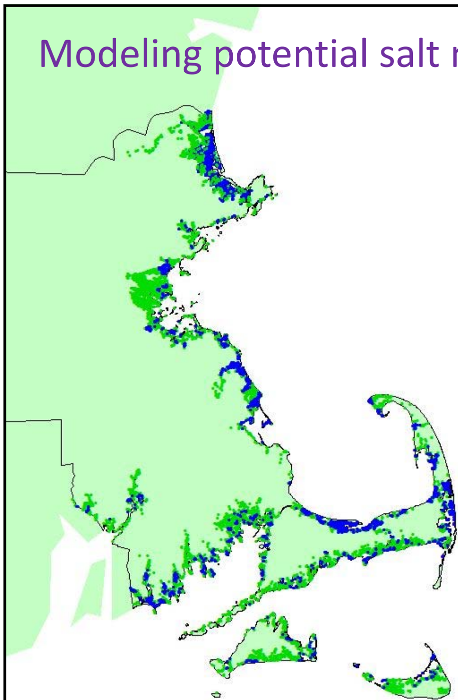
Tidal restrictions

Have 67 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 didn't have data for isolated tide gates.

Modeling potential salt marshes



Logistic regression:

marsh vs. upland

= elevation + tide range + dummy

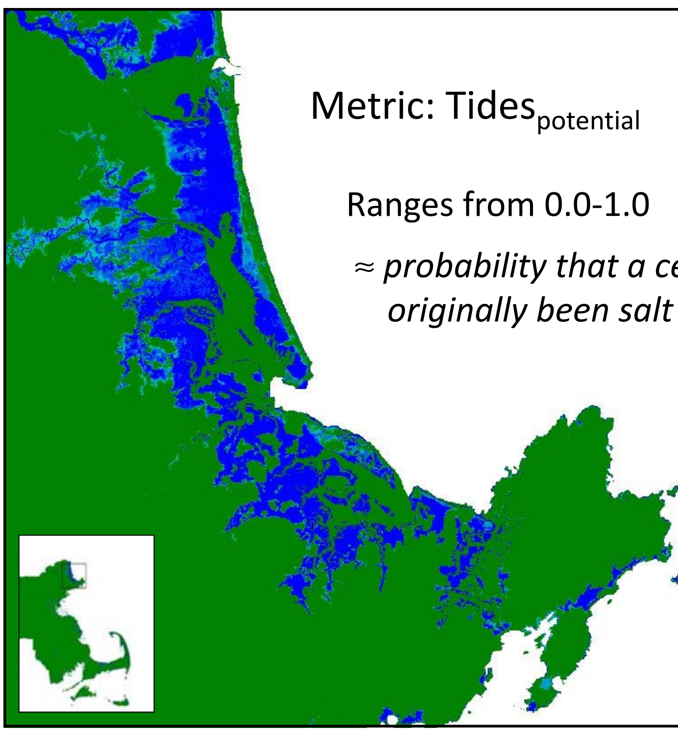
2500 random points in each

- Upland
- Salt marsh

$P < 0.001$

correct classification rate = 91%

	marsh	upland	(actual)
marsh	2259	296	
upland	149	2406	
(predicted)			

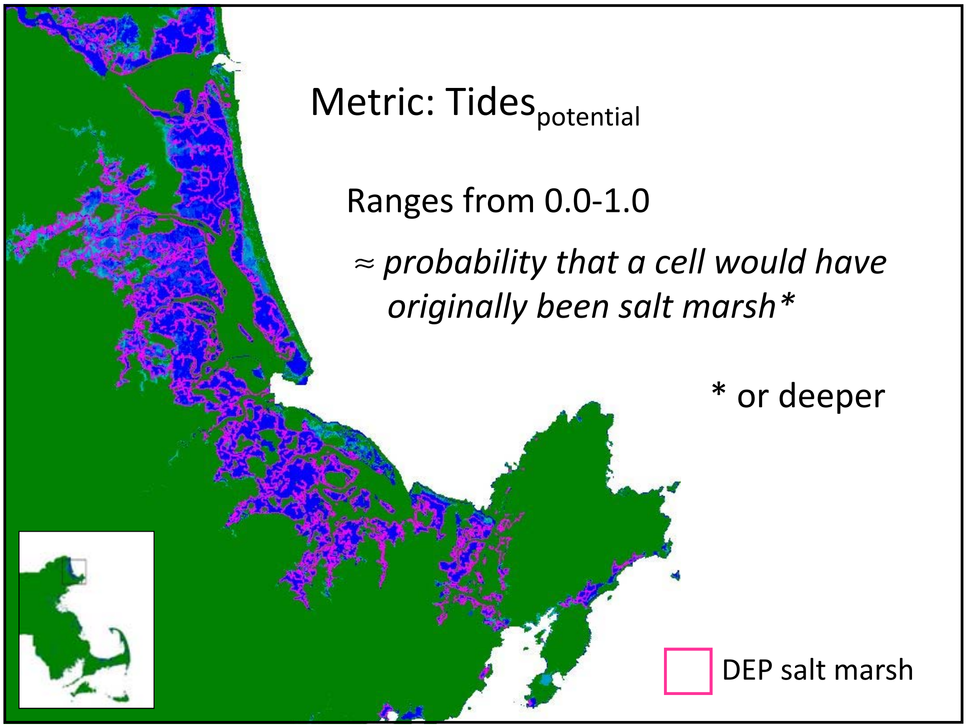


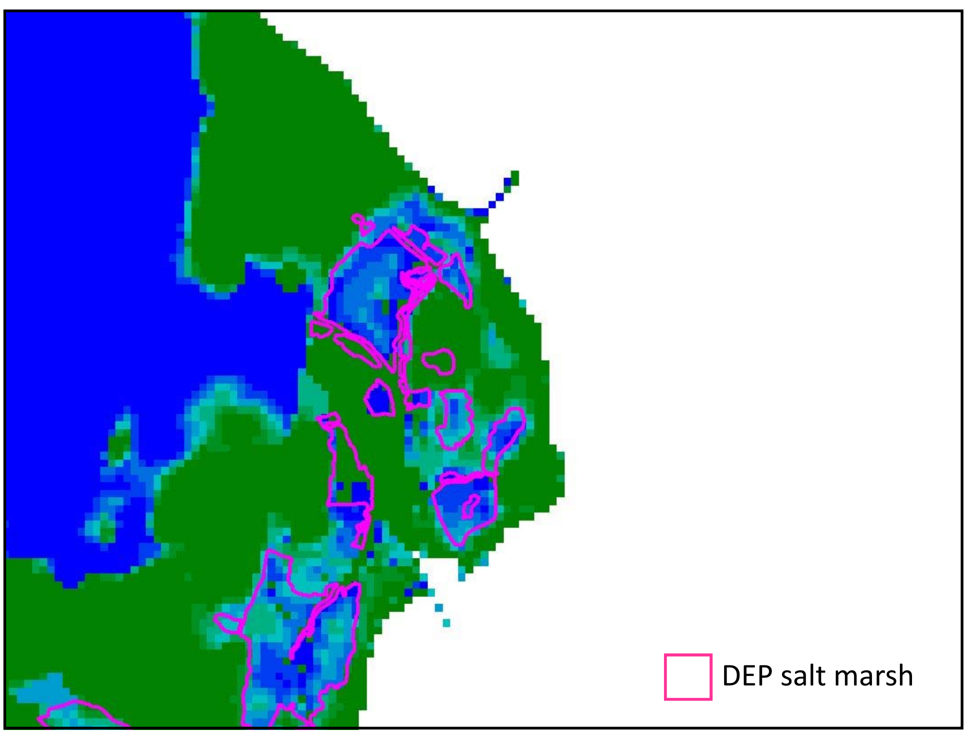
Metric: $\text{Tides}_{\text{potential}}$

