How Will CT's Coastal Marshes Respond to Sea Level Rise (SLR)

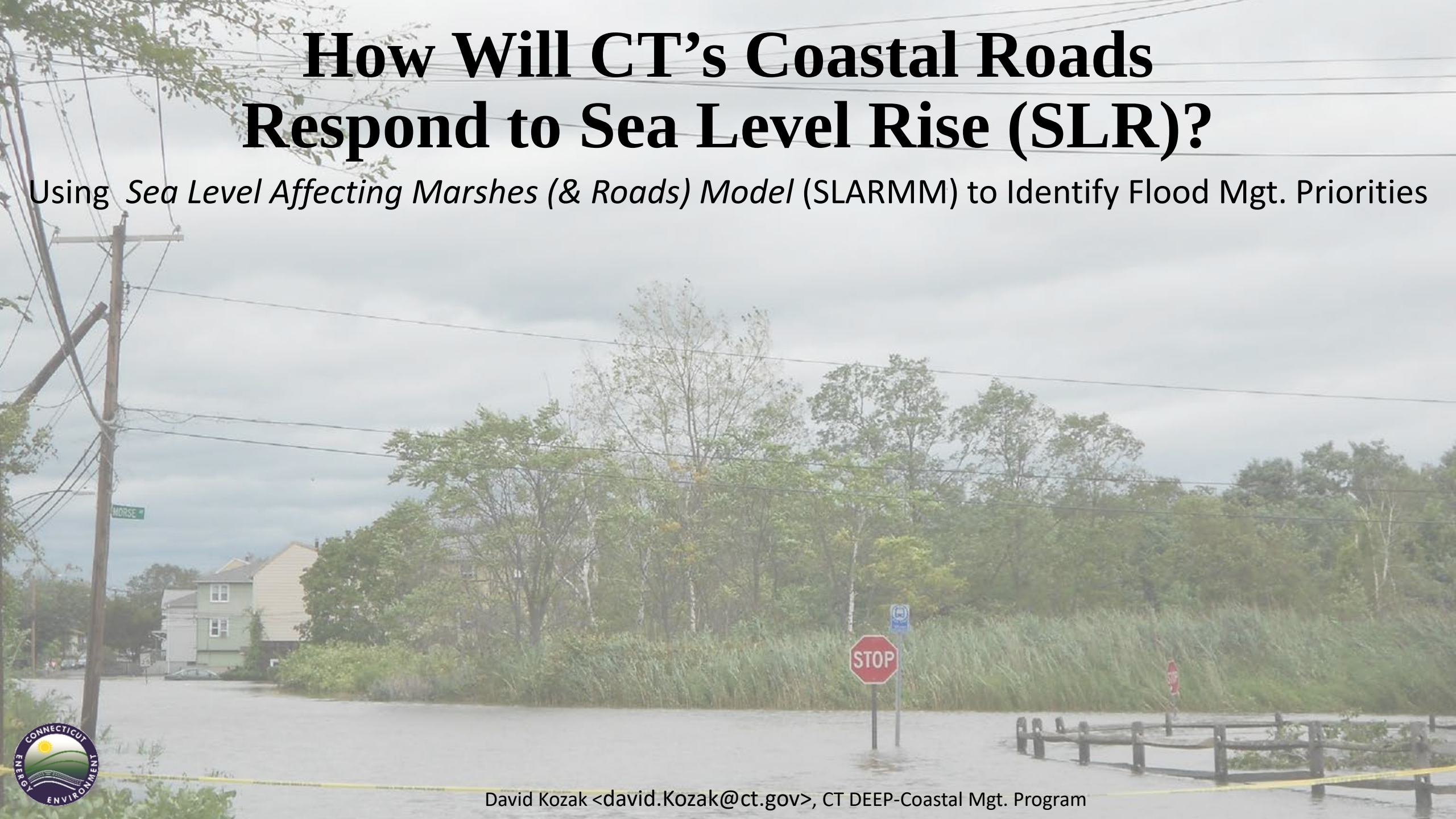
Using *Sea Level Affecting Marshes Model (*SLAMM)
to Identify Marsh Conservation & Management Priorities

David Kozak david.Kozak@ct.gov, CT DEEP-Coastal Mgt. Program

East River Marsh & Preserve, Guilford, CT

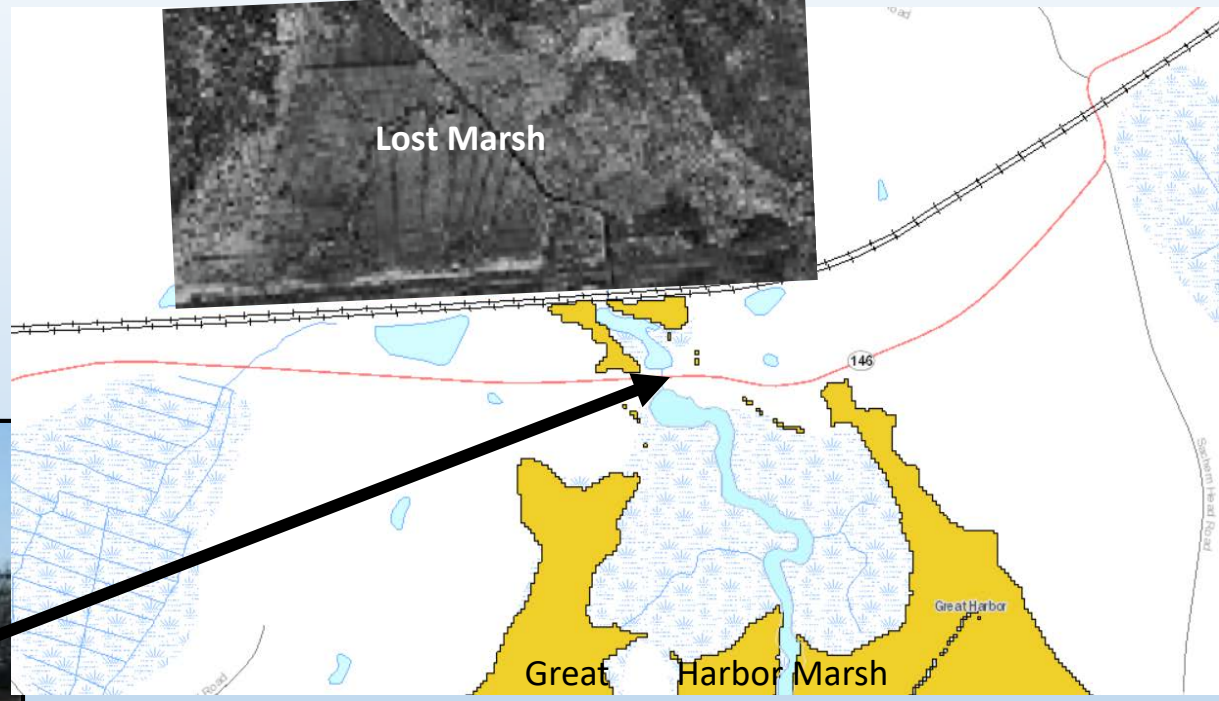
How Will CT's Coastal Roads Respond to Sea Level Rise (SLR)?

Using *Sea Level Affecting Marshes (& Roads) Model* (SLARMM) to Identify Flood Mgt. Priorities



David Kozak <david.Kozak@ct.gov>, CT DEEP-Coastal Mgt. Program

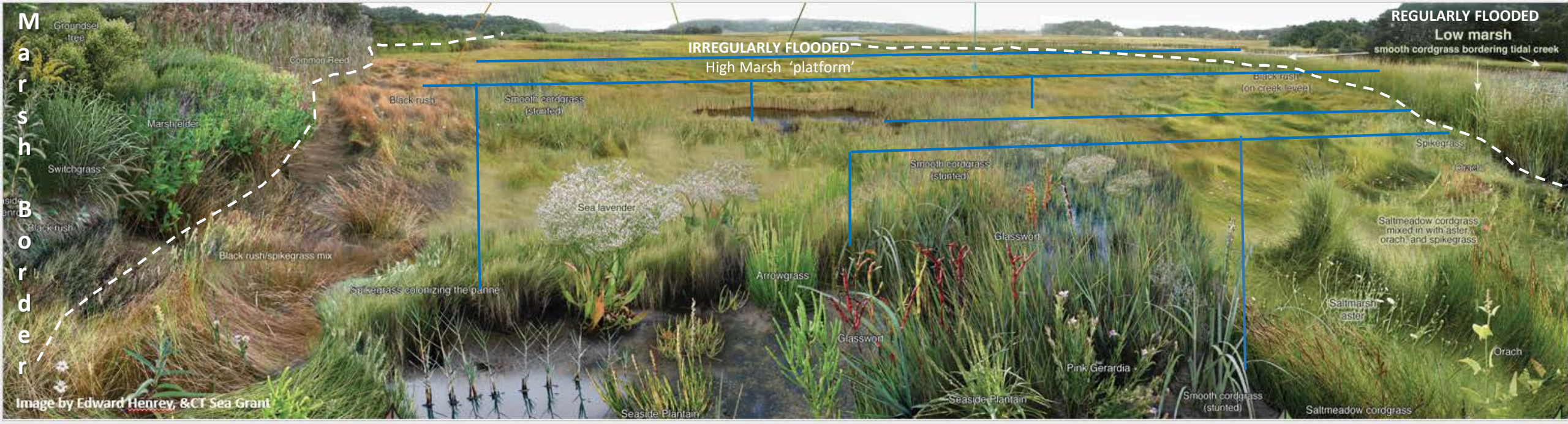
Manage Road → Manage Marsh



Marshes as Coastal Flooding Pathways

Increasing flood frequencies → road reconstruction (& tide gate modifications?)

Coastal Marshes are . . .

