Predicting effects of sea level rise on a marsh restoration project

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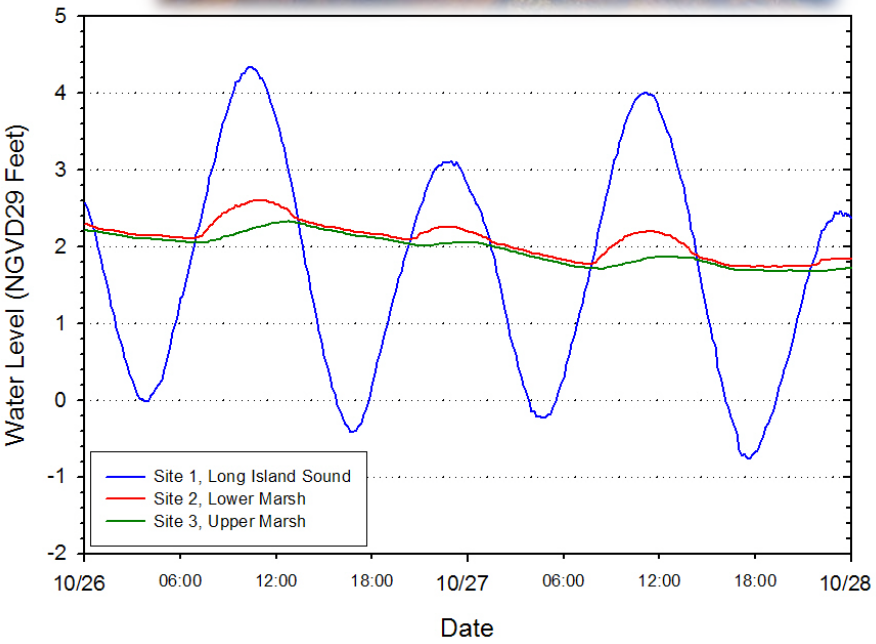
Sea Level Rise and Salt Marsh Restoration Workshop

Anthropogenic Systems

- Alteration of the system hydraulics
- How will the system evolve?
- Projecting changes
  - Habitat loss or swapping
  - Upland flooding potential