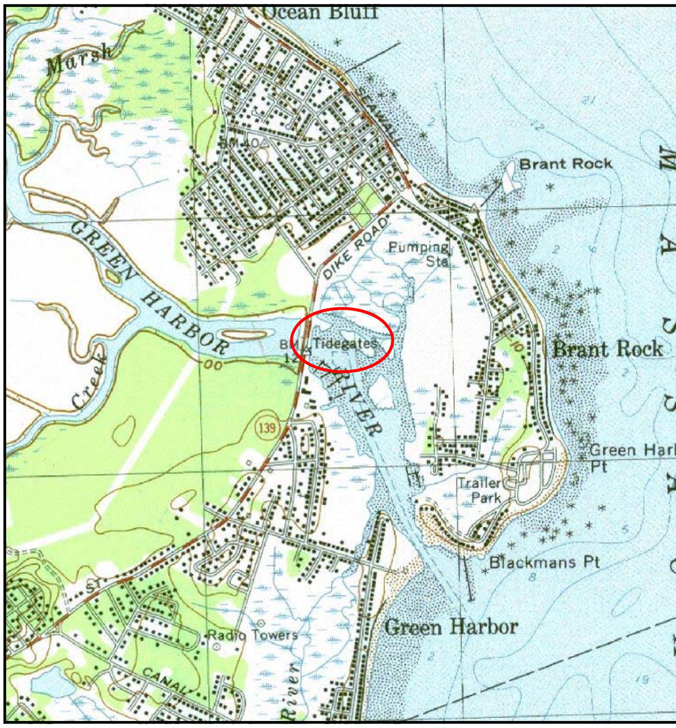
Ranges from 0.0-1.0

≈ *probability that a cell would have originally been salt marsh**

* or deeper

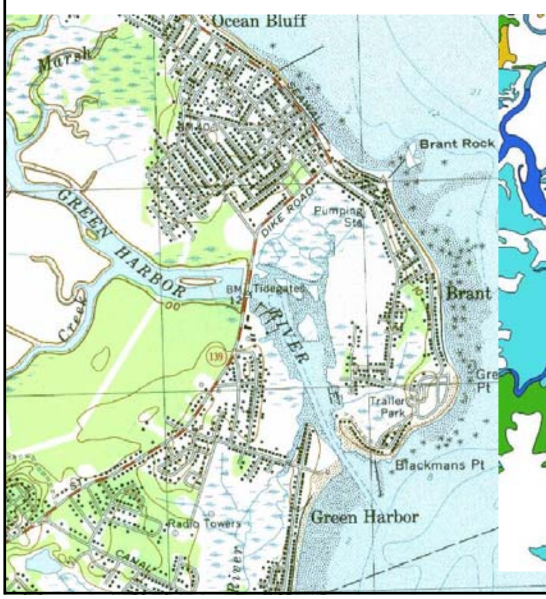

Metric: $Tides_{potential}$
Ranges from 0.0-1.0
≈ *probability that a cell would have originally been salt marsh**
* or deeper
DEP salt marsh

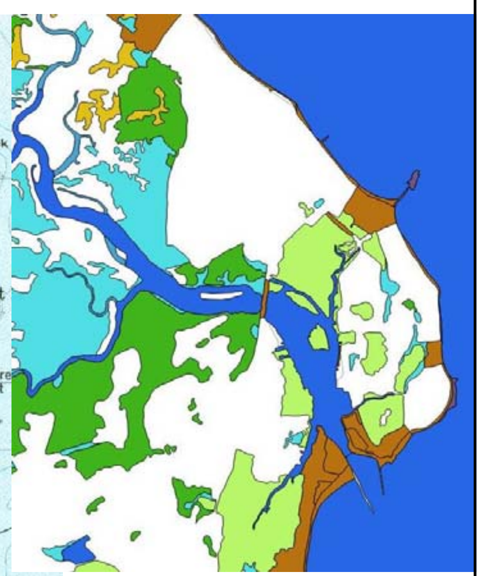

DEP salt marsh



Wetlands above tide gates are now freshwater

MassDEP Wetlands





Estimating severity of unsurveyed tidal restrictions

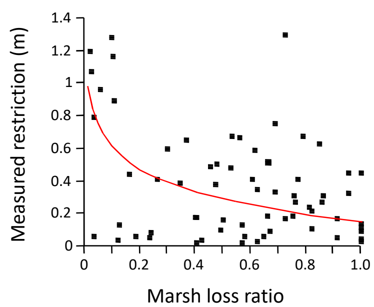
Marsh loss ratio =

$$1 - \frac{\text{area of observed salt marsh (DEP wetlands)}}{\text{area of potential salt marsh (tides}_{\text{potential}} > 0.5)}$$ above each restriction

Values range from 0 (no loss) to 1.0 (complete loss)