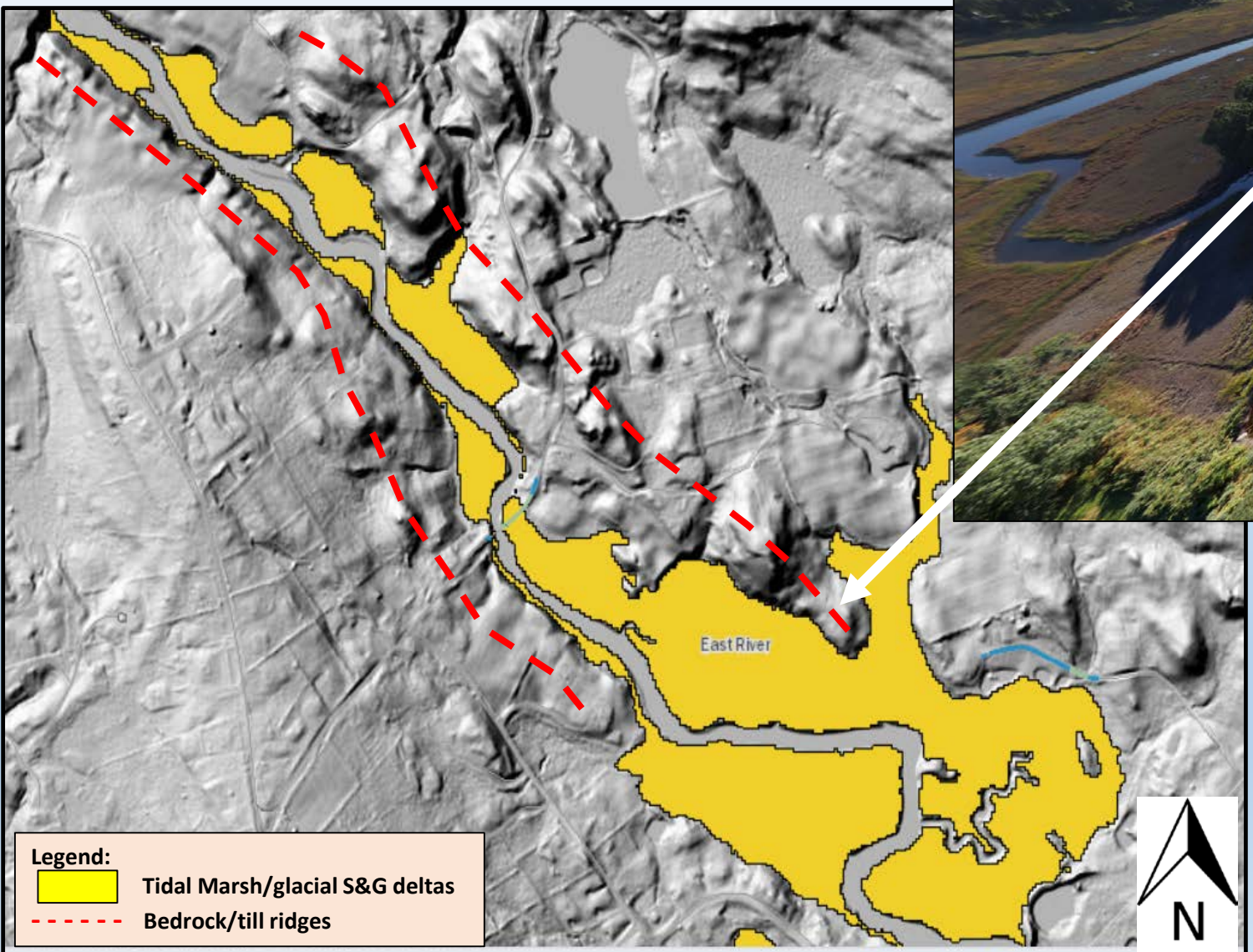


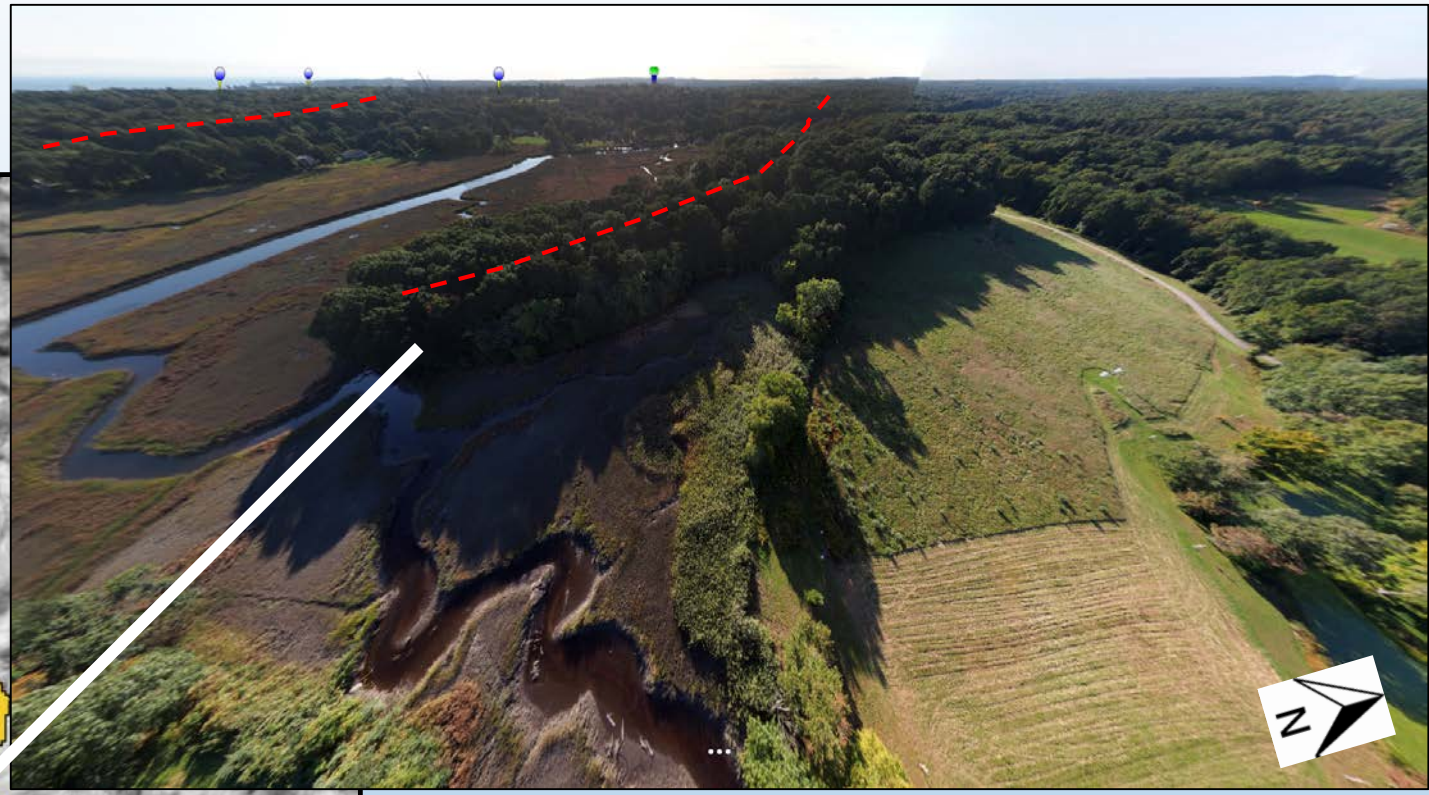
. . . transition areas between dry uplands and **low energy** coastal waters subject to **ebb and flood of tides** supporting **salt tolerant plants**

Ditched, Filled, Drained, Diked vs. ‘Undisturbed’ *Marsh*

CT's Embayment Dominated Estuarine Shoreline

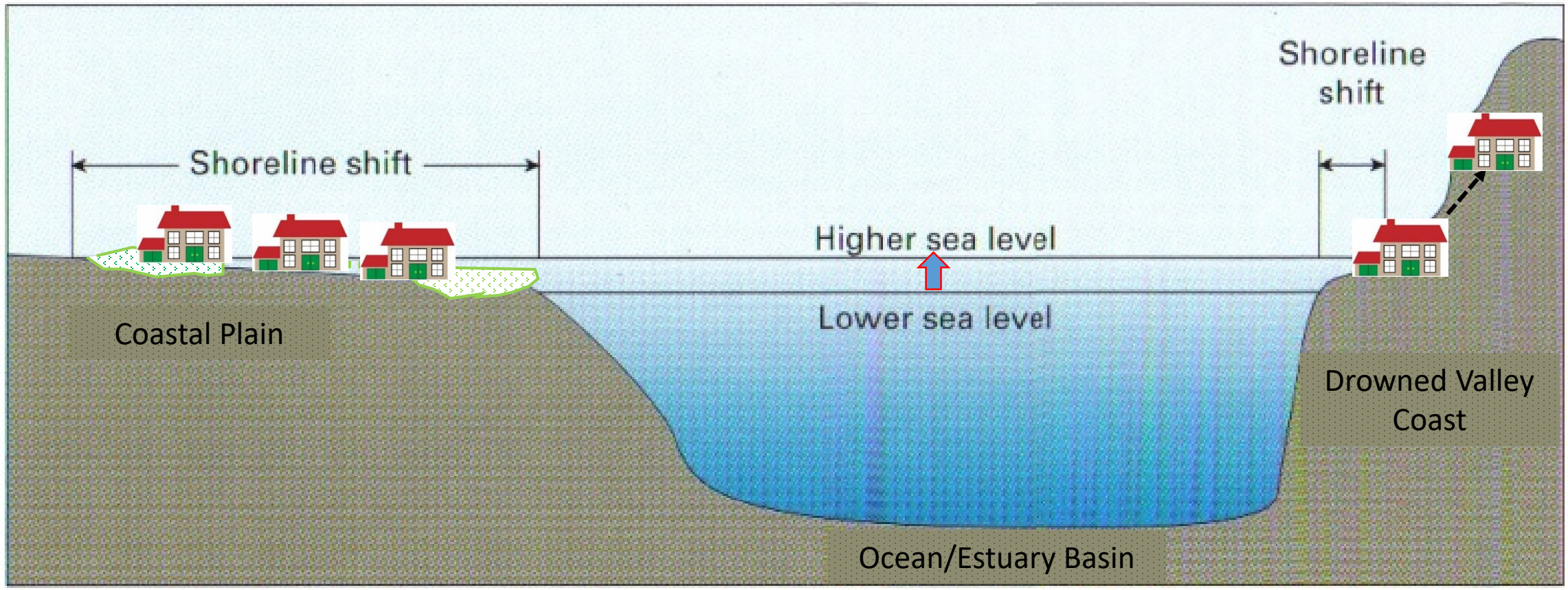
Marshes in Glacial Meltwater Valley S&G Deltas





SLR on Coastal Plain vs. CT's Drowned Valley Coast

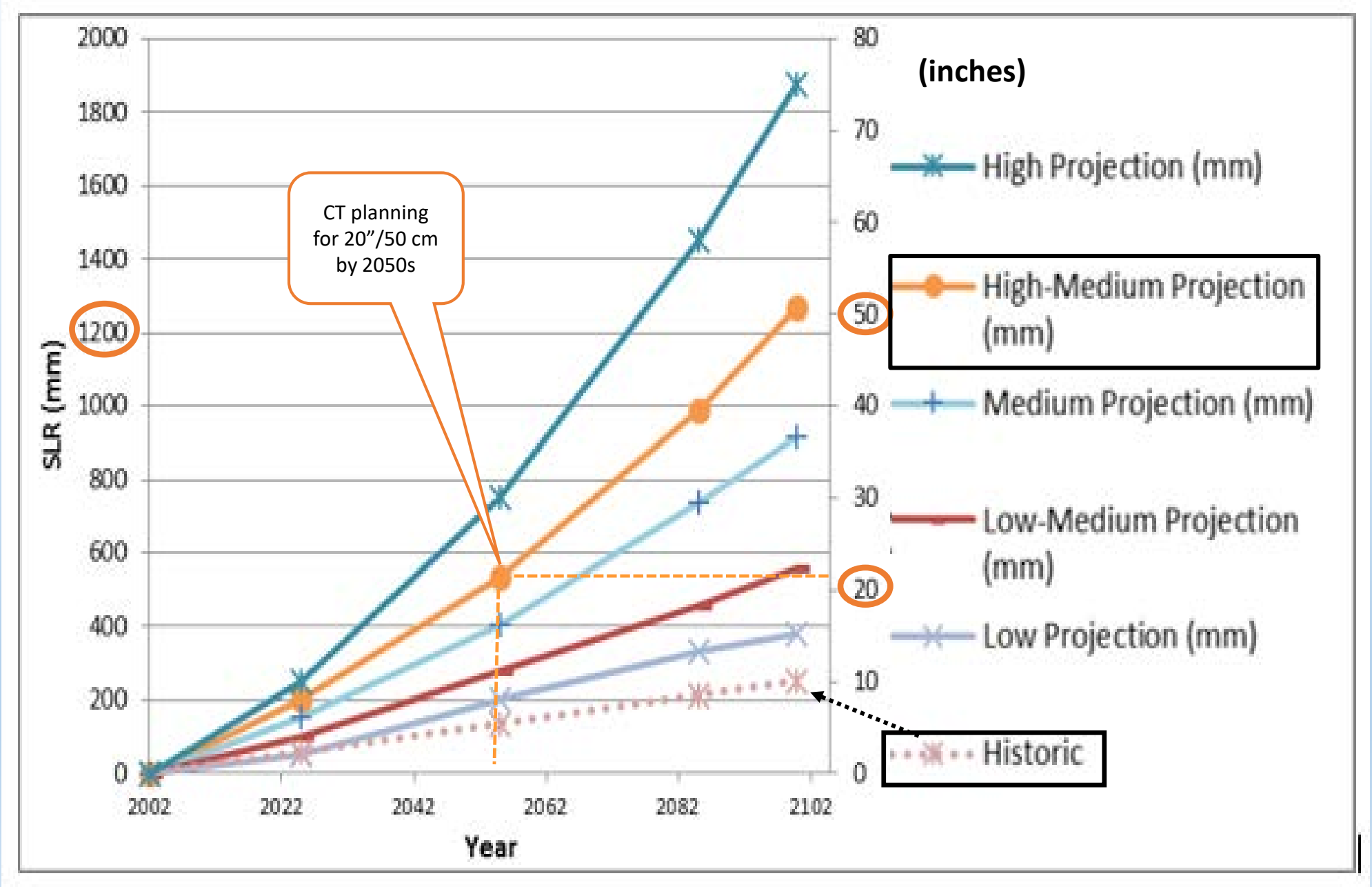
Small vertical changes in water level shift coastlines dramatically on gently sloping coasts but cause only minor shifts on steep coasts.