  - Sediment transport and accretion
  - Salinity levels
  - Velocities
  - Storm Impacts
  - Tidal exchange and flushing
  - Beach / inlet system
  - Fisheries
  - Sea Level Rise



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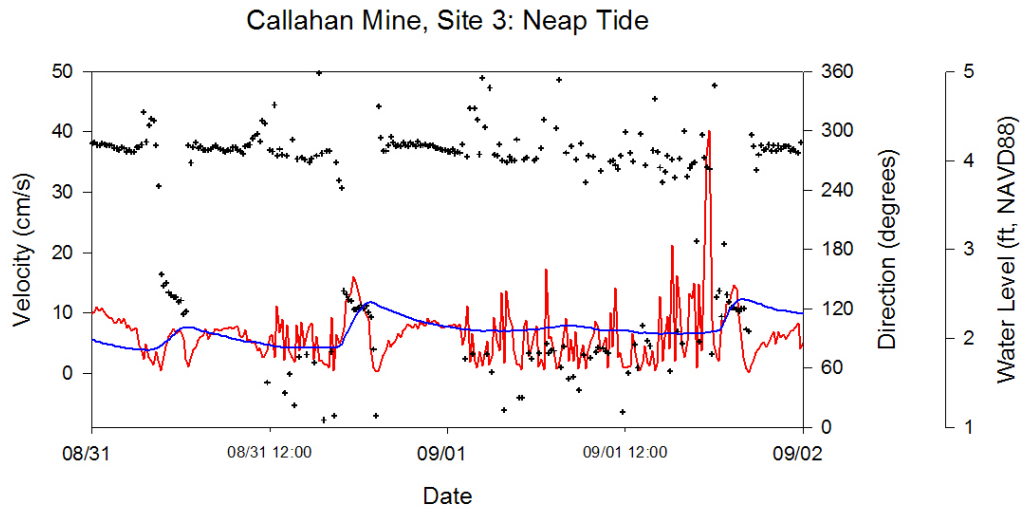
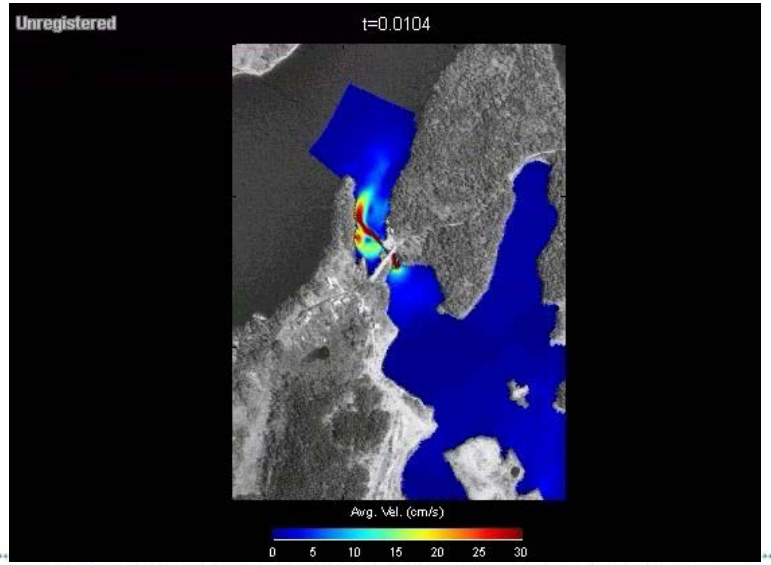
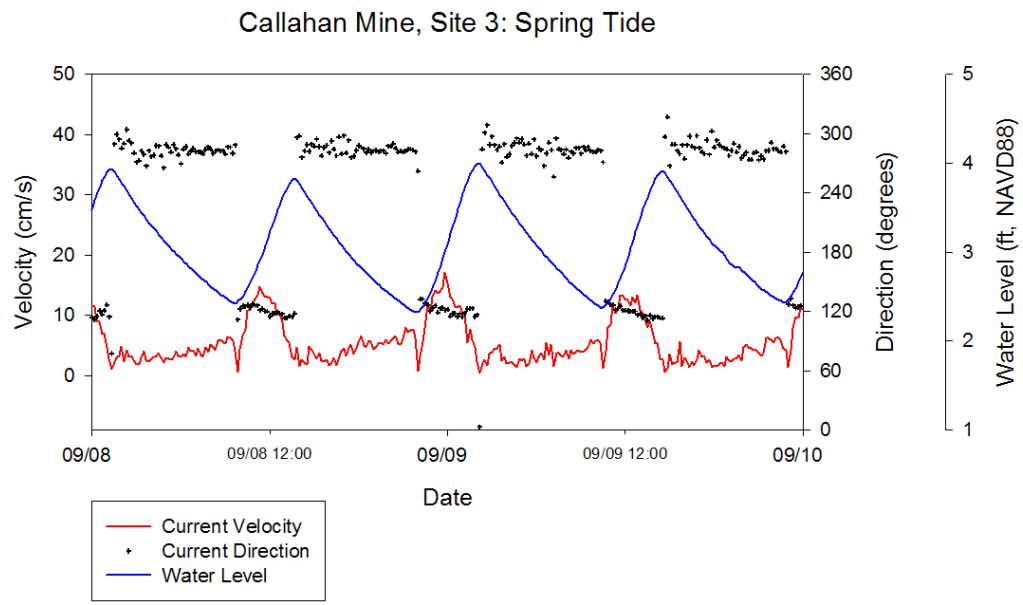
Complex systems