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

Estimating severity of unsurveyed tidal restrictions



restriction height = ln(marsh loss ratio), weighted by predicted marsh size

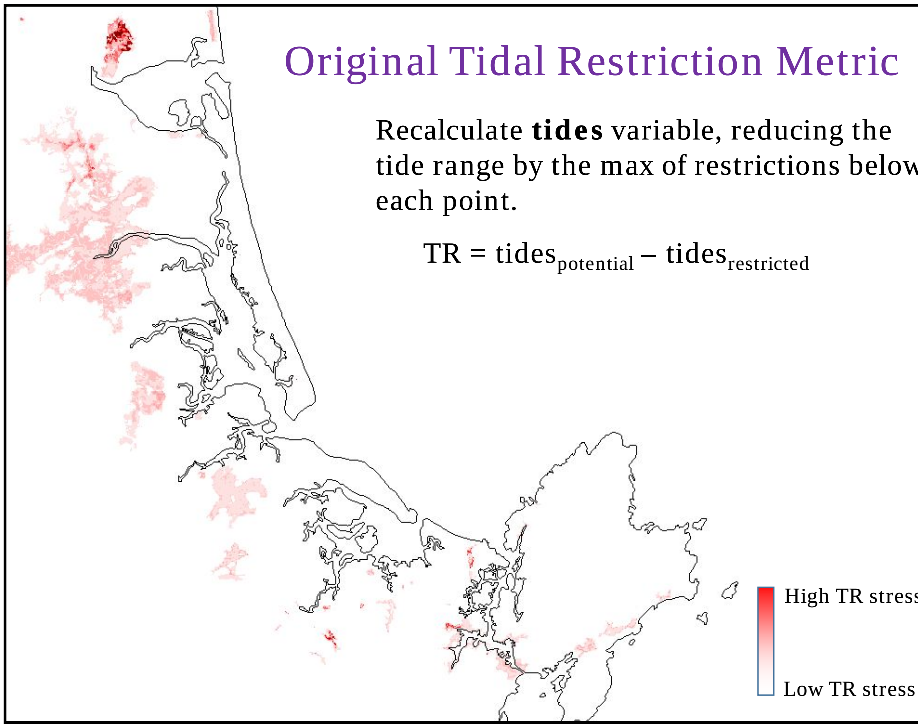
$n = 67$
$P < 0.001$
$r^2 = 0.41$

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

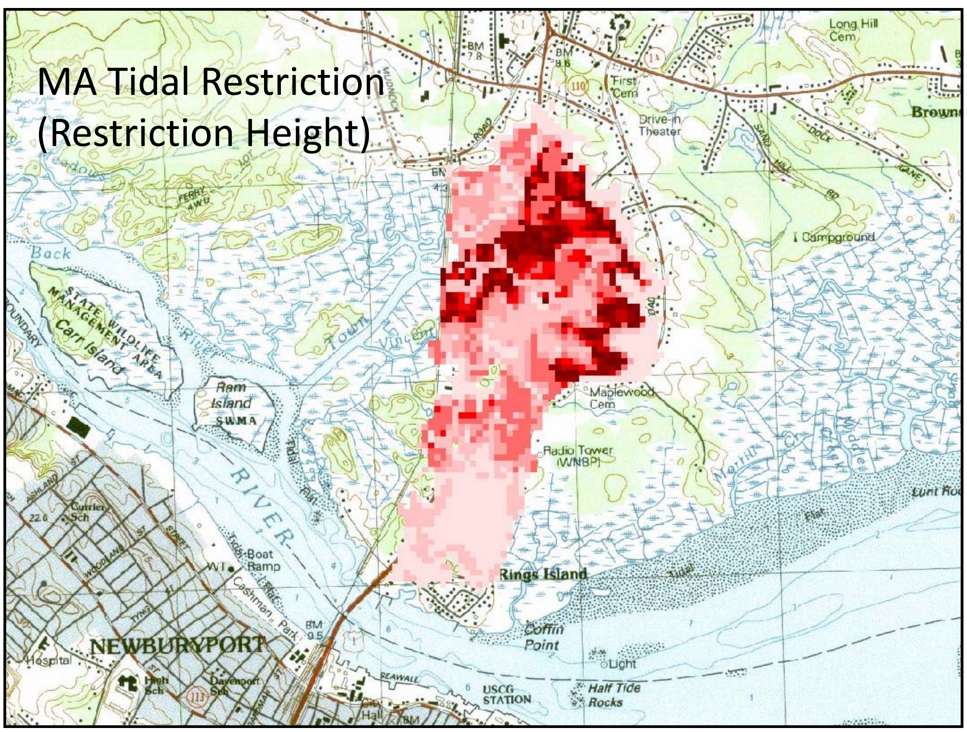
Original Tidal Restriction Metric

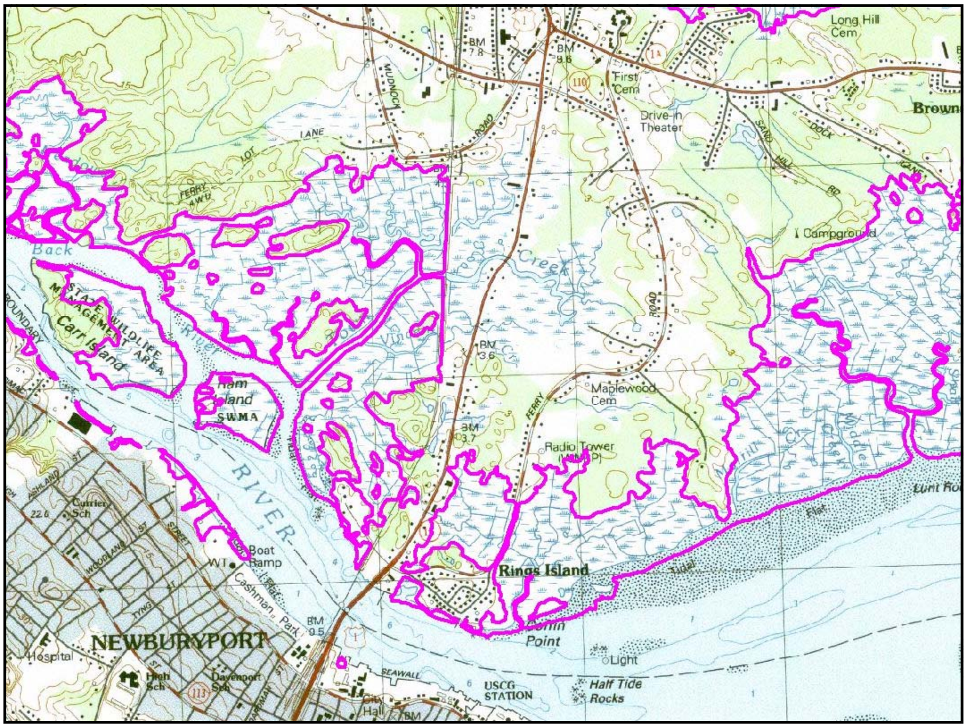
Recalculate **tides** variable, reducing the tide range by the max of restrictions below each point.

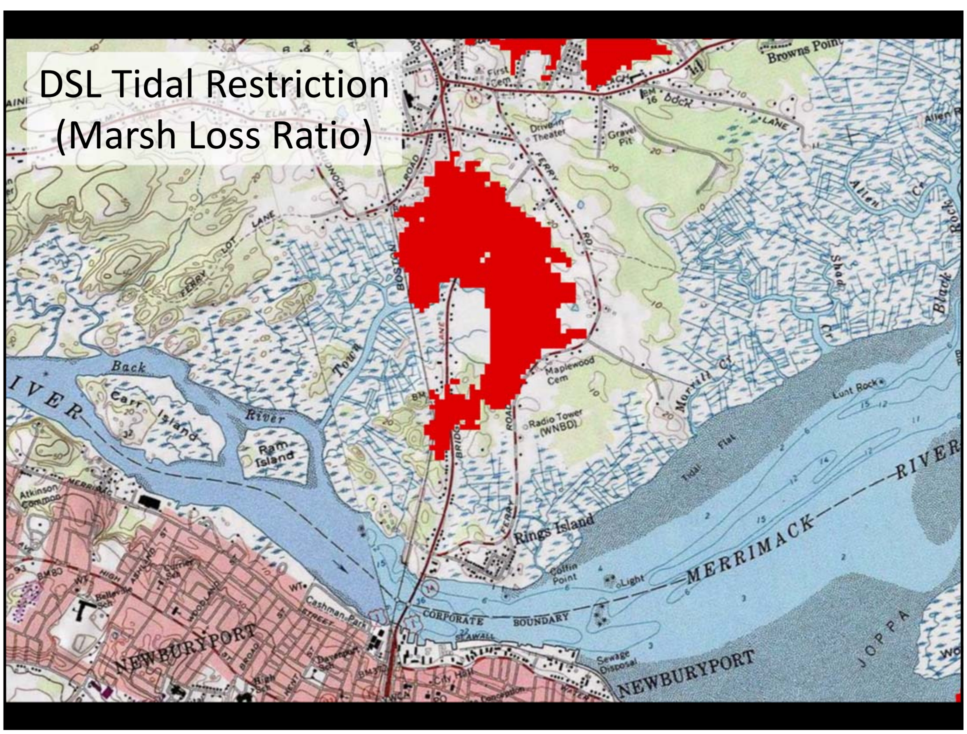
$$TR = tides_{potential} - tides_{restricted}$$

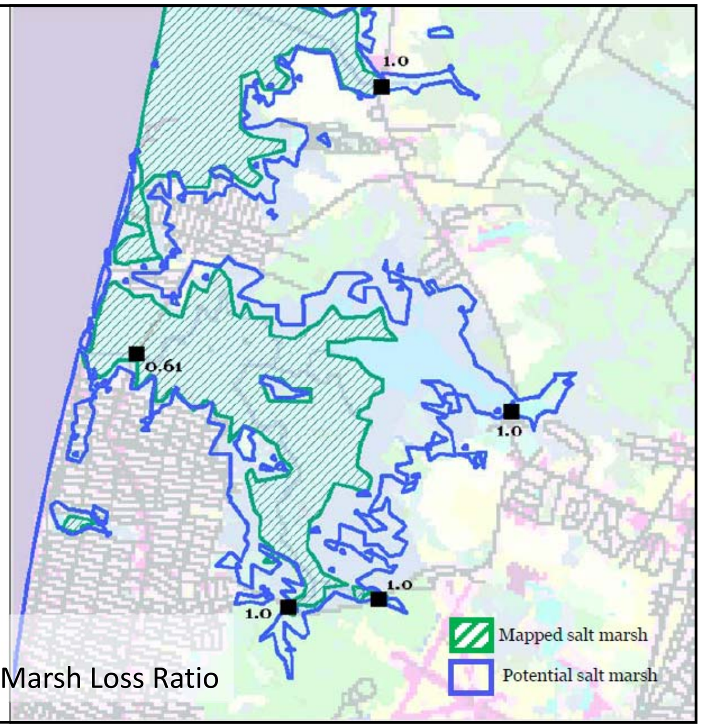


MA Tidal Restriction (Restriction Height)



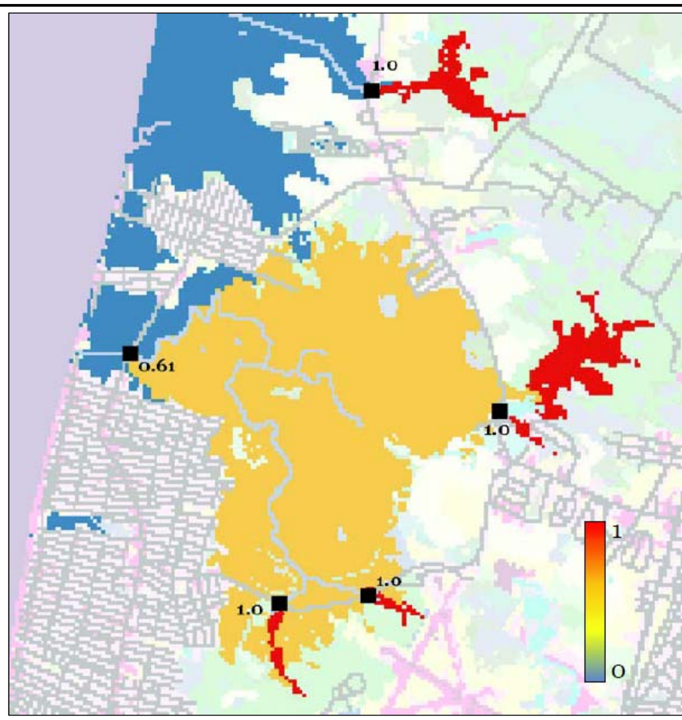

Long Hill Cem
First Cem
Drive-in Theater
Brown
Campground
Back River
Creek
STATE WILDLIFE MANAGEMENT AREA
Carr Island
Ram Island
SWMA
Maplewood Cem
Radio Tower
RIVER
Rings Island
Coffin Point
Light
Lunt Rock
Tidal Flat
Boat Ramp
Cashman Park
NEWBURYPORT
Hospital
USCG STATION
Half Tide Rocks
SEAWALL