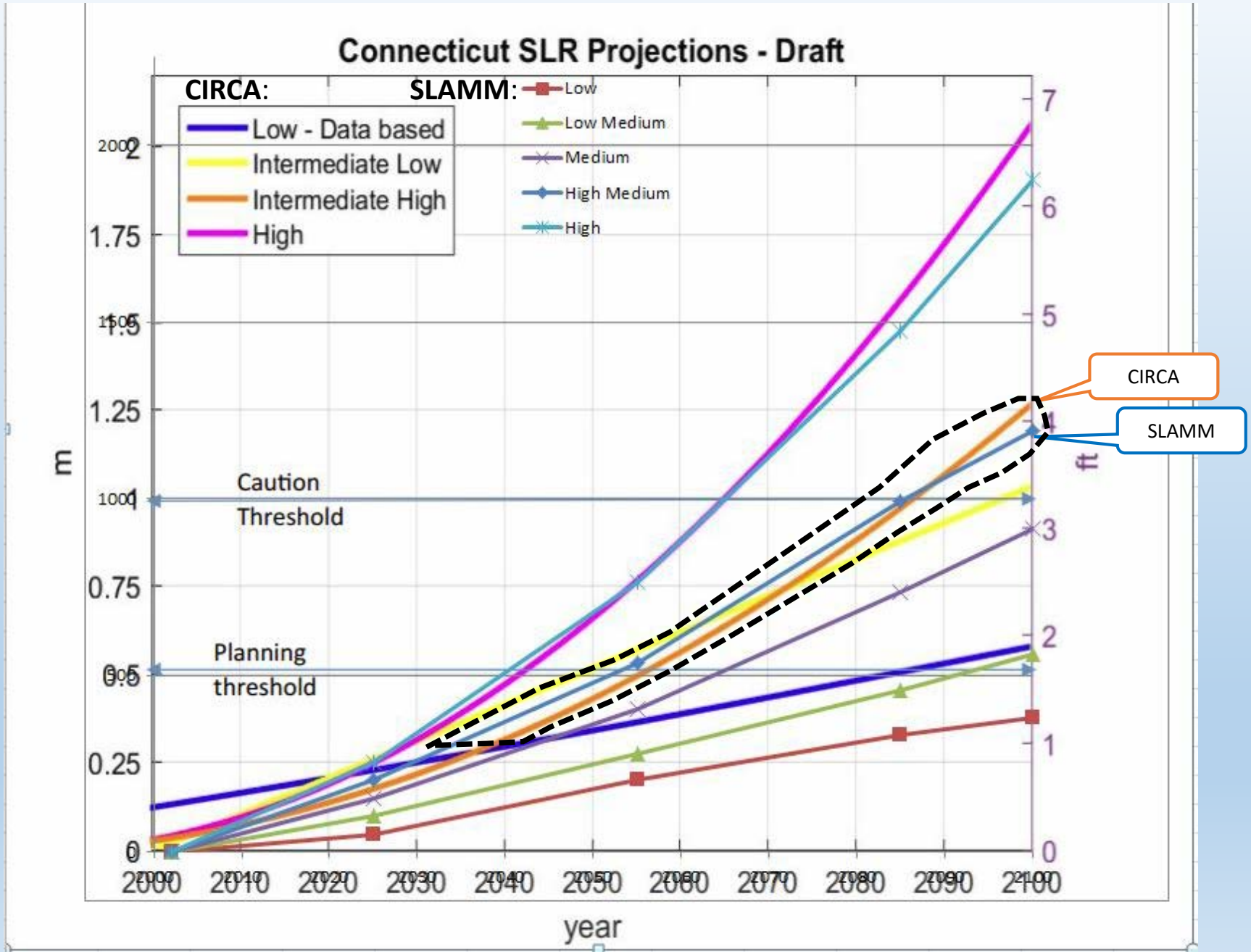


SLAMM Objectives: How Will SLR . . .

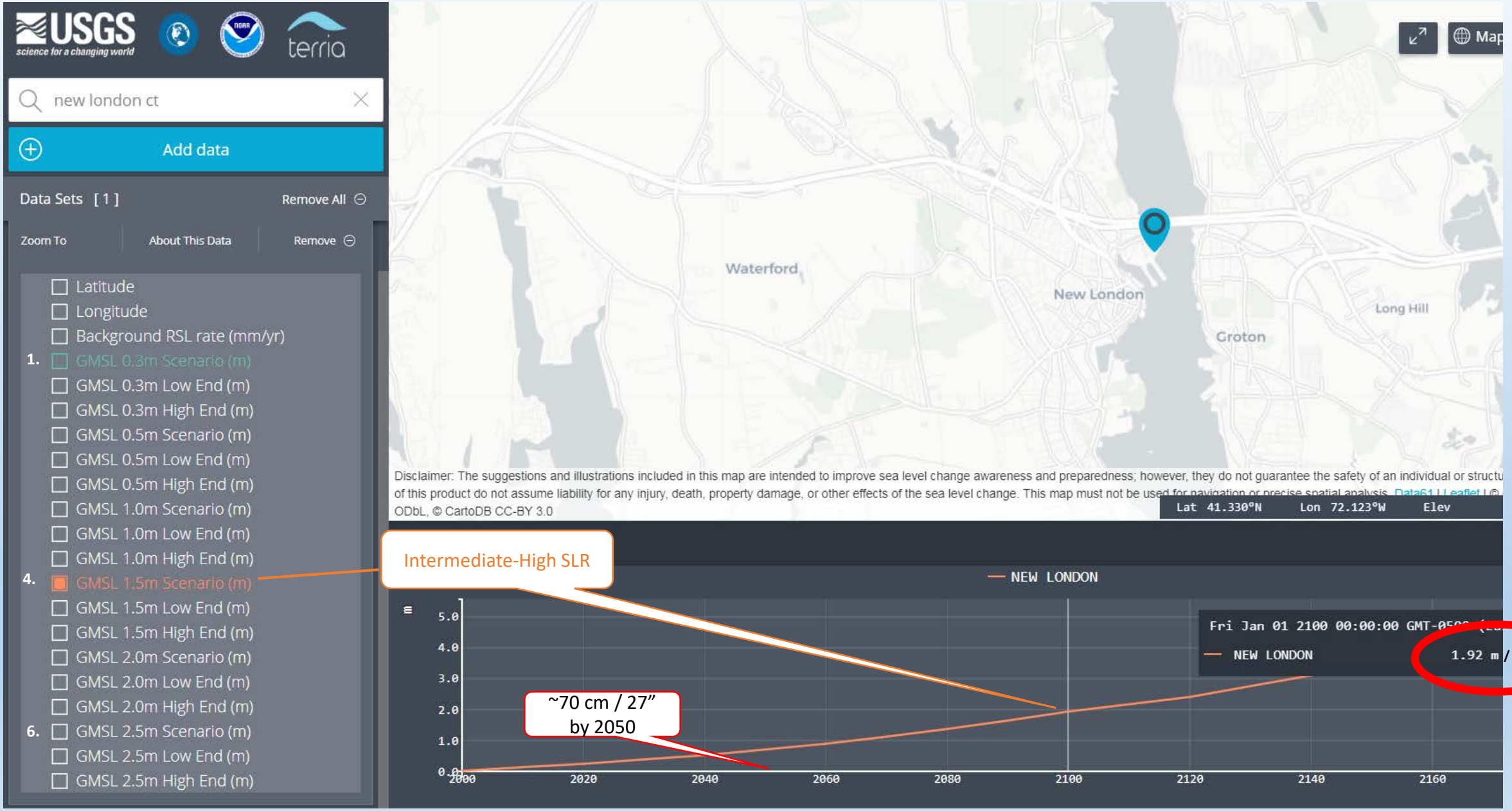
1. Change the kind and extent of CT's coastal marshes?
2. Change road flooding frequencies?
3. Inform marsh restoration/creation opportunities?

SLAMM's LIS Projected Sea Level Rise

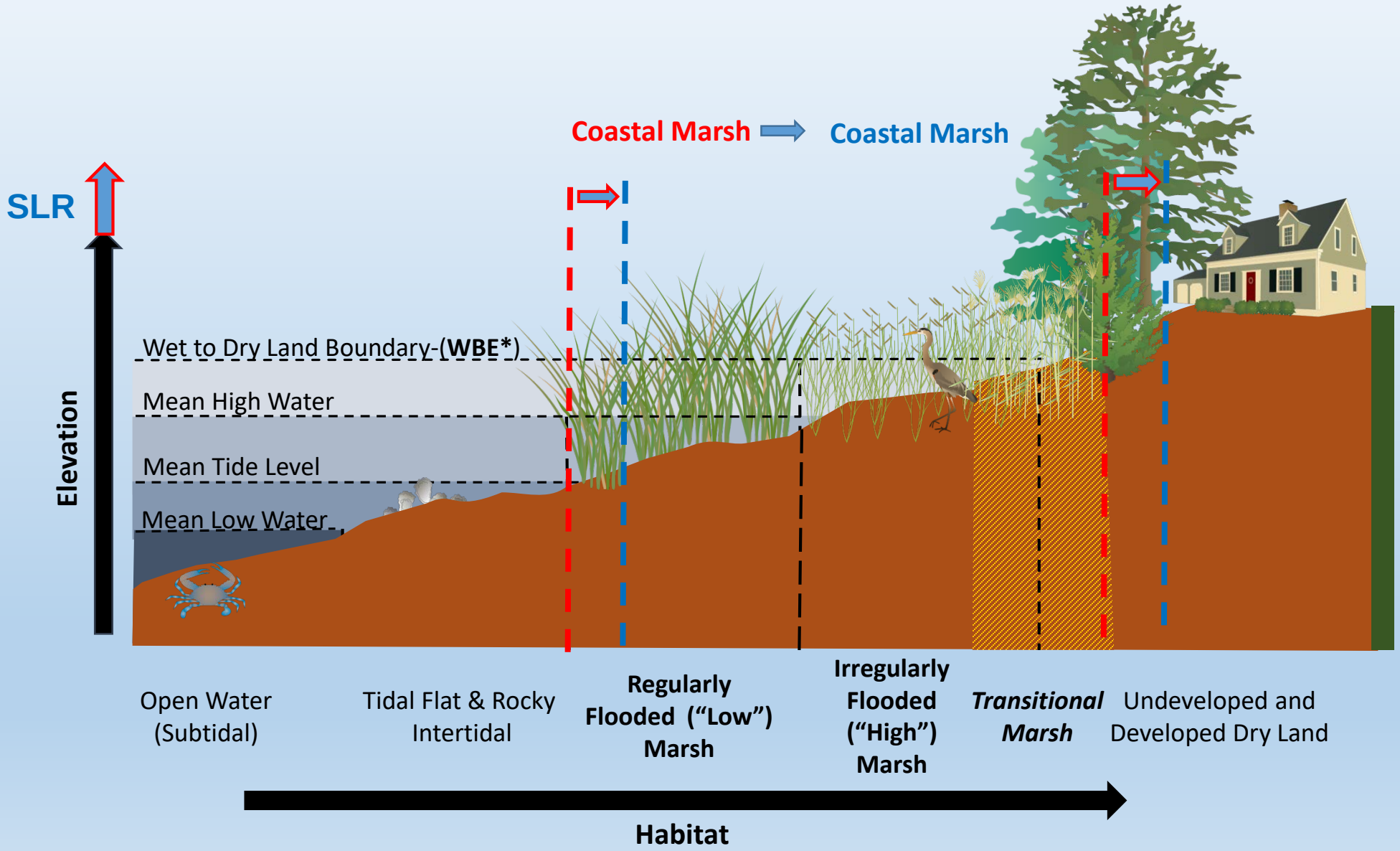



Connecticut SLR Projections - Draft
CIRCA:
SLAMM:
Low - Data based
Intermediate Low
Intermediate High
High
Low
Low Medium
Medium
High Medium
High
Caution Threshold
Planning threshold
CIRCA
SLAMM
m
ft
year
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
0
1
2
3
4
5
6
7