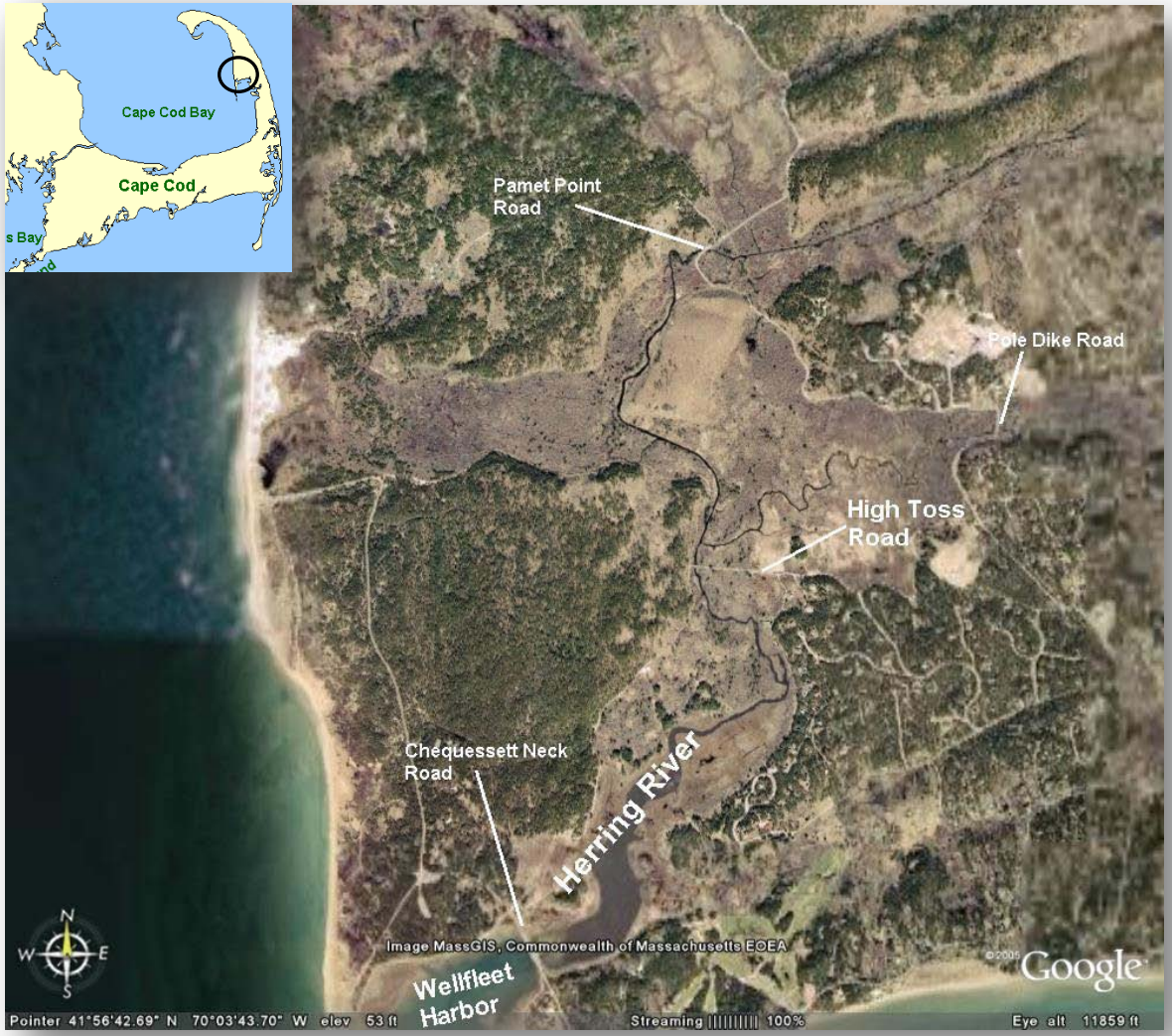






Case Study Background

- Largest estuary on Outer Cape Cod
- Compound dike system at entrance, numerous natural and anthropogenic constrictions
- Surrounding low lying infrastructure
- Multiple tributaries and basins