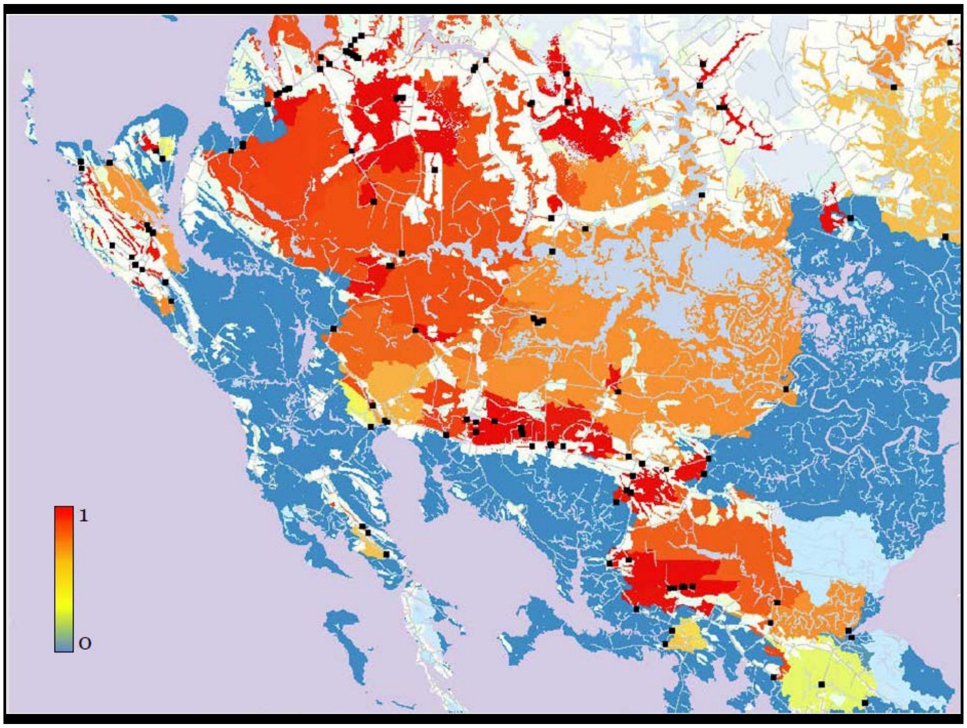

DSL Tidal Restriction
(Marsh Loss Ratio)
Browns Point
Drive-in Theater
Gravel Pit
Back River
Carr Island
Ram Island
Maplewood Cem
Radio Tower (WNBD)
Rings Island
Coffin Point
Light
Lunt Rock
Tidal Flat
MERRIMACK RIVER
CORPORATE BOUNDARY
Sewage Disposal
NEWBURYPORT
JOPPA



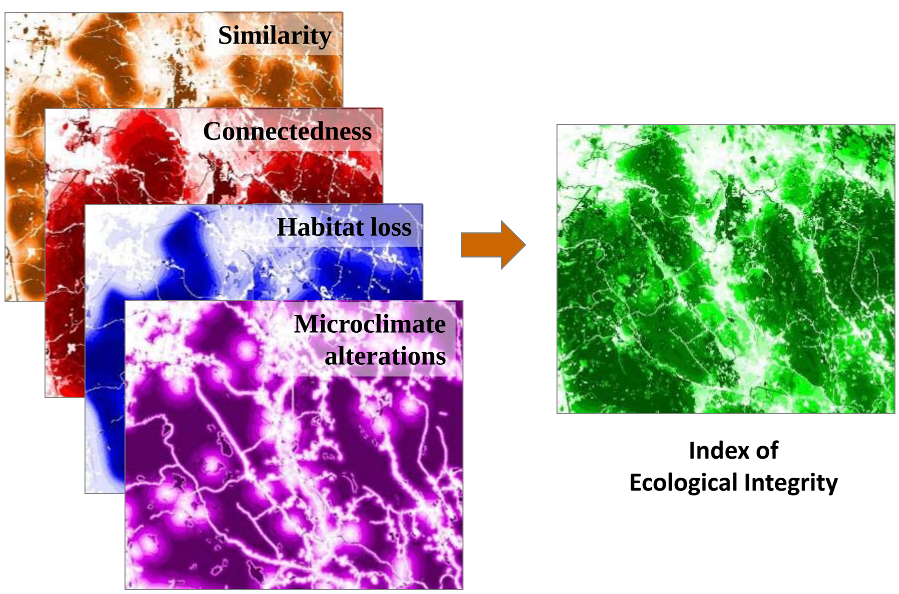
DSL
Tidal Restriction = Marsh Loss Ratio

Salt marsh cells receive score of the maximum scoring down-gradient restriction

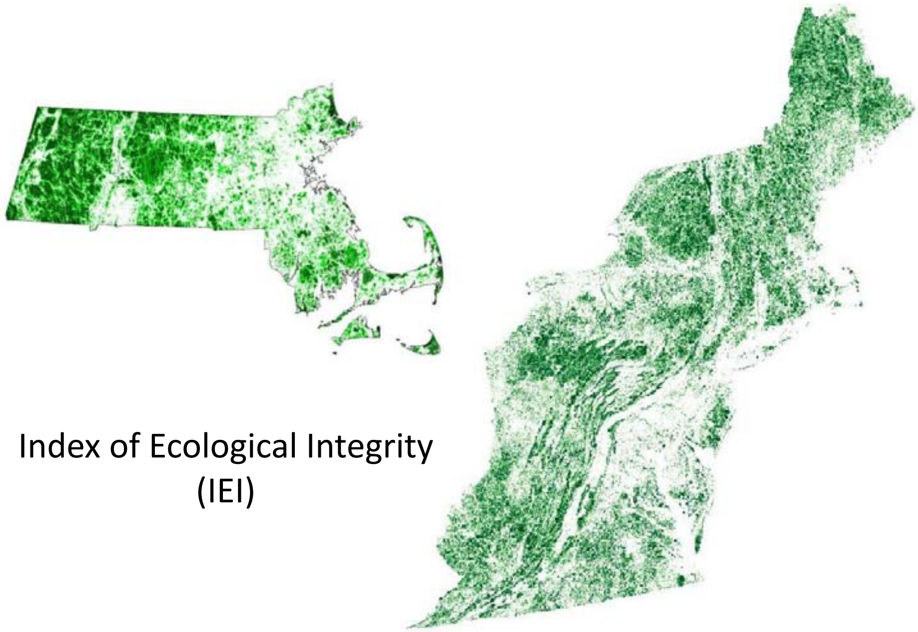




Metrics are combined into an index of ecological integrity



Index of Ecological Integrity



Index of Ecological Integrity (IEI)

Designing Sustainable Landscapes: Project Executive Summary

A project of the University of Massachusetts Landscape Ecology Lab

Principals:

- Kevin Mcgarigal, Professor
- Brad Compton, Research Associate
- Ethan Plunkett, Research Associate
- Bill Deluca, Research Associate
- Joanna Grand, Research Associate

With support from:

- North Atlantic Landscape Conservation Cooperative (US Fish and Wildlife Service, Northeast Region)
- Northeast Climate Science Center (USGS)
- University of Massachusetts, Amherst

Report date: 17 March 2017

Reference:

McGarigal K, Compton BW, Plunkett EB, Deluca WV, and Grand J. 2017. Designing sustainable landscapes: project executive summary. Report to the North Atlantic Conservation Cooperative, US Fish and Wildlife Service, Northeast Region.