4th National Climate Assessment's 6 SLR Scenarios for CT's Eastern Shoreline

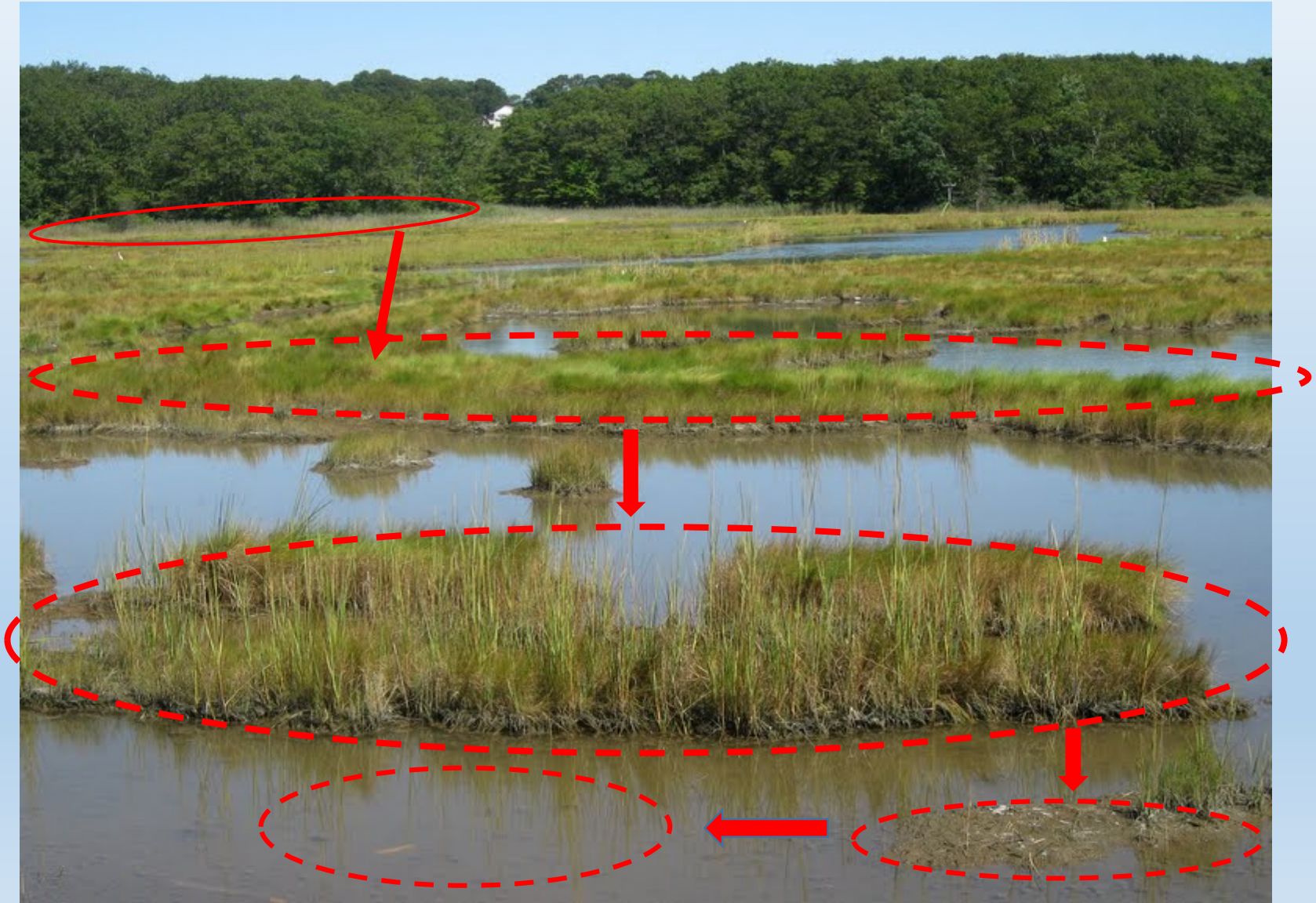


Shoreline Habitat Boundaries' Response to SLR

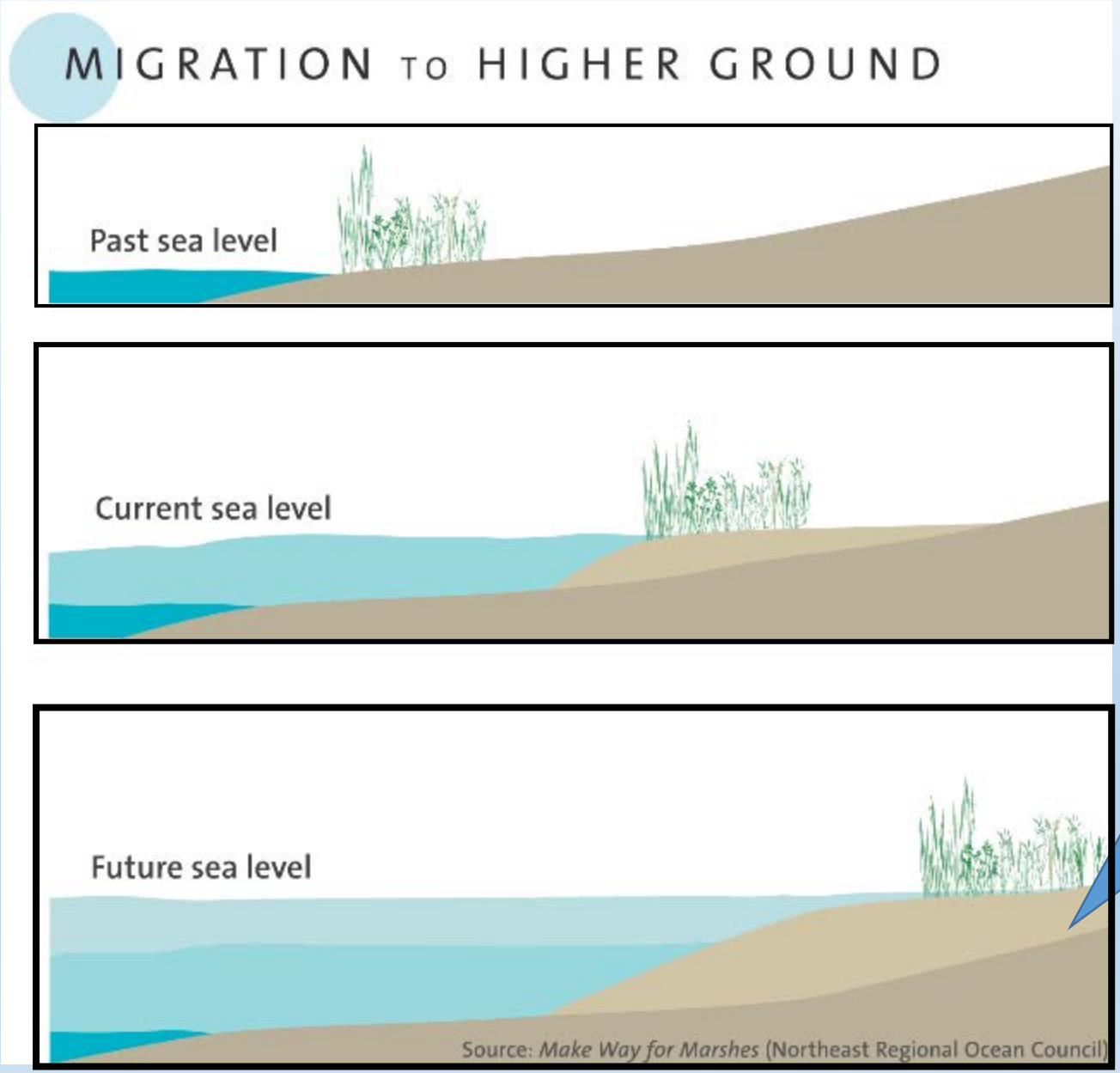


* ~ 30-day tidal water inundation elevation

SLAMM Progression of Saltmarsh Response to SLR



Coastal Marsh Response to SLR



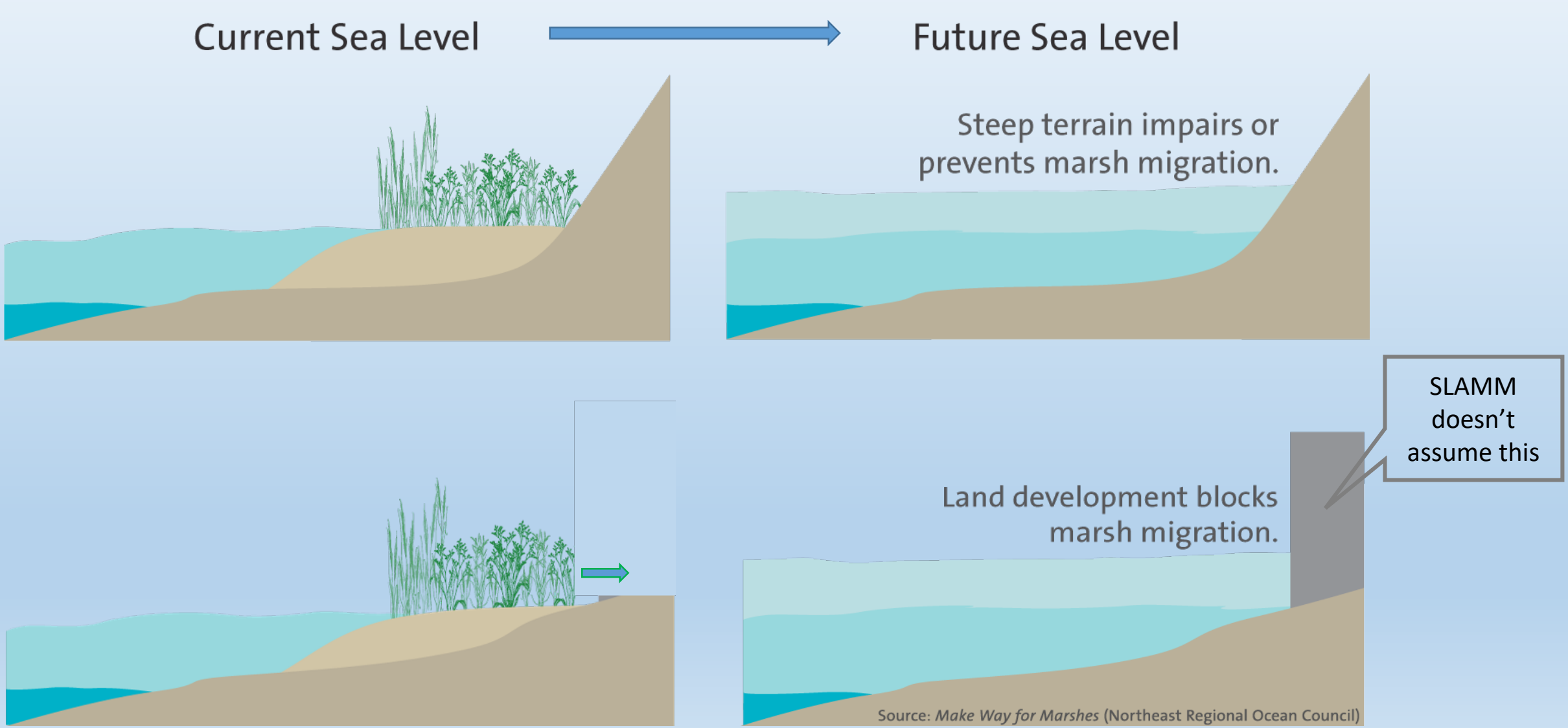
Locations - ✓

Viability - (?)