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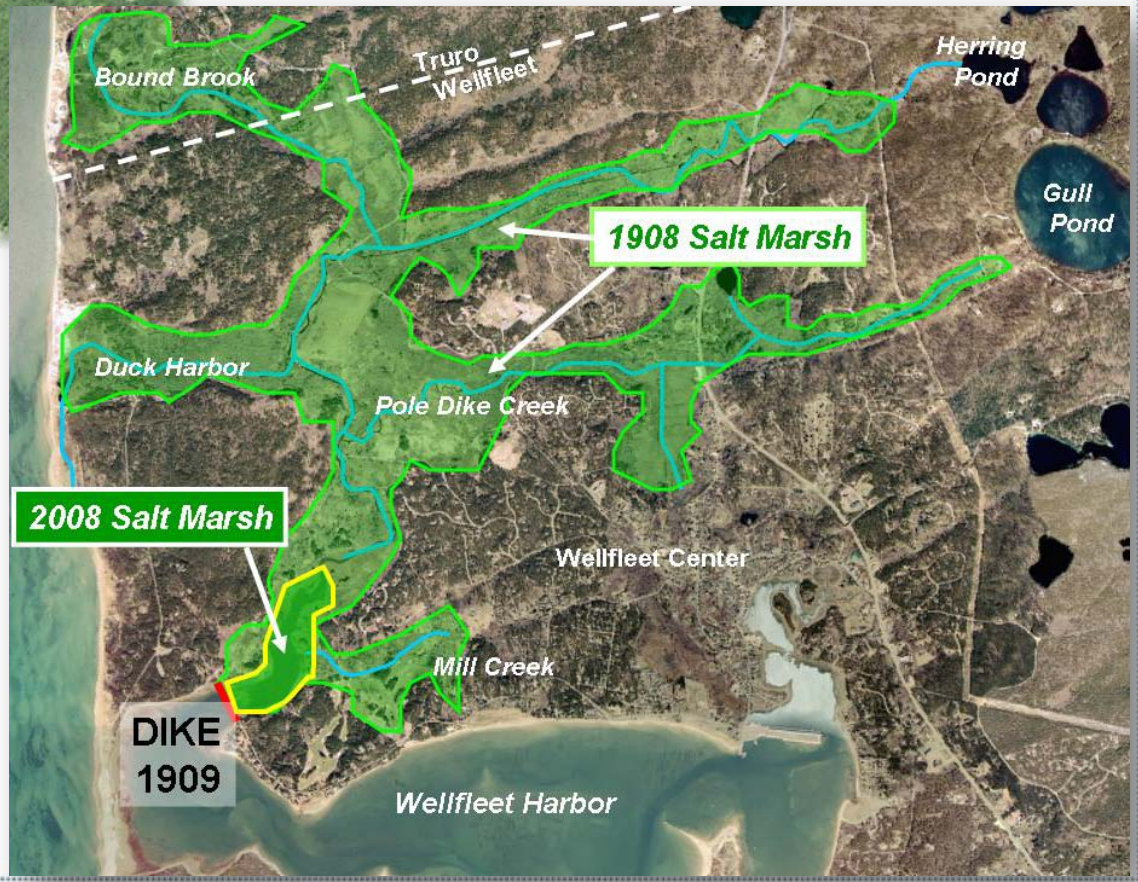
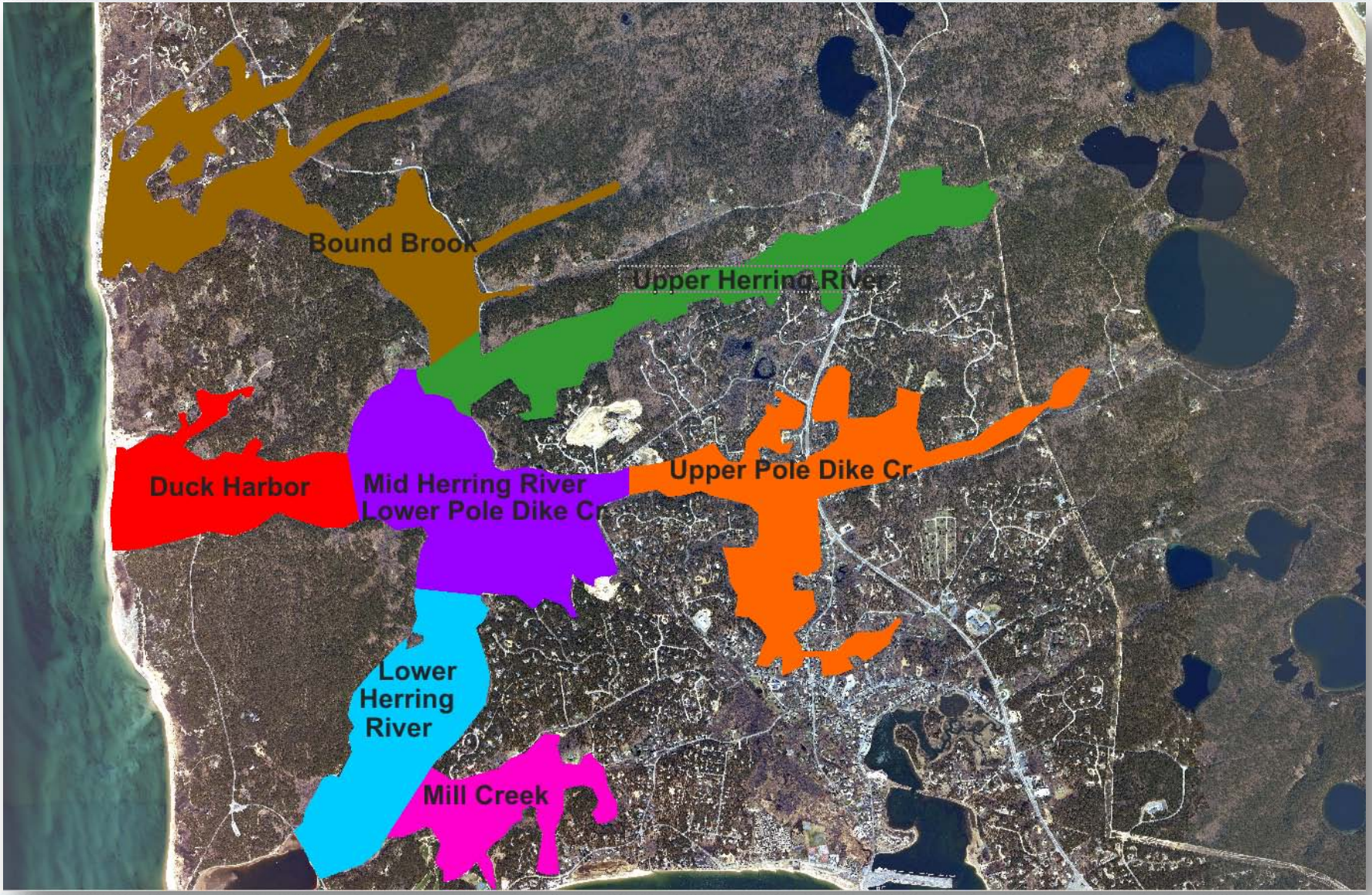
Case Study Background