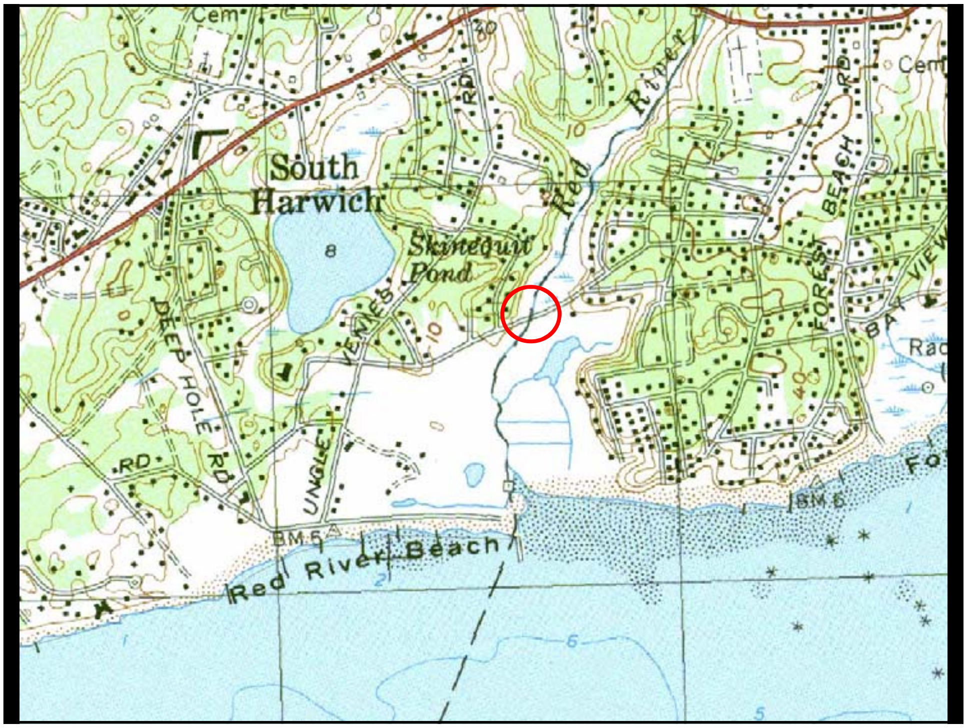
Designing Sustainable Landscapes (DSL)

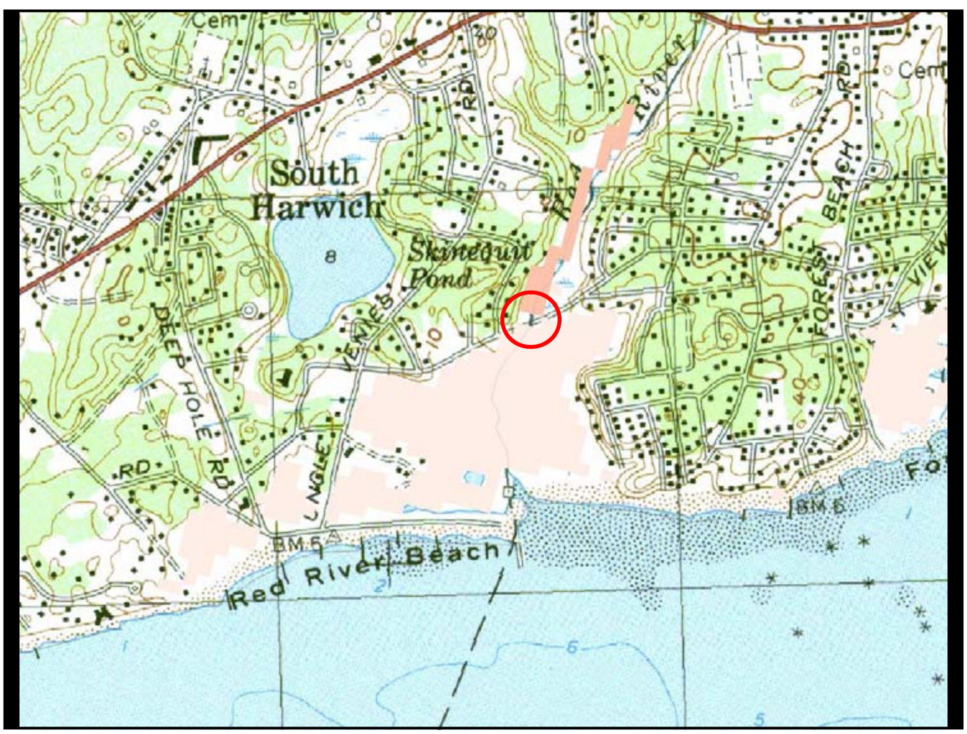
- CAPS IEI
- Critical Linkages
- Habitat for Representative Species
- Landscape Change Scenarios
  - Urban growth
  - Ecological succession
  - Vegetation disturbance
  - Climate change

↓

Landscape Conservation Design

- Connect the Connecticut
- Nature's Network


Cem
South
Harwich
Skinequit
Pond
Red River
DEEP HOLE RD
RD
UNGLE
VENIES
FOREST BEACH RD
BAY VIEW
BM 5
Red River Beach
BM 6
Cem


Cem
South
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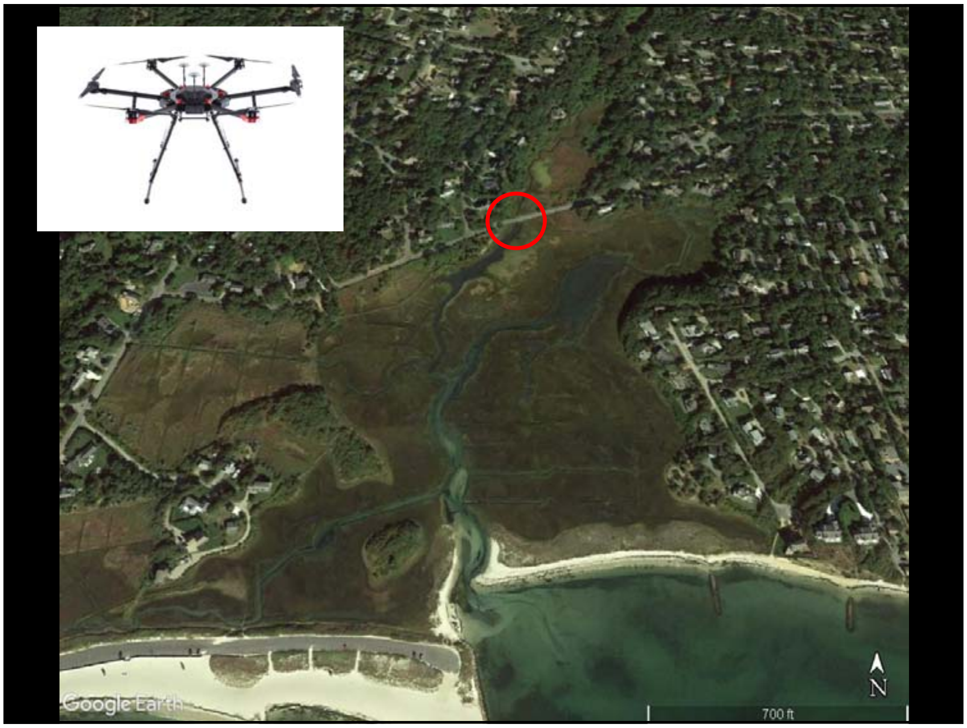
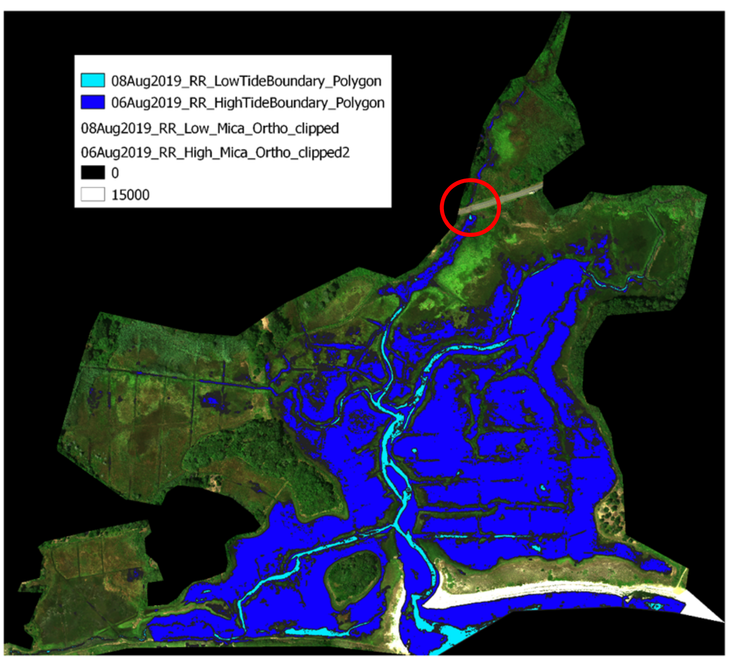
RD
VENIES
FOREST BEACH RD
VIEW
BM 5
Red River Beach
BM 6
Cem