Protected vs/ unprotected - ?

Landowner response - ?

BARRIERS TO MARSH MIGRATION → MARSH LOSS



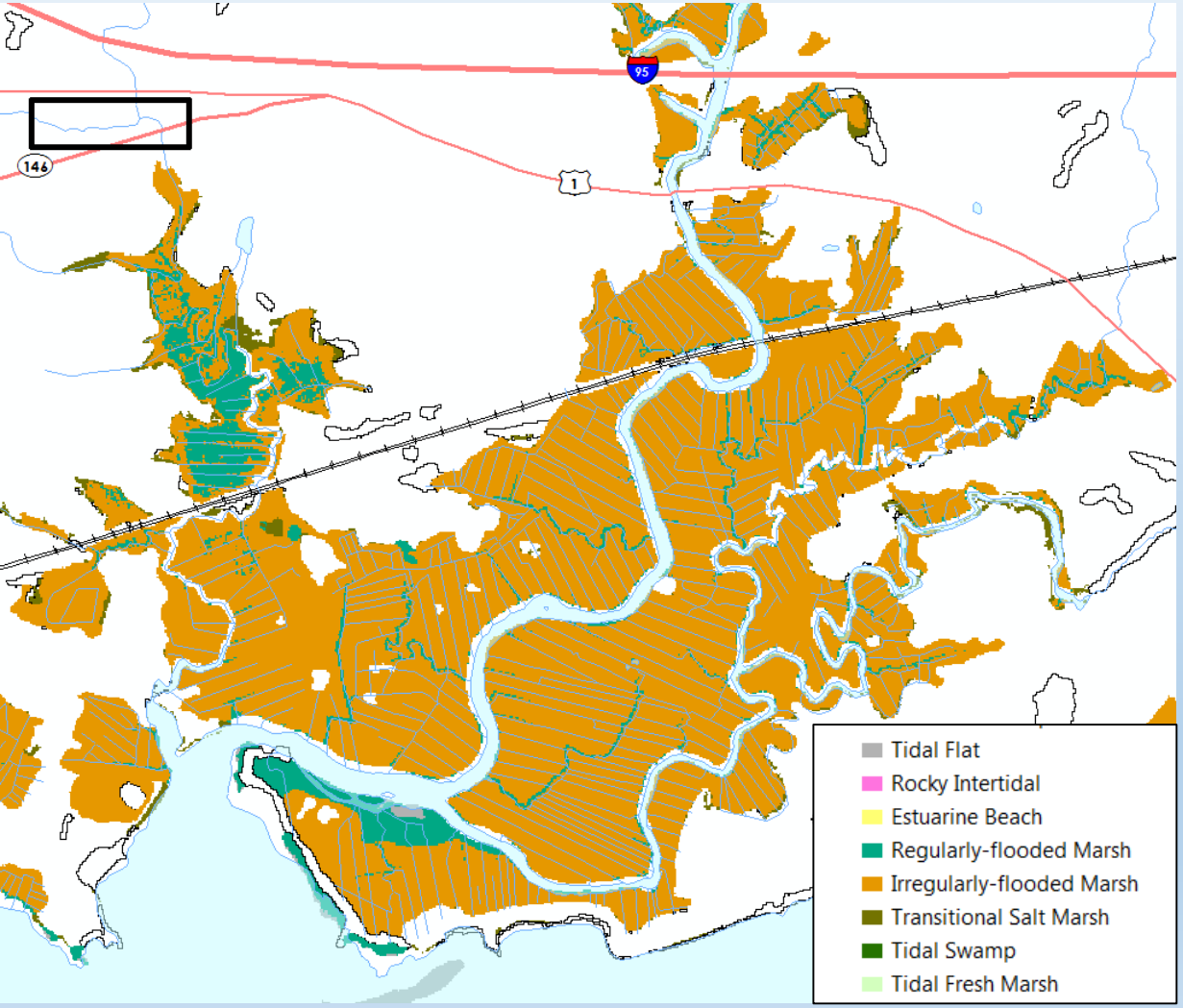
A Saltmarsh with Nowhere to Go/Grow

SLAMM → Two Types of Results

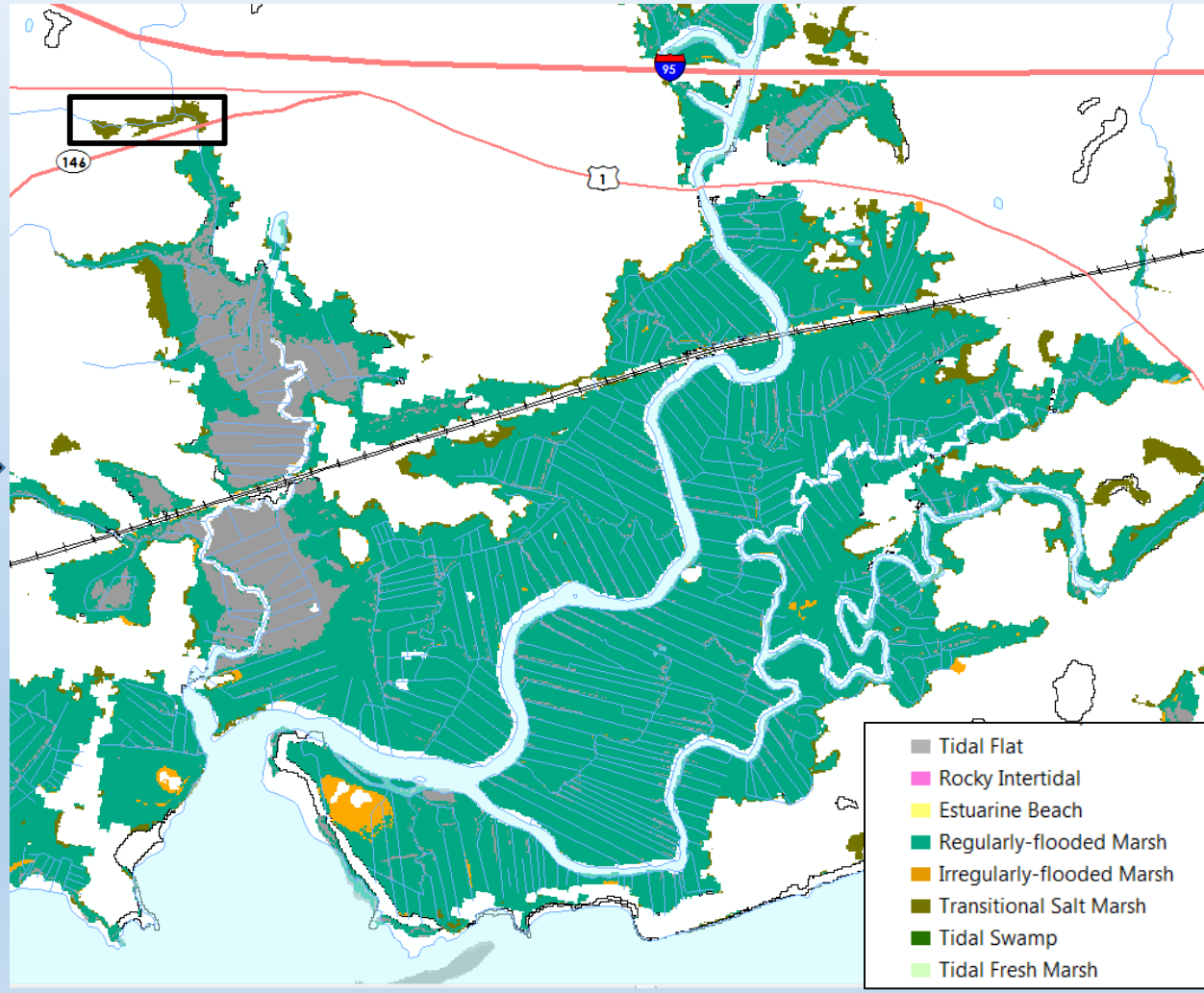
- **Deterministic** –single SLR rates and marsh attribute values
- **Probabilistic** – multiple SLR rates and marsh attribute values

East River Marsh Change – Deterministic (High SLR)

2010



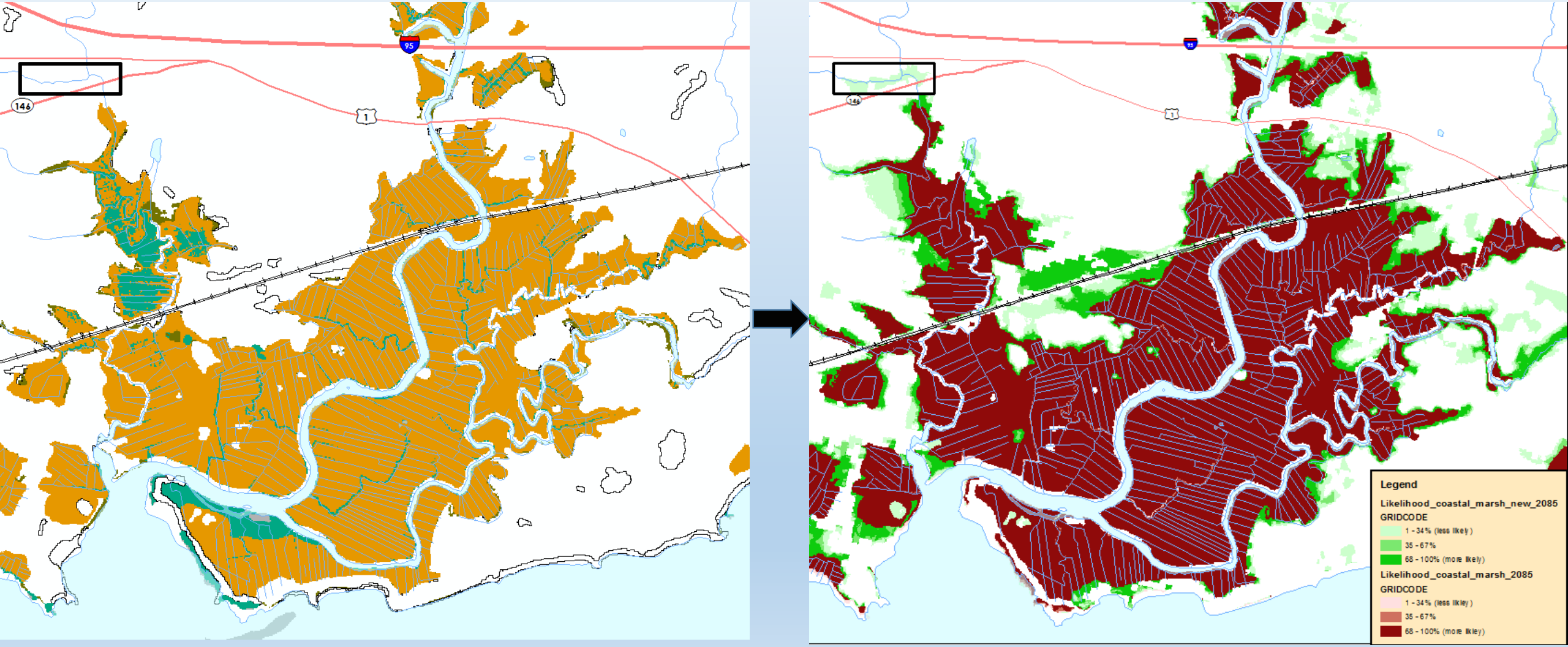
2085



East River Marsh Change – Probabilistic Results (all SLRs)