- Dike constructed in 1909
- Reduced marsh by over 1,000 acres

- Dike consists of 3 culvert bays, adjustable sluice gate, two flap gates



Sub-Embayments



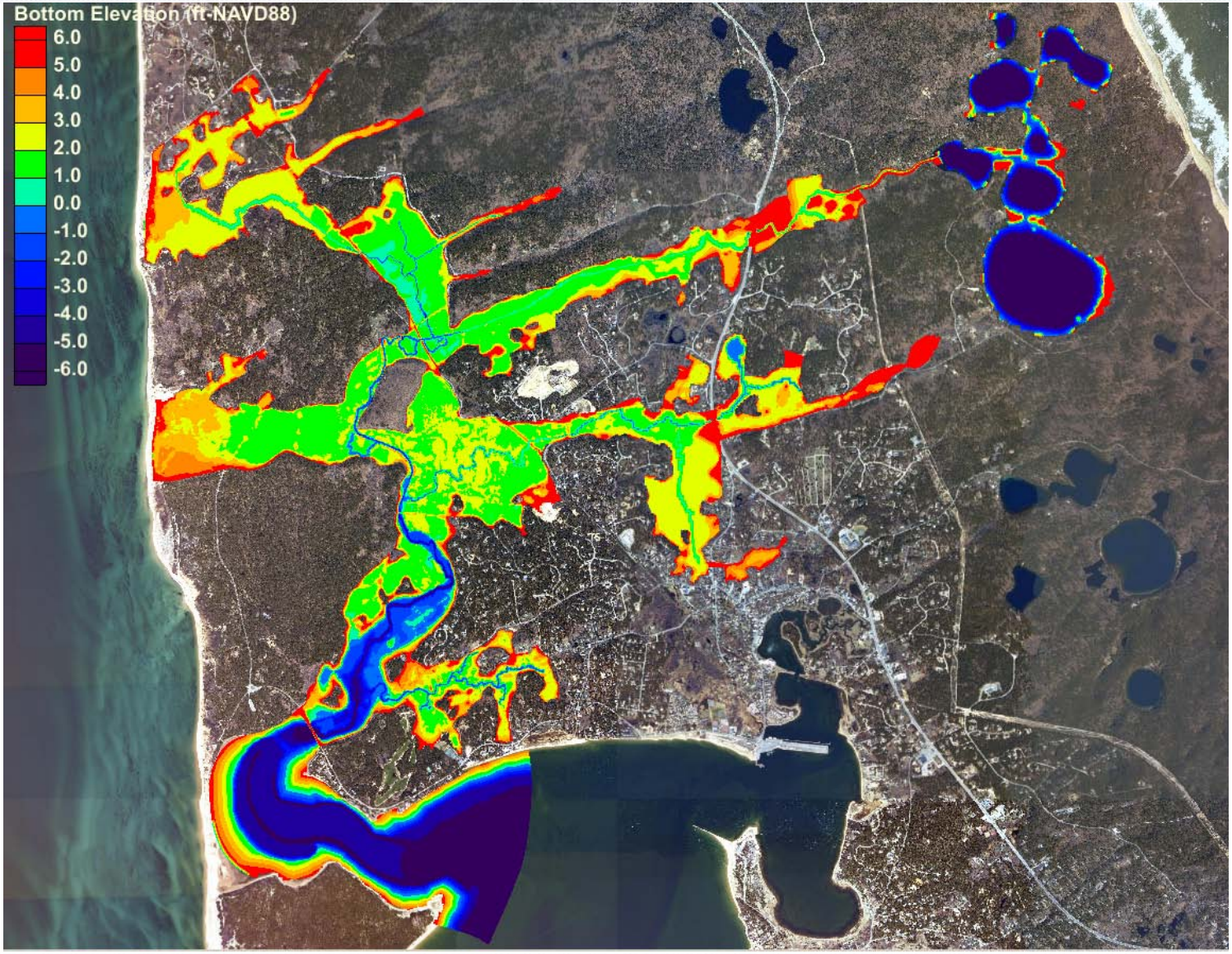
Existing Data

Bathymetry / Topography

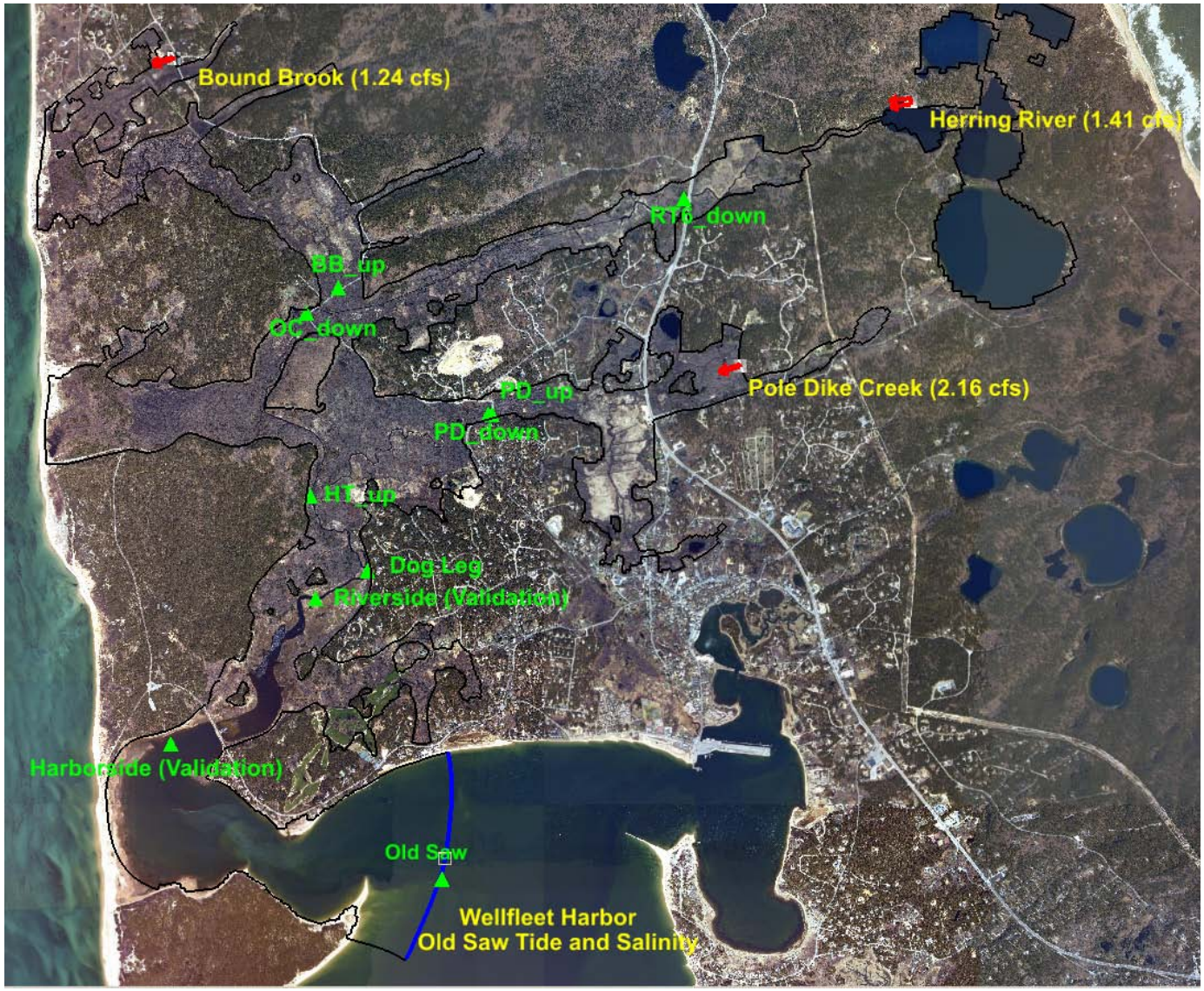
- Contemporary Photogrammetry

- 1999 Creek Cross-sections
- 2006 SLADE Road Survey
- 2007 Creek Cross-sections
- 2009 "Gut" Bathymetry

Bathymetric Mesh

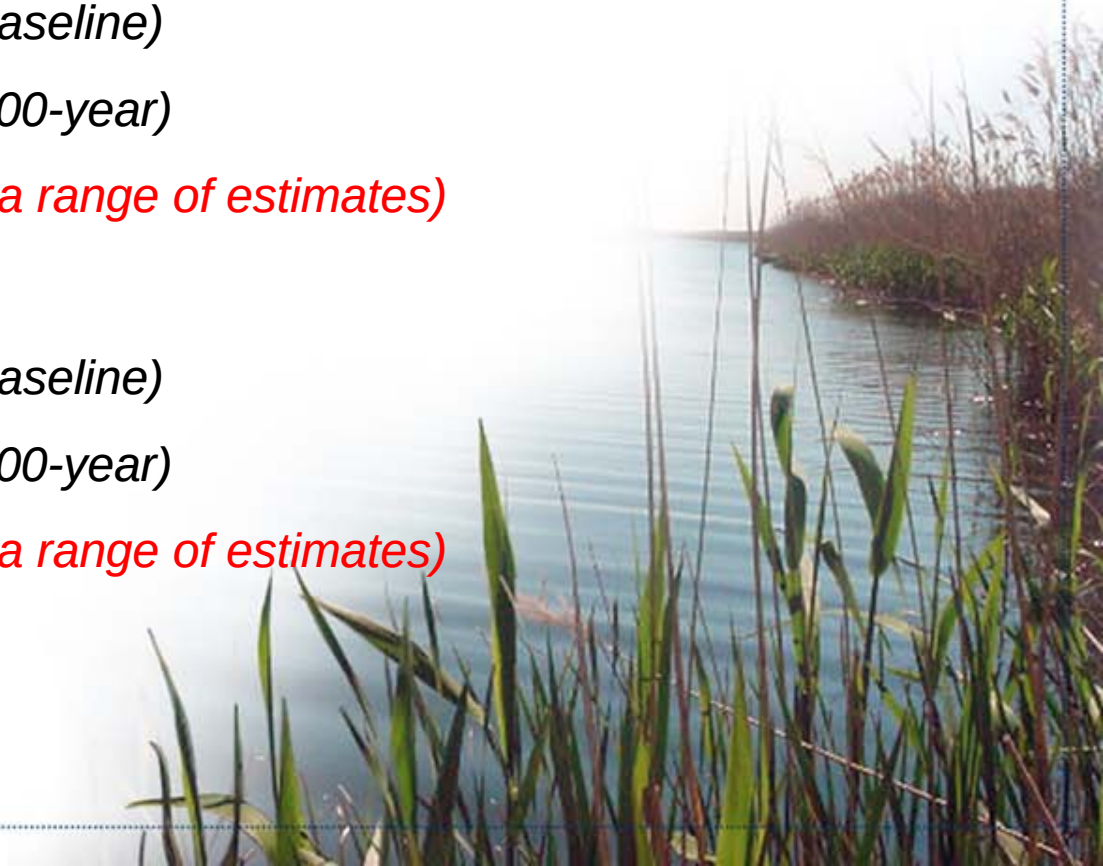


Gage Locations



Model Approach

- *Phase I – Model Calibration (9/17/07 – 10/4/07)*
- *Phase II – Model Validation (9/30/99 – 10/7/99)*
- *Phase III – Existing Conditions Simulations*
  - *Normal Tidal Conditions (Baseline)*
  - *Storm Scenarios (1-year, 100-year)*
  - *Sea Level Rise (*including a range of estimates)*
- *Phase IV – Alternatives*
  - *Normal Tidal Conditions (Baseline)*
  - *Storm Scenarios (1-year, 100-year)*
  - *Sea Level Rise (*including a range of estimates)*