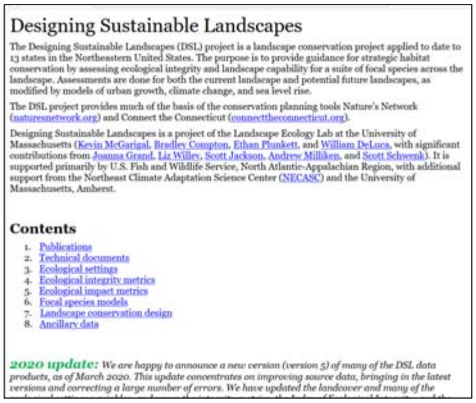




Marsh Inundation

Designing Sustainable Landscapes:
www.umassdsl.org/

CAPS (existing MA results):
www.umasscaps.org



Designing Sustainable Landscapes

The Designing Sustainable Landscapes (DSL) project is a landscape conservation project applied to date to 13 states in the Northeastern United States. The purpose is to provide guidance for strategic habitat conservation by assessing ecological integrity and landscape capability for a suite of focal species across the landscape. Assessments are done for both the current landscape and potential future landscapes, as modified by models of urban growth, climate change, and sea level rise.

The DSL project provides much of the basis of the conservation planning tools Nature's Network (naturesnetwork.org) and Connect the Connecticut (connecttheconnecticut.org).

Designing Sustainable Landscapes is a project of the Landscape Ecology Lab at the University of Massachusetts (Kevin McGarigal, Bradley Compton, Ethan Plunkett, and William DeLuca, with significant contributions from Joanna Grand, Liz Willey, Scott Jackson, Andrew Milliken, and Scott Schwenk). It is supported primarily by U.S. Fish and Wildlife Service, North Atlantic-Appalachian Region, with additional support from the Northeast Climate Adaptation Science Center (NECASC) and the University of Massachusetts, Amherst.

Contents

1. Publications
2. Technical documents
3. Ecological settings
4. Ecological integrity metrics
5. Ecological impact metrics
6. Focal species models
7. Landscape conservation design
8. Ancillary data

2020 update: *We are happy to announce a new version (version 5) of many of the DSL data products, as of March 2020. This update concentrates on improving source data, bringing in the latest versions and correcting a large number of errors. We have updated the landcover and many of the*

Contact:
Scott Jackson, sjackson@umass.edu

UMass Amherst
The Center for Agriculture, Food and the Environment

United States Environmental Protection Agency

MassDEP
Commonwealth of Massachusetts
Department of Environmental Protection

U.S. Fish & Wildlife Service
Department of the Interior

North Atlantic LCC
North Atlantic Landscape Conservation Cooperative

Returning The Tide:
A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Howard Schnabolk
NOAA Restoration Center
Charleston, SC

Overview

- NOAA Restoration Center Programs and Projects
- History and extent of tidal hydrology modifications in the Southeast U.S.
- Guidance Manual
  - Approach
  - Structure, Tools, Resources
  - Guidance Manual Topic Areas & Recommendations

NOAA Restoration Center

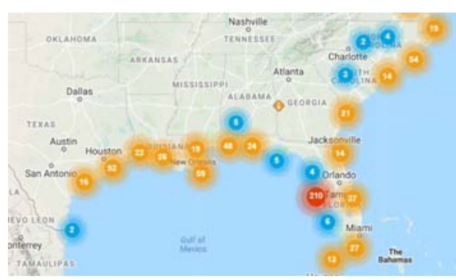
Damage Assessment, Remediation, and Restoration Program (DARRP)

- Goal: Restore injured resources and services following an oil spill or release of hazardous substances

NOAA Restoration Center

Community-based Restoration Program

- RC competitive grant program
- Cooperative agreements with grantees (state, local governments, NGO's, etc)
- RC staff provides oversight and technical assistance
- All projects include a "target species" and some level of scientific monitoring
- South Atlantic region dominated by hydrologic/saltmarsh, oyster restoration, and living shoreline projects



History of Tidal Modification in Southeastern U.S.

- Multiple barriers/ blockages to tidal flow commonly constructed in the 1940's, 50's, 60's
  - Agriculture – impoundments for rice
  - Livestock grazing
  - Road construction – sediment from marsh used to create road platform
  - Causeway construction – borrowed material from bay bottom to connect islands to mainland
  - Migratory bird (i.e. duck) habitat impoundment– changes salt marsh to freshwater
  - Mosquito control – managed impoundments or ditching/draining
  - Dredge spoil disposal- often placed on marsh

Extent of Tidal Hydrology Modification in Southeastern U.S.

Impoundments

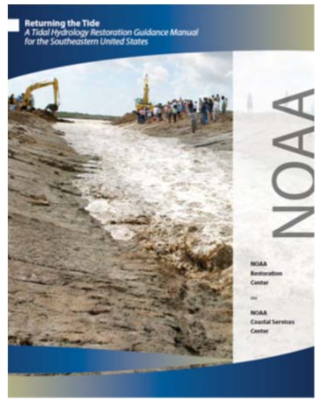
- More than 16,000 ha on east coast of Florida
- 14-16% of coastal wetland in South Carolina
- More than 15,000 ha in Louisiana

Restricted or blocked tidal flow
Little or no fish access
Poor water quality, etc.

Returning The Tide:
A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Providing practical guidance and tools with the goals of:

- Encouraging additional projects
- Improving ecological success
- Advancing the science of restoration



Restoring Tidal Hydrology Workshop


Restoring Tidal Hydrology
Breaking Down Barriers

Fostering an exchange of information among experienced and potential practitioners of tidal hydrologic restoration in the U.S. Southeast region

Workshop Proceedings

January 2008
Charleston, South Carolina

NOAA Restoration Center
NOAA Coastal Services Center
National Oceanic and Atmospheric Administration
2008

- NOAA staff and 13 tidal hydrology experts designed workshop
- ~75 attendees; Jan 16 & 17 2008
- Workshop Objectives:
  - Exchange of information between experienced and potential practitioners
  - Identify gaps in knowledge, research and tools related to hydrologic restoration
- Breakout sessions, plenary and panel discussions
- Proceedings formed the basis for the guidance manual.

Restoring Tidal Hydrology Workshop

Design: *What are the implications of storm surge on project designs?*

Scientific Evaluation: *What monitoring strategies can be employed to determine the footprint benefitted by the project?*

Construction: *What strategies are effective for contractor selection?*

Permitting: *What assistance can regulatory agencies provide to project planners?*

Community Involvement: *What are the typical concerns of local communities regarding hydrologic restoration projects?*

Returning The Tide:
A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Contents of Document:

- Main Body - 7 chapters, each covering a “topic area” associated with the multiple phases of project implementation. Includes “Project Spotlights”
- Project Portfolios- Comprehensive and consistent information on 13 completed projects.
- Toolkit- provides resources for the multiple phases of project planning and implementation. It includes easy-to-use checklists, agency contact information and summaries of tips from the manual.

Returning The Tide:

A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Chapter 1: Background

- Reasons for historic tidal modifications
- Impacts on different estuarine habitats
- Ecological / economic benefits

Table 1. Example tidal hydrology restoration projects.