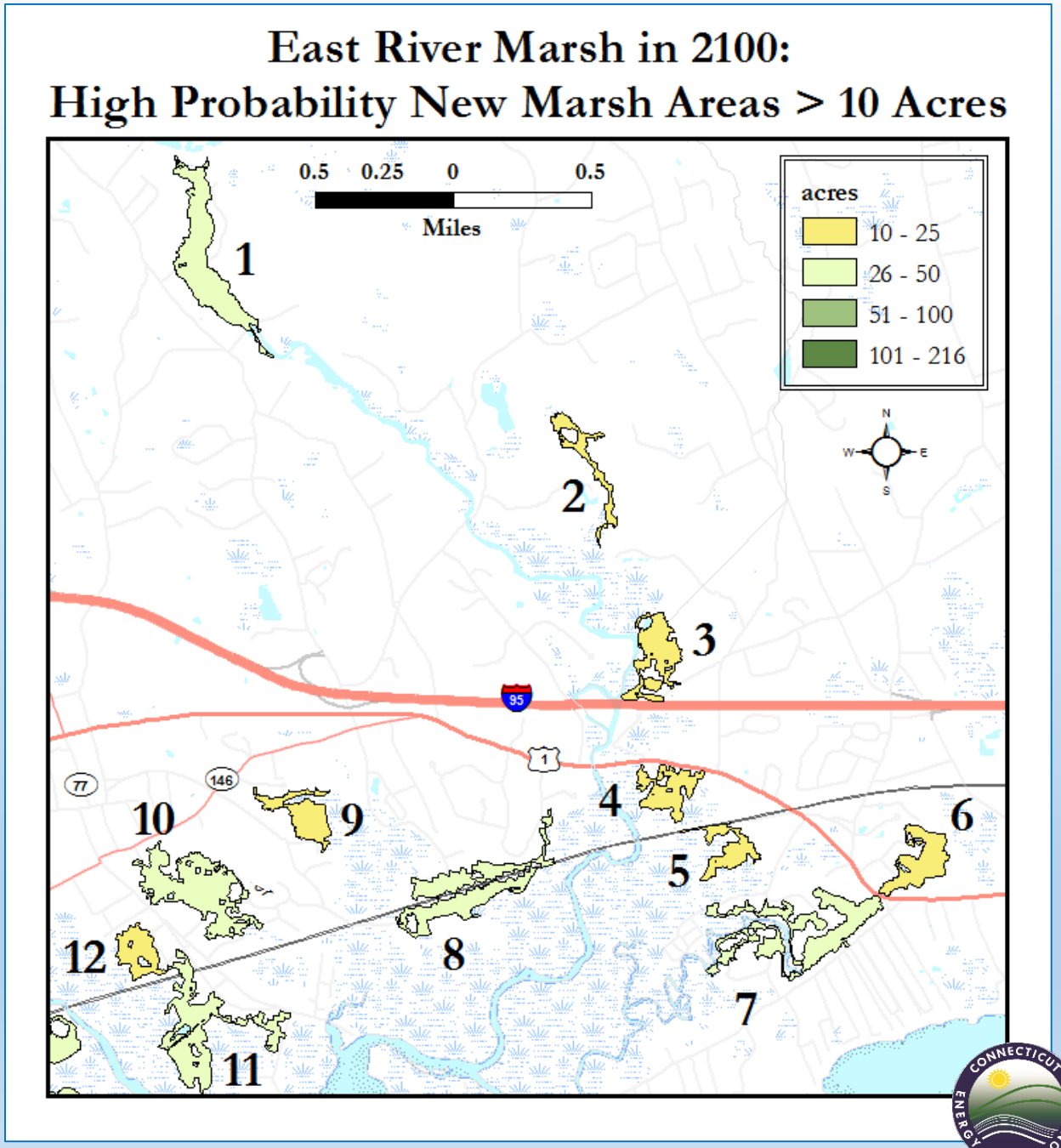
2010

2085



Management Strategy

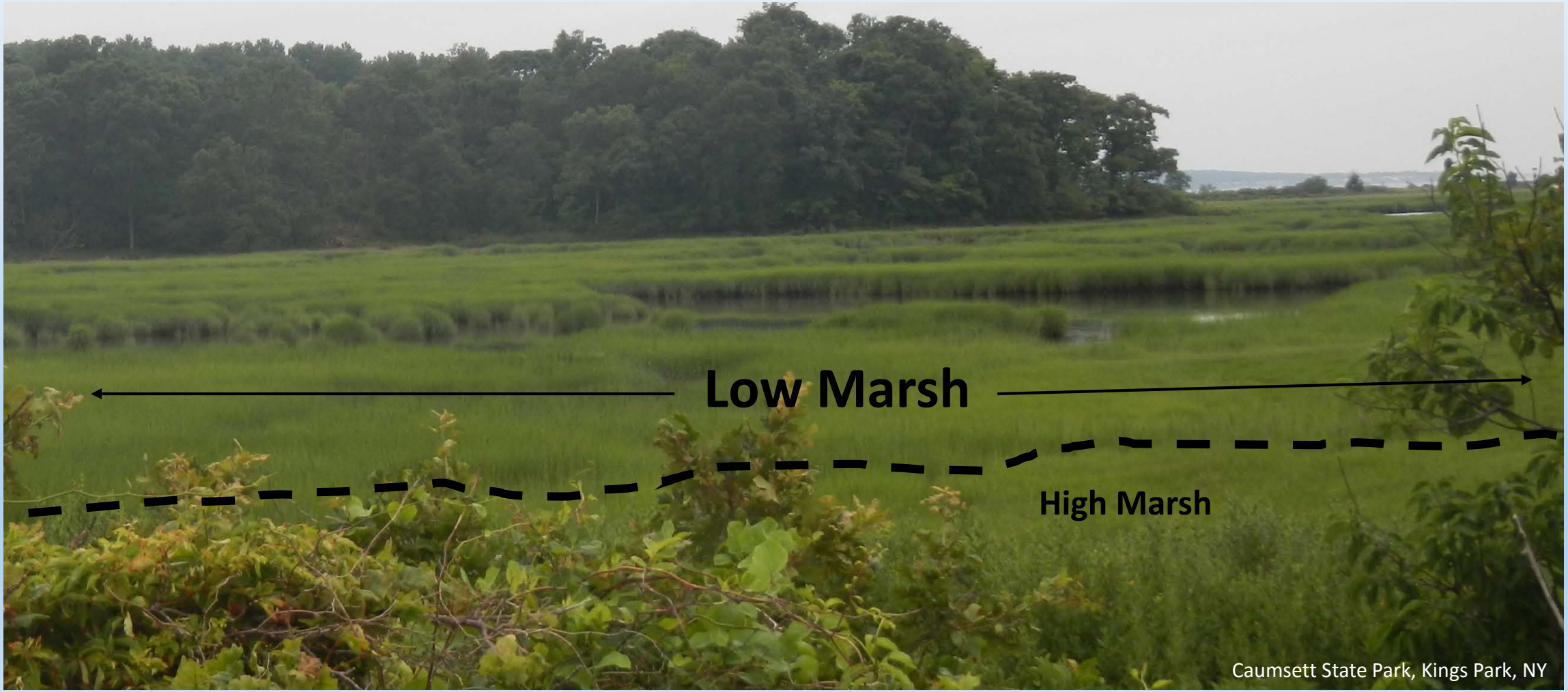
- Conserve larger, high likelihood marsh migration ar



Predicted Marsh Change by 2100
All CT Tidal Marshes- Alternative SLRs

Marsh Classes	2010 (acres)	Marsh Change by 2100 (acres) Alternative SLR		
		Medium	High-Medium	High
High-Marsh	10,413	-8,486	-9,815	-10,200
Low-Marsh	1,969	11,320	10,097	6,215
Transitional Marsh	1,366	971	1,112	1,086
Tidal-Fresh Marsh	731	-138	-402	-665
Total	**14,479**	**3,667**	**992**	**-3,564**

No. Shore L. I. **Low Marsh** Dominated Coastal Wetland



LIS' Saltmarsh Future?

CT's 21 Largest Tidal Marshes

Large (> 10 acres) Higher Probability* **New Marsh** (2085)

Marsh	# new marsh areas	Total Area (acres)	# tax parcels	% of Area POS*
Hammonasset River	5	**115**	24	91%
Barn Island	3	**124**	80	50%
West River	4	39	48	16%
East River	5	41	71	7%
Hammock River	3	14	47	1%
Black Hall River	4	31	31	0%
Great Island	7	49	82	43%
Lord Cove	1	34	11	89%
Plum Bank Oyster River (PBOR)	2	20	88	10%
Quinnipiac River	6	63	28	27%
Selden Creek	7	**103**	14	77%
Stratford Great Meadows	7	**107**	48	29%
* Protected Open Space				