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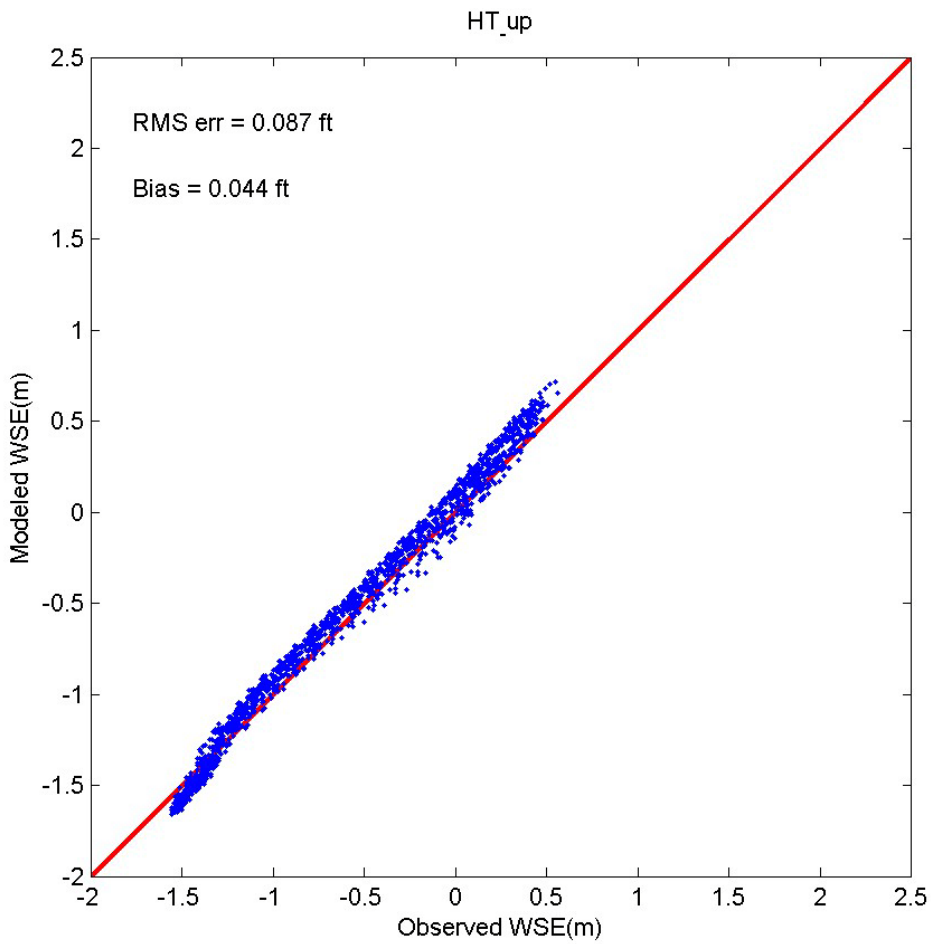
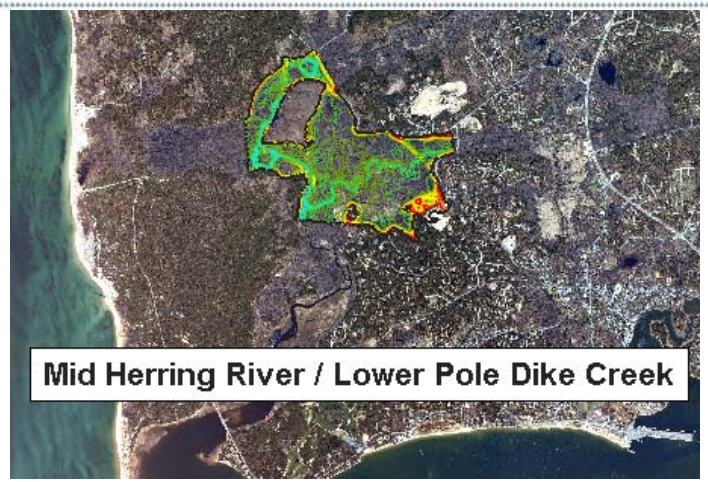
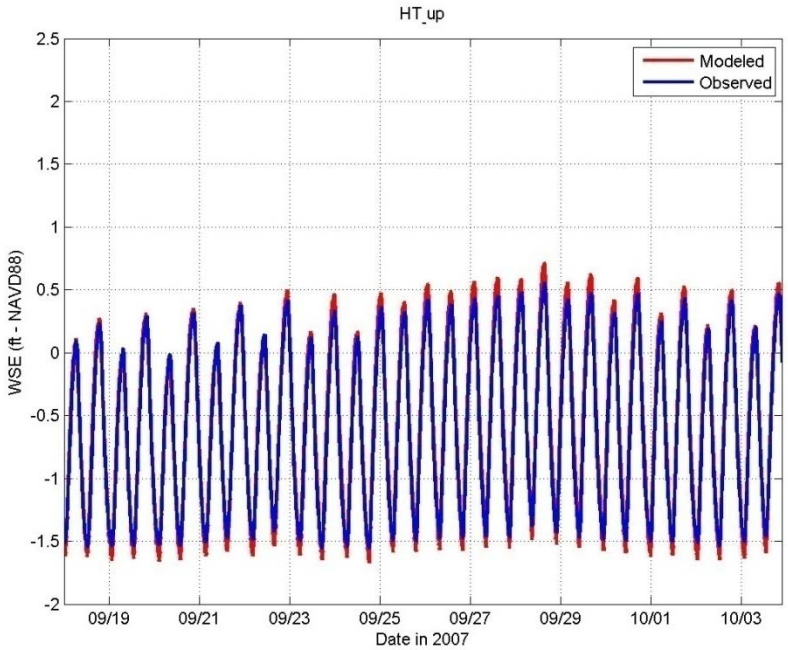
Model Calibration