Name	Modification/ solution	Acres	Habitat type	Total Cost	Cost/acre
Bahia Grande *Brownsville, TX*	Dredge-fill/Breach	6,500	Soft bottom, sand	$1,800,000	$277
Hopedale *St. Bernard Parish, LA*	Levee/Water control structure	3,086	Salt marsh	$2,140,000	$693
St. Vincent Island *St. Vincent Island, FL*	Road construction/ removal and culverts	1,925	Salt marsh	$46,000	$24
Fort DeSoto *Pinellas County, FL*	Causeway/Bridge	1,140	Mangrove, soft bottom, seagrass	$1,600,000	$1,403
Don Pedro *Charlotte County, FL*	Road construction and dredge-fill/ Culvert and scrape down	32	Mangrove, salt marsh	$104,800	$3,275
Clam Bayou *Sanibel Island, FL*	Causeway/Box culverts	290	Mangrove, oyster, seagrass	$1,000,000	$3,448
Tarpon Bay *Naples, FL*	Causeway/Box culverts	360	Water column	$1,300,000	$3,611
Wildcat Cove *St. Lucie County, FL*	Culverts	100	Mangrove, upland	$84,000	$840
Sandpiper Pond *Murrels Inlet, NC*	Sedimentation/Breach	35	Salt marsh	$81,000	$2,314

Returning The Tide:

A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Chapter 2: Project Identification, feasibility, and planning

- Regional Planning vs. Opportunistic Projects
- Structural characteristics of restoration opportunities
- Common ecological changes
- Funding
- Building a project team

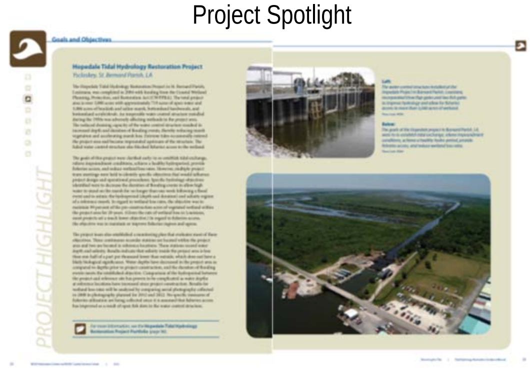
Returning The Tide:
A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Chapter 3:

Goals and Objectives

- The importance of goals and objectives; biological targets
- Methods for establishing goal and objectives;
- Common tidal hydrology restoration goals and objectives;

Project Spotlight



Returning The Tide:
A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Chapter 4: Project Design

- Ecological and physical parameters
- Pros/Cons of various design strategies and techniques
- Sea-level rise considerations
- Hydrologic modeling

Table 4a. Ecological and physical site parameters critical to project design.

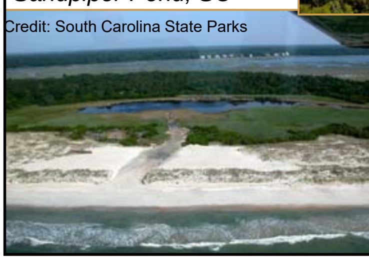
Ecological Parameter	Importance to Project Design
Tidal prism (range in volume of water from high to low tide)	The volume of water moving through the site under current conditions will influence design components, including size and location of breaches and tidal channels.
Flow velocity	Flow velocity will influence design options with regard to appropriate sizes for breaches or culvert structures.
Salinity regime	Salinity strongly influences distribution of plant and animal communities as well as soil characteristics. Understanding the current salinity regime will aid in developing appropriate targets for post-restoration salinity regimes. Soil or interstitial salinities should also be investigated for proper plant selections.
Tidal footprint	The expanse of area currently influenced by tidal inundation is important information for engineering and modeling efforts. Effects should be modeled for both the existing and projected areas of influence (including trends in sea level rise). It is possible that negative impacts could result from redirecting water flow from its current location.
Freshwater inflows (surface and ground)	Sources, locations, and volumes of freshwater inflows will influence the ecological function in a restored site and must be considered during the design. They will also influence water retention within the site and potential flooding concerns of adjacent property.
Surface elevation	The topography and bathymetry within and around the site will impact the movement and location of water, influencing soil types, plant and habitat types. Project design may entail alteration of existing elevations, as appropriate, to meet goals and objectives. It should also account for any local trends in land subsidence.
Plant communities	Locations and types of plant communities provide insight into soil characteristics and typical flooding patterns. Locations of exotic and native species should also be considered. It may be desirable to design a project that preserves native plant communities (especially coastal upland, maritime forest, and high marsh plant communities – see ***Designing for Sea Level Rise*** on page 30).
Species composition (faunal and vegetation, threatened and endangered)	Vegetation and faunal community composition will be a critical factor in the permitting phase of the project. It is important to understand the community composition so potential impacts of a design can be analyzed prior to submitting permitting applications.
Soil characteristics	Soil characteristics will provide insight into current flooding patterns and can be useful in researching any potential historic soil contamination. Historic data may also help the project team locate the best location for restoring tidal connections or wetland communities based on former hydric soil locations. Soil characteristics are also a critical engineering factor in terms of stability, subsidence, and seepage which could affect structural design and support.
Climate	Seasonal wind and barometric pressure, frequency of droughts and storms, etc. can affect hydrological patterns and wetland sustainability. Having an understanding of the local seasonal extremes may be helpful in designing projects.
Adjacent lands	Land cover, use, and ownership of adjacent lands are important design considerations. Land cover (and habitat functionality) will directly influence the ecological outcomes at the project site. Landownership (private or public) and use may provide for a range of design considerations, including public access, adjacent development activities, and future downstream and upstream impacts to the project site.

Culvert Placement
St. Vincent Island NWR

Box Culvert Placement
Tarpon Bay, Florida

Barrier Breach
Sandpiper Pond, SC

Water Control Structure
Hopedale, Louisiana



Bridge Installation
Fort DeSoto, Florida

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A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Table 5a. Example project permitting summary

Example Project	Federal Permitting	State Permitting	ESA/ NEPA issues	Notes
Bahia Grande *Texas*	USACE NWP 27	Environmental Assessment (EA) required due to archaeological issues	None	A contractor was hired to draft the EA to expedite the process. See the Bahia Grande Project Portfolio on page 92.
Hopedale *Louisiana*	USACE CWA Section 404	Coastal Use and Water Quality permits	None	See the Hopedale Project Portfolio on page 98.
Fort DeSoto *Florida*	USACE NWP 27	FL's Environmental Resource Permit (ERP) process coordinates state and USACE permits; SWFWMD permit	Manatee habitat	Permit to include "stop-work" order with manatee sightings. See the Fort DeSoto Project Portfolio on page 110.
Don Pedro *Florida*	USACE NWP 27	Southwest Florida Watershed Management District (SWFWMD) required significant technical and engineering data	None	The SWFWMD permit was submitted with letter requesting Nationwide Permit 27 approval; permit was issued within days. See the Don Pedro Project Portfolio on page 122.
Clam Bayou *Florida*	USACE NWP 27	FL's Standard General Permit	Manatee habitat	Designed permits to provide movement for manatees. See the Clam Bayou Project Portfolio on page 128.
Wildcat Cove *Florida*	USACE NWP 27	FL's Standard General Permit	None	The permitting process only took 90 days due to team's familiarity with permitting staff (compared to a typical six-month processing time). See the Wildcat Cove Project Portfolio on page 140.
Sandpiper Pond *South Carolina*	USACE CWA Section 404	SC's Department of Health and Environmental Control coordinated state permits	Project area once contained threatened species (seabeach amaranth)	Permit stipulates that no work is to occur during sea turtle nesting season. See the Sandpiper Pond Project Portfolio on page 146.
North River Farms *North Carolina*	USACE CWA Section 404	Coastal Area Management Act permit (through NC's Department of Environment and Natural Resources – DENR)	None	An Erosion Control Plan was required through the DENR's Land Quality division. See the North River Farms Project Portfolio on page 152.

Chapter 5: Permitting and Regulatory Compliance

- Federal Legislation regulating tidal hydrology restoration (ESA,CZMA,MSA,CWA,NEPA)
- Building successful relationships with regulating agencies

NOAA FISHERIES

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A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Chapter 6: Construction & Maintenance

- Selecting a Contractor
- Budgeting
- Scheduling
- Implementation (i.e. site prep, contingency planning)
- Post-construction management and maintenance
- Challenges of construction in estuaries

NOAA FISHERIES

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 103

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Chapter 7: Scientific Evaluation and Monitoring

- What and how to monitor;
- Where and when to monitor;
- Guidelines for how to determine restoration effectiveness;
- Discussion on how a practitioner can contribute to furthering the science and understanding of tidal hydrology restoration

NOAA FISHERIES

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | NOAA Fisheries | Page 104

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A Tidal Hydrology Restoration Guidance Manual for the Southeastern United States

Chapter 8: Community Support

- Building Programmatic (long-term) support for restoration
- Building project-level support
- Developing volunteer strategies
- Volunteers and monitoring

Table 8a. Strategies for successful public support.