* New marsh with majority of area with probability of new marsh > 33%

Coastal Marsh Resilience to SLR by 2100*

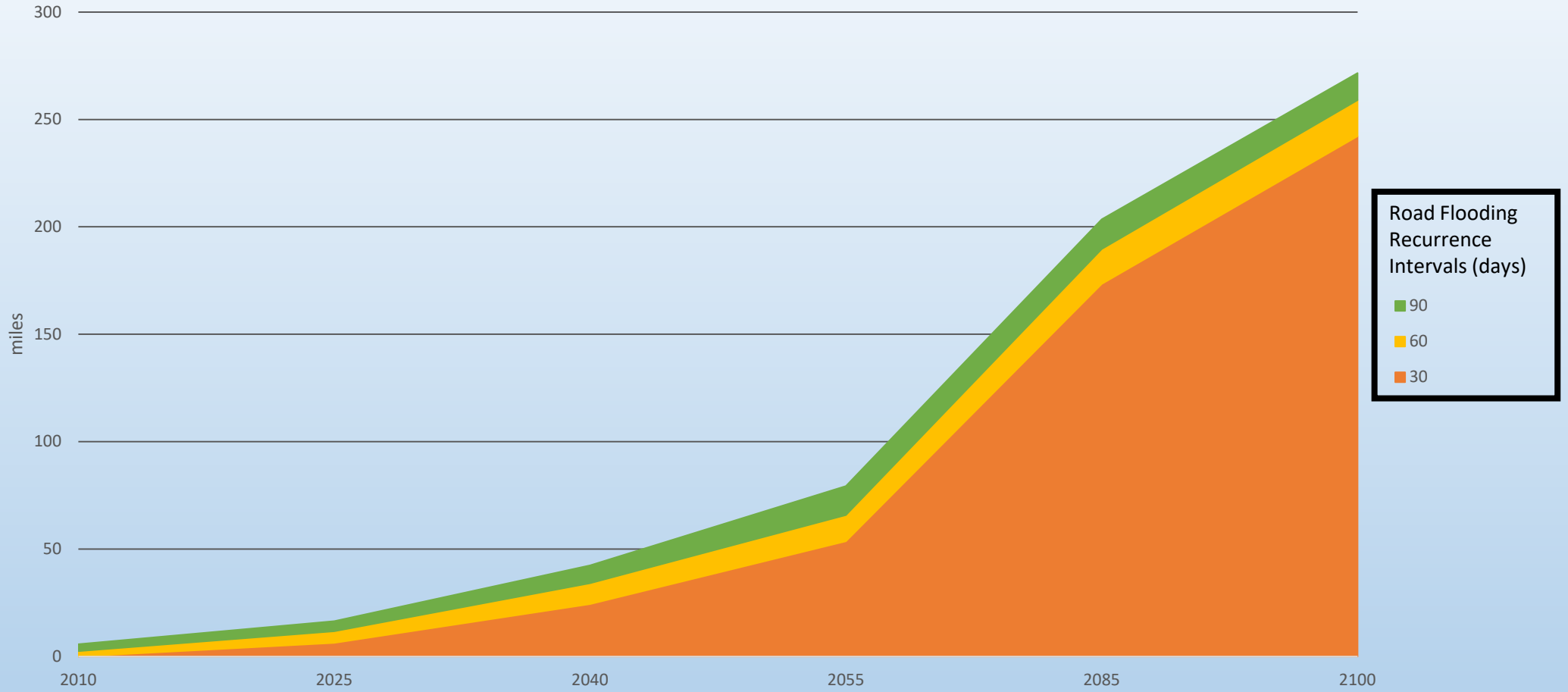
Marsh	2010 High Marsh (acres)	2100 High Marsh (>33%) (acres)	2100 Total Marsh (acres)	2100 Marsh Ratio High : Total	Resilience Ranking High Marsh / Total Marsh 2100
Stratford Great Meadows	383	128	777	0.164	1
Ferry Point	97	19	126	0.150	2
Nells Island	398	86	691	0.125	3
West River	**333**	**50**	**525**	**0.095**	4
Gulf Pond Indian River	150	26	292	0.091	5
Ragged Rock Creek	338	36	412	0.087	6
Pattagansett River	145	21	250	0.082	7
Plum Bank Oyster River	376	49	611	0.080	8
Barn Island	316	54	680	0.080	9
Hammonasset River	**300**	**80**	**1086**	**0.074**	10
Black Hall River	92	22	342	0.065	11
Selden Creek	2	24	426	0.056	12
Great Harbor	**35**	**9**	**162**	**0.055**	13
Menunketesuck River	182	16	301	0.055	14
Hammock River	300	26	481	0.054	15
Great Island	697	51	960	0.053	16
Hoadley Neck Stony Creek	**118**	**9**	**198**	**0.047**	17
Essex Great Meadows	164	10	209	0.046	18
Lord Cove	403	24	579	0.042	19
East River	**778**	**50**	**1285**	**0.039**	20
Quinnipiac River	530	45	1316	0.034	21

*** Ranked according to % of total marsh forecasted to be high marsh (with >33% probability) by 2100 - considers ALL SLAMM SLR scenarios**

Road Flooding Bluff Pt. State Park, Groton, CT
11/26/18 Extreme High Tide Event

2 feet of tidal water at Amtrak overpass from catch basin surcharge/Poquonnuck River flooding

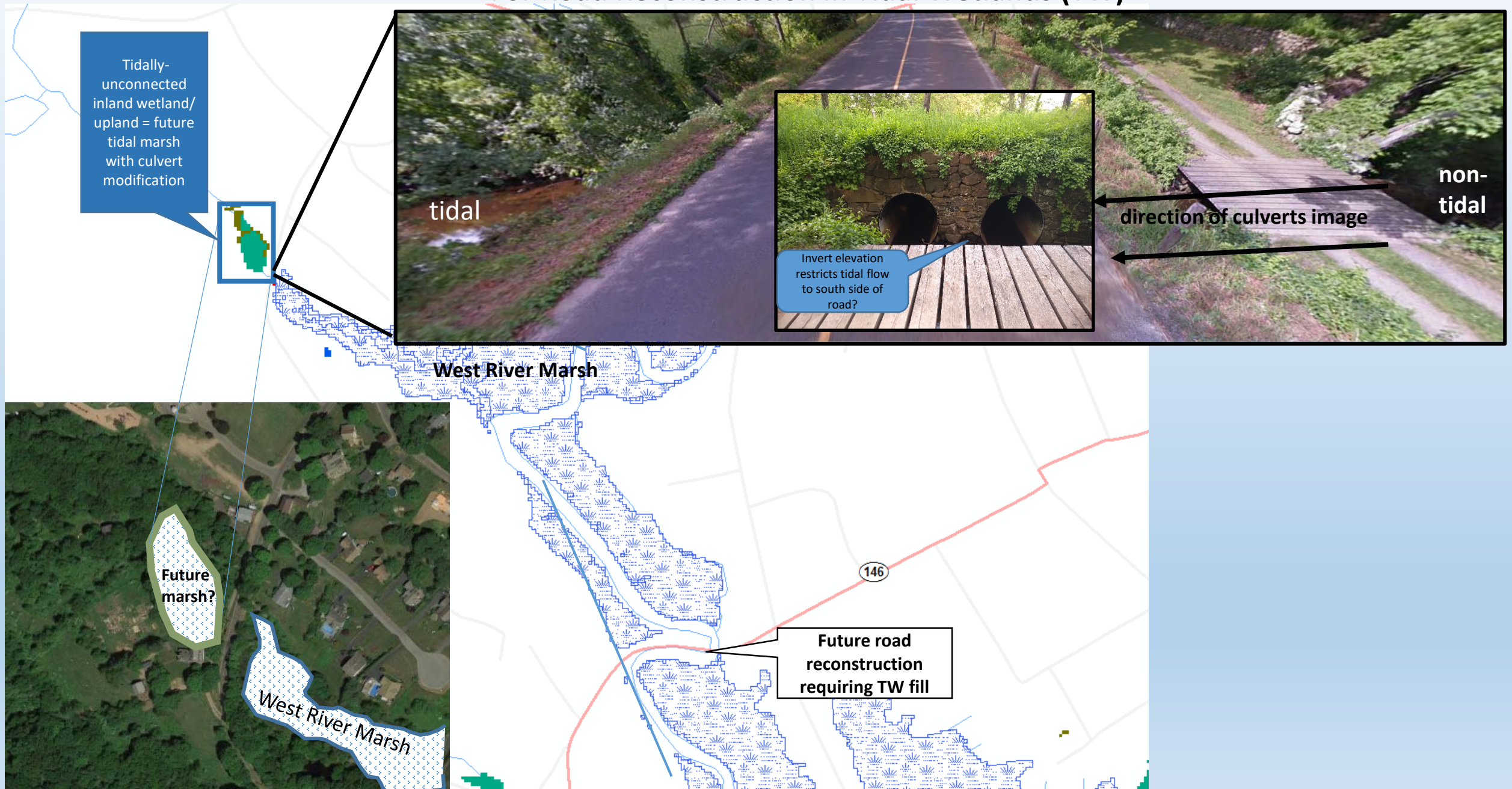
Statewide All Roads Flooding Frequencies
(floods at least every ___ days)



Year	</= 30 days	</=60 days	</= 90 days	∑ tidal flood
2010		3	3	6
2025	6	5	5	16
2040	24	10	8	42
2055	54	12	13	79
2085	173	16	14	204
2100	242	17	13	272

Modify Hydraulic Connections at Road Crossings

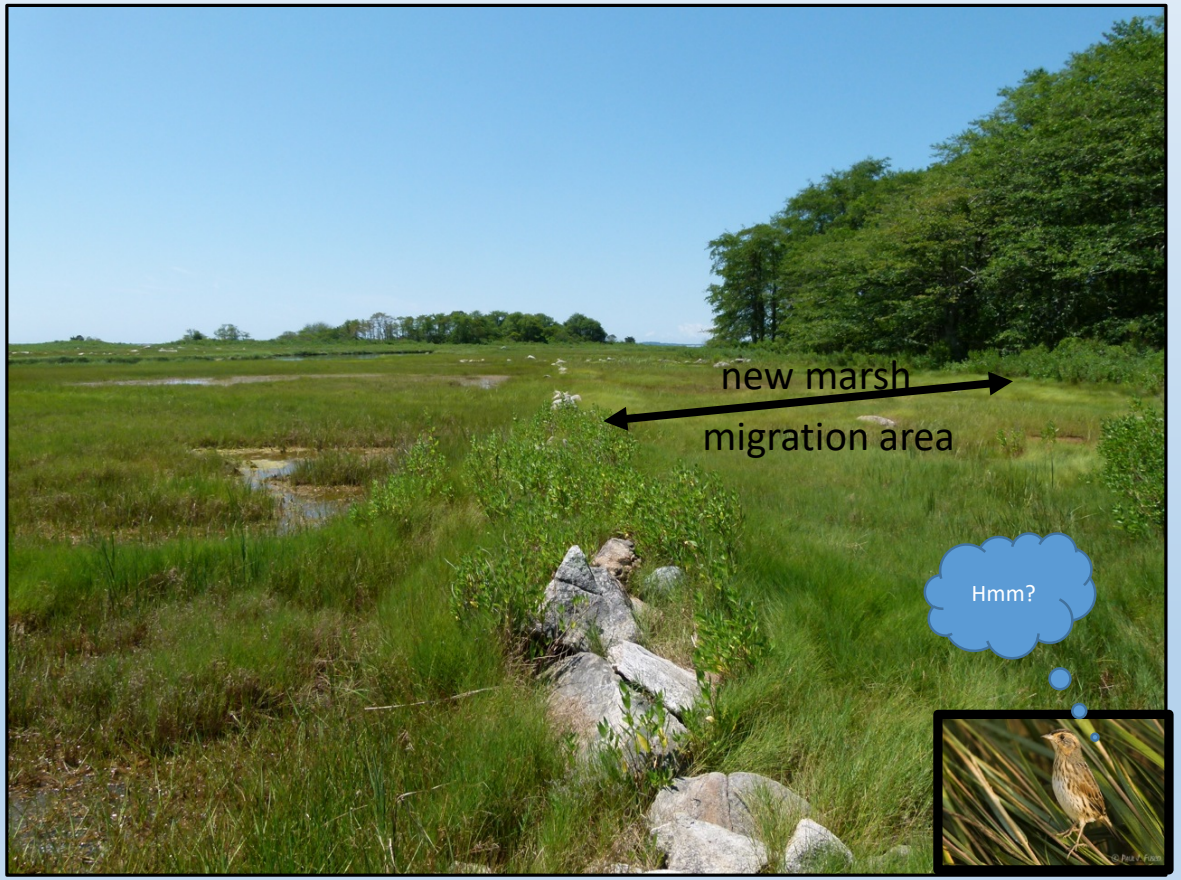
SLR Marsh Creation/Restoration Opportunities as Mitigation for Tidal Wetland (TW) Filling For Road Reconstruction in Tidal Wetlands (TW)



Road Flooding Mgt. = Marsh Management

Road Flooding Management

Marsh Migration Management



Vertical marsh migration rate = 6.5-6.6 mm/yr (@ Sherwood Island State Park); 1.7-2.1 mm/yr (Hammonasset State Park). Based on 5 decades of sediment foraminifera analysis. RSLR at Bridgeport for 1964-2018) = 2.9 mm/yr.

Historic Rates of Lateral Marsh Migration?

Vertical marsh migration rate = 6.5-6.6 mm/yr (@ Sherwood Island State Park); 1.7-2.1 mm/yr (Hammonasset State Park).
Based on 5 decades of sediment Foraminifera analysis. RSLR at Bridgeport for 1964-2018 = 2.9 mm/yr., Anisfeld, et al. 2019

Connecticut Environmental Conditions Online

Maps and Geospatial Data for Everyone

Featured Topics

These topics have received special treatment and are each mini-websites inside CT ECO.

Sea Level Rise Effects on Roads & Large Marshes

To better understand how Connecticut's coastal area marshes and roads may respond to sea level rise (SLR), Sea Level Affecting Marshes Model (SLAMM) was applied to Connecticut's shoreline. This viewer displays the model's results for Connecticut's 21 largest marshes and all coastal area roads.

Long Island Sound Blue Plan Viewer

The purpose of the Long Island Sound Blue Plan is to identify and protect places of traditional use and ecological significance, and to minimize conflicts, now and in the future. This includes preserving a collective vision of Long Island Sound, and facilitating a transparent, science-based decision-making process. The Blue Plan Map Viewer contains all data layers for the project in a format for exploration.

2016 Imagery and Lidar

Orthoimagery (3 inch pixel resolution) and Lidar elevation data for all of Connecticut collected in the spring of 2016. The flight is Connecticut's first statewide acquisition this high level of detail.

Lidar (Elevation)

Information about Lidar datasets for Connecticut. For those datasets with DEM tiles, explore the elevation, hillshade, shaded relief, slope and aspect in an interactive map viewers and as image services.

2012 Aerial Imagery

Learn about, view or download statewide, 4-band aerial imagery

Connecticut MS4 Supporting Layers (water quality and impervious surface)

Layers supporting Connecticut's MS4 Stormwater permit including 2012, 1 foot, statewide impervious surface are available for viewing and download.

Fish Community Data

CT DEEP's freshwater fish and macro-invertebrate community data (historic and current). Available to view and download.

Connecticut Bears

Researchers at the University of Connecticut are collaborating with CT DEEP to create the first scientifically-based estimate of the number of black bears in Connecticut. Learn about this research and about CT's bear population in this interactive story map.

Carbon Mapping

A study that applied research-based coefficients to UConn's land cover maps to assess and view the impact of land cover change on Carbon in Connecticut. Read about the research and what is shows along with an interactive map viewer.

CT Environmental Conditions Online

Sea Level Rise Effects on Roads & Large Marshes

Search...

Tool Labels

Home | Full Extent | Initial View | Previous Extent | Next Extent | Pan | Bookmarks | Distance | Layer List | Print | Export | Share

Layers

- Connecticut
  - Base Layers
  - Marsh Names
  - Road Flooding
    - *All Roads (coastal area)*
    - State Roads Only (coastal area)
  - Marsh Photos
  - Marsh Boundaries
  - New Marsh
    - New Marsh - High Probability
    - New Marsh All
  - High Marsh
  - Marsh Loss
    - Initial Marsh Area (2010)
    - Town
  - Aerial Imagery

Gray Bas...

USACE, CT DEEP | CT DEEP | Esri, HERE, Garmin, NGA, USGS, NPS

Home | Layers

1:500 | 0 3 6mi

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Sea Level Rise Effects on Roads & Large Marshes

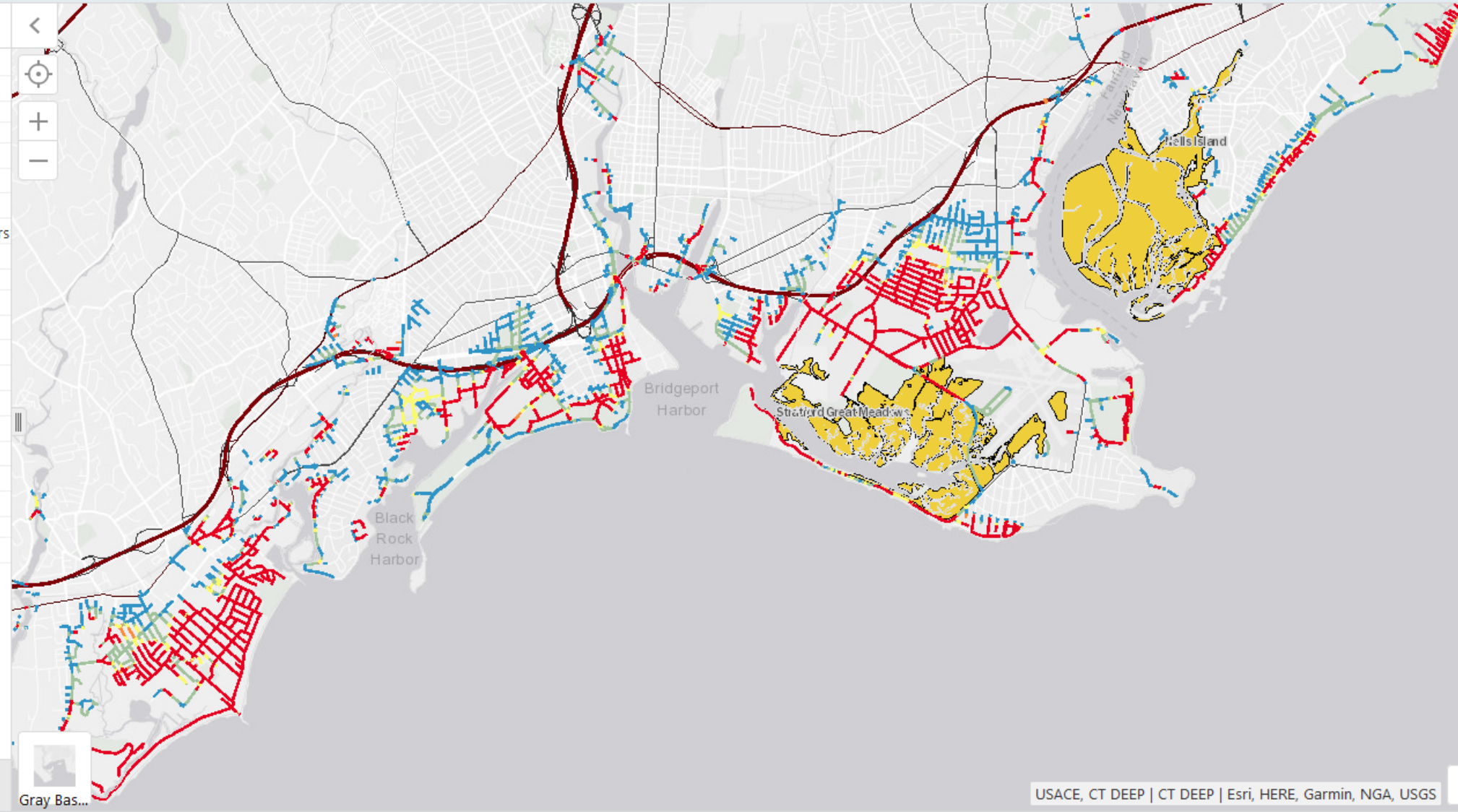
Search...

Tool Labels

Home | Full Extent | Initial View | Previous Extent | Next Extent | Pan | Bookmarks | Distance | Layer List | Print | Export | Share

Legend

- **Town**
  - Town
- **SLAMM**
  - **Road flooding 2085**
    - Floods at least every 30 days
    - Floods between every 30 to 60 days
    - Floods between every 60 to 90 days
    - Floods between every 90 days and 10 years
    - Floods between every 10 and 100 years
  - **State Roads Only (coastal area)**
    - Special Road Feature
    - Local Road, City Street
    - Other
    - Primary Highway
    - Primary State Highway
    - Secondary State Highwa
    - Vehicular trail
  - Initial Marsh Boundary 2010
  - Initial Marsh Area (2010)
- **Gray Base Map**
  - Light Gray Canvas Base



Gray Bas...

USACE, CT DEEP | CT DEEP | Esri, HERE, Garmin, NGA, USGS

Home | Legend

1:500 | 0 | 0.5 | 1mi

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CT Environmental Conditions Online — Sea Level Rise Effects on Roads & Large Marshes

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    - High Marsh Probability 2055
    - High Marsh Probability 2085
    - High Marsh Probability 2100
    - Initial High Marsh Area (2010)
  - Marsh Loss
    - Likelihood Marsh Loss 2055
    - Likelihood Marsh Loss 2085
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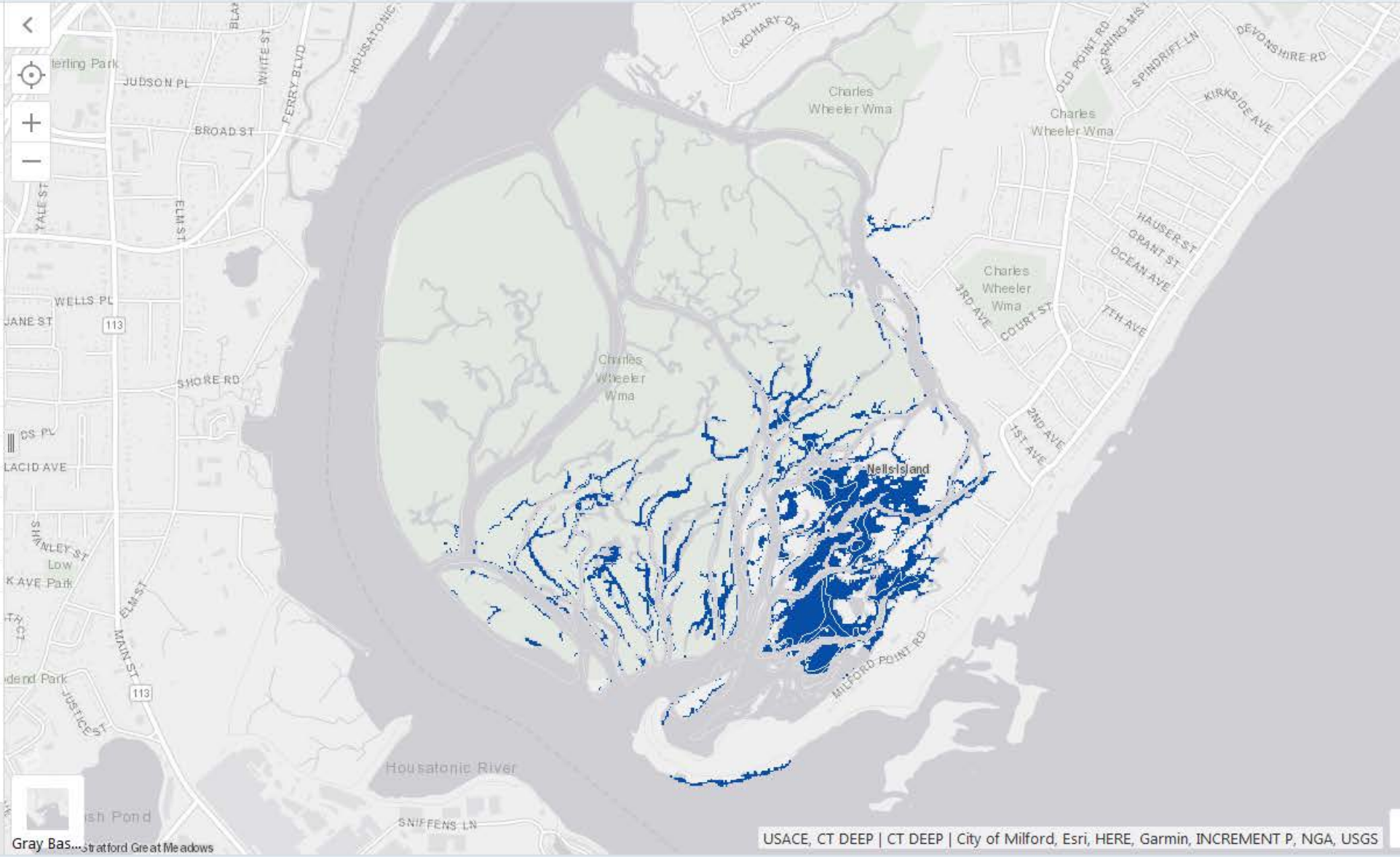

Home | Layers

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Guilford Ballfield
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Marsh Management Questions

- ☞ **Marsh migration area conservation vs. marsh restor./creation?**
- ☞ **Marsh migration area regulation vs. acquisition?**
- ☞ **Marsh migration conservation area priorities?**
- ☞ **Greatest obstacles to successful marsh migration conservation?***

* (other than $)

Questions?