Strategy	Guidance
Engage early	Communicate early with the community to help gain approval from landowners directly affected by or adjacent to the project area. Having affected stakeholders serve as project proponents can help build public support.
Hold public meetings	Provide the public an opportunity to weigh in on the project idea long before plans have been finalized. It is also helpful to make field trips to restored ecosystems, so that community members can envision a finished product in their neighborhood (Casagrande 1997).
Clearly translate project goals and objectives	Avoid complex science jargon during public meetings and when developing outreach materials. Use non-scientific language, well-versed speakers, graphics, and charts to avoid confusion and educate your audience. Modeling activities can be especially challenging to describe. Remember that the ecological benefits of restoring tidal flow are not necessarily obvious to the general public.
Incorporate community interests	Understand community interests related to the characteristics and history of the project location. On occasion, restoration projects can be designed to meet primary ecological goals while simultaneously satisfying community goals with limited additional expense. For instance, aesthetic benefits realized from a project may provide increases in adjacent property values.
Utilize success stories	Enable community understanding of the project. Utilize simple schematics and visualizations of similar projects during meetings, in outreach materials, and when working with the media.
Address misinformation	Use the media to disseminate correct information that directly addresses community concerns if misinformation is widespread.
Reexamine the project	Reexamine the project if substantial and valid community opposition exists. Incorporate community concerns into subsequent plans, or if opposition is insurmountable, accept that the project may not be viable.

Toolkit:

of project activities along the coast.

A list of organizations involved with technical and financial support for restoration is available in the ***Toolkit*** *(page 175).*

- *Approach academic institutions to discuss*

Major Components of a Monitoring Plan

For an overview of the most common components included in a monitoring plan, see the monitoring plan template in the ***Toolkit*** *(page 205).*

The monitoring plan should be developed concurrently with the design and construction plans and should flow directly from the goals and objectives of the project, including both

also commit to certain budget items, if they have the expertise on staff to complete them.

Example financial documents, independent cost estimates, and a match analysis tool can be found in the ***Toolkit*** *(page 200-203).*

Writing a statement of work. The statement, or scope, of work (SOW), developed by the project team, is a narrative description of the

endangered species or their critical habitat.

An example template used for ESA consultation is available in the ***Toolkit*** *(page 186).*

Coastal Zone Management Act. The Coastal

Toolkit

Tools, Tips, and Templates for **Project Identification, Feasibility, and Planning** 166
Toolkit Resource #1: Summary of Recommendations 167
Toolkit Resource #2: Site Hydrology Evaluation Questions 167
Toolkit Resource #3: Project Identification Checklist 168
Toolkit Resource #4: GIS and Online Mapping Resources 170
Toolkit Resource #5: Project Feasibility Questions Worksheet 173
Toolkit Resource #6: Organizations Providing Technical/Financial Support 175

Tools, Tips, and Templates for **Goals and Objectives** 176
Toolkit Resource #7: Summary Recommendations 176
Toolkit Resource #8: Project Goals Worksheet 177
Toolkit Resource #9: Project Objectives Worksheet 178
Toolkit Resource #10: References for Adaptive Management 179

Tools, Tips, and Templates for **Project Design** 180
Toolkit Resource #11: Summary Recommendations 180
Toolkit Resource #12: Recommended (Minimum) Modeling Inputs 181
Toolkit Resource #13: Additional Design Resources 181
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Toolkit Resource #15: Hydrological Model Summary Table 182

Tools, Tips, and Templates for **Permitting and Regulatory Compliance** 184
Toolkit Resource #16: Summary Recommendations 185
Toolkit Resource #17: Federal Regulatory Policies, Citations, and Websites 185
Toolkit Resource #18: U.S. Fish & Wildlife Service ESA Consultation Template 186
Toolkit Resource #19: NOAA Community-based Restoration Program NEPA Checklist 190
Toolkit Resource #20: U.S. Army Corps of Engineers Contact Information 195
Toolkit Resource #21: State Regulatory Agency Contact Information 196

Tools, Tips, and Templates for **Construction and Maintenance** 198
Toolkit Resource #22: Summary Recommendations 198
Toolkit Resource #23: Example Construction Process Outline 199
Toolkit Resource #24: Example Multi-Funder Project Budget 200
Toolkit Resource #25: Match Analysis Tool 201
Toolkit Resource #26: Example Independent Cost Estimates 202

Tools, Tips, and Templates for **Scientific Evaluation and Monitoring** 204
Toolkit Resource #27: Summary Recommendations 204
Toolkit Resource #28: Monitoring Plan Template 205
Toolkit Resource #29: Monitoring Data Collection Forms 206
Toolkit Resource #30: Example Wildlife Monitoring Datasheet 210

Tools, Tips, and Templates for **Community Support** 212
Toolkit Resource #31: Summary Recommendations 212
Toolkit Resource #32: NGOs Focusing on Coastal Restoration and Community Involvement in the Southeastern United States 213
Toolkit Resource #33: Resources for Developing Volunteer Management Programs 213

Providing tools, tips, and templates for effective tidal hydrology restoration in the Southeastern United States

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Project Portfolios:

He found that their contribution has been beneficial for long-term repeated measures.

For more information, see the **Little River Marsh Restoration Project Portfolio** *(page 158).*

Below are some monitoring activities critical for evaluating effectiveness of

Newman Branch Tidal Hydrology Restoration Project
Apollo Beach, Hillsborough County, FL

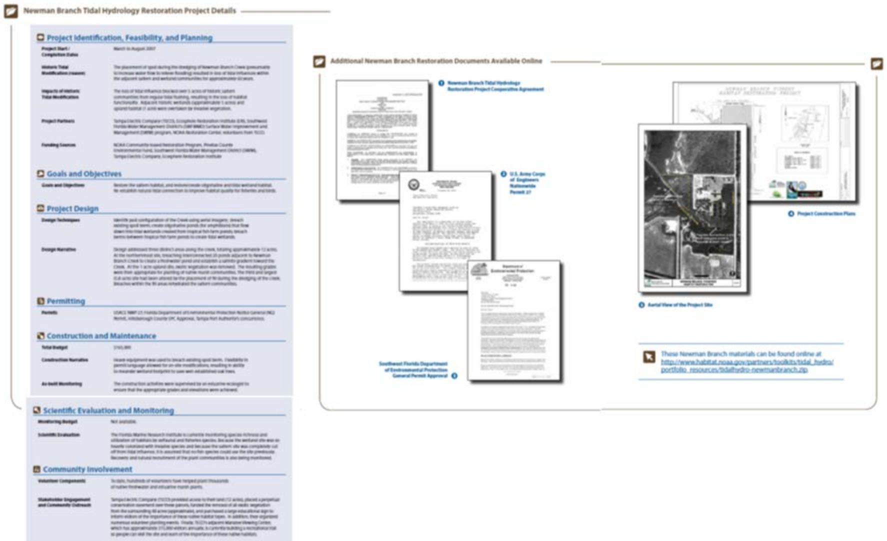
Background

Outcomes / Status

Lessons Learned

Project Contact

Project Portfolios:



Howard Schnabolk
NOAA Restoration Center
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Link to Returning The Tide:
http://masgc.org/hydrorestoration/monitor

Design and Operational Tools

- Mike Ruth, PG
- Geologist, Federal Highway Administration
- Design Tools
  - Kind of depends – What are we addressing – bridge? Culvert? Tide gate? Causeway/Dam
  - Existing Transportation Engineering Manual/Guidance
  - USACE requirements, USFWS, NOAA, USCG
  - Hydraulic Models
- Operational Tools
  - Identification – inventories, remote sensing/GIS, ground truthing, catalogue
  - Regulatory – existing programmatic agreements (resource agencies)
  - USACE RGL 18-01
  - FHWA - Development of Programmatic Mitigation Plans 23 CFR 450.214

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Funding Tools

Funding Tools	
NOAA	Coastal Resilience Grants Program and Community-based Restoration Program
USFWS	National Coastal Wetlands Conservation Grant Program, The Coastal Program and National Fish Passage Program
ACOE	Estuary Restoration Act and Water Resources Development Act funds
FEMA	Public Assistance Program, Hazard Mitigation Grant Program, and National Flood Insurance Program Community Rating System
FHWA	Emergency Relief Program, and Emergency Relief for Federally Owned Roads Program; Development of Programmatic Mitigation Plans
USDA NRCS	Watershed Protection and Flood Prevention Program
EPA	319 Grants, Wetland Program Development Grants
Multiple	Natural Resource Damage Assessment, The Five Star Program, and Urban Water Grant Program

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- **Mike Ruth PG**, mike.ruth@dot.gov

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Watershed Academy Webcast

More webcasts coming soon!

www.epa/gov/watershedacademy

The slides from today's presentations are posted.
A recording will be posted within the next month.

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Participation Certificate

- If you would like to obtain a participation certificate you can access the PDF in the **Handouts** section of your control panel.

- You can type each of the attendees names into the PDF and print the certificates.

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Thank You!

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