Model Calibration







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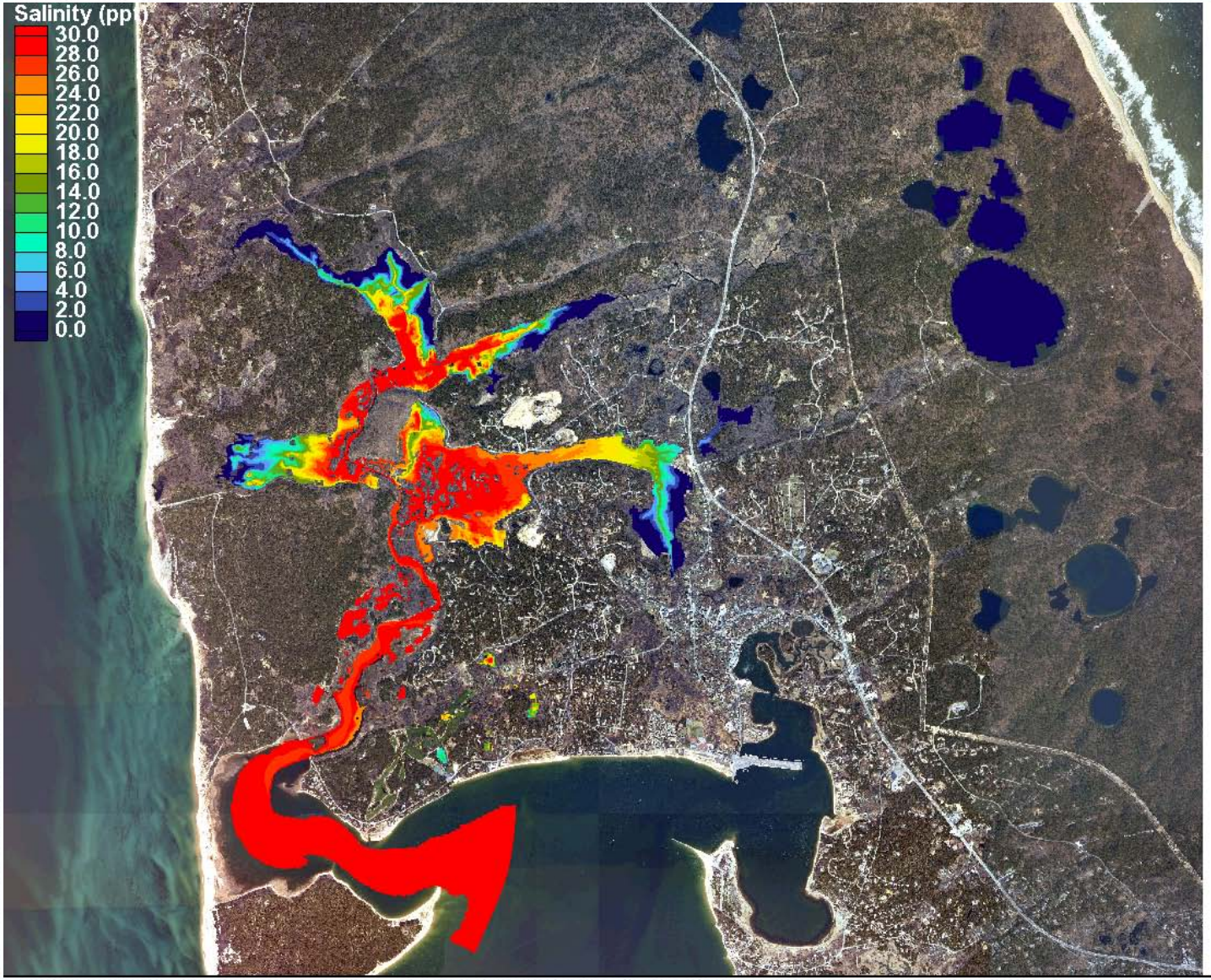
Alternative Simulations – Full Open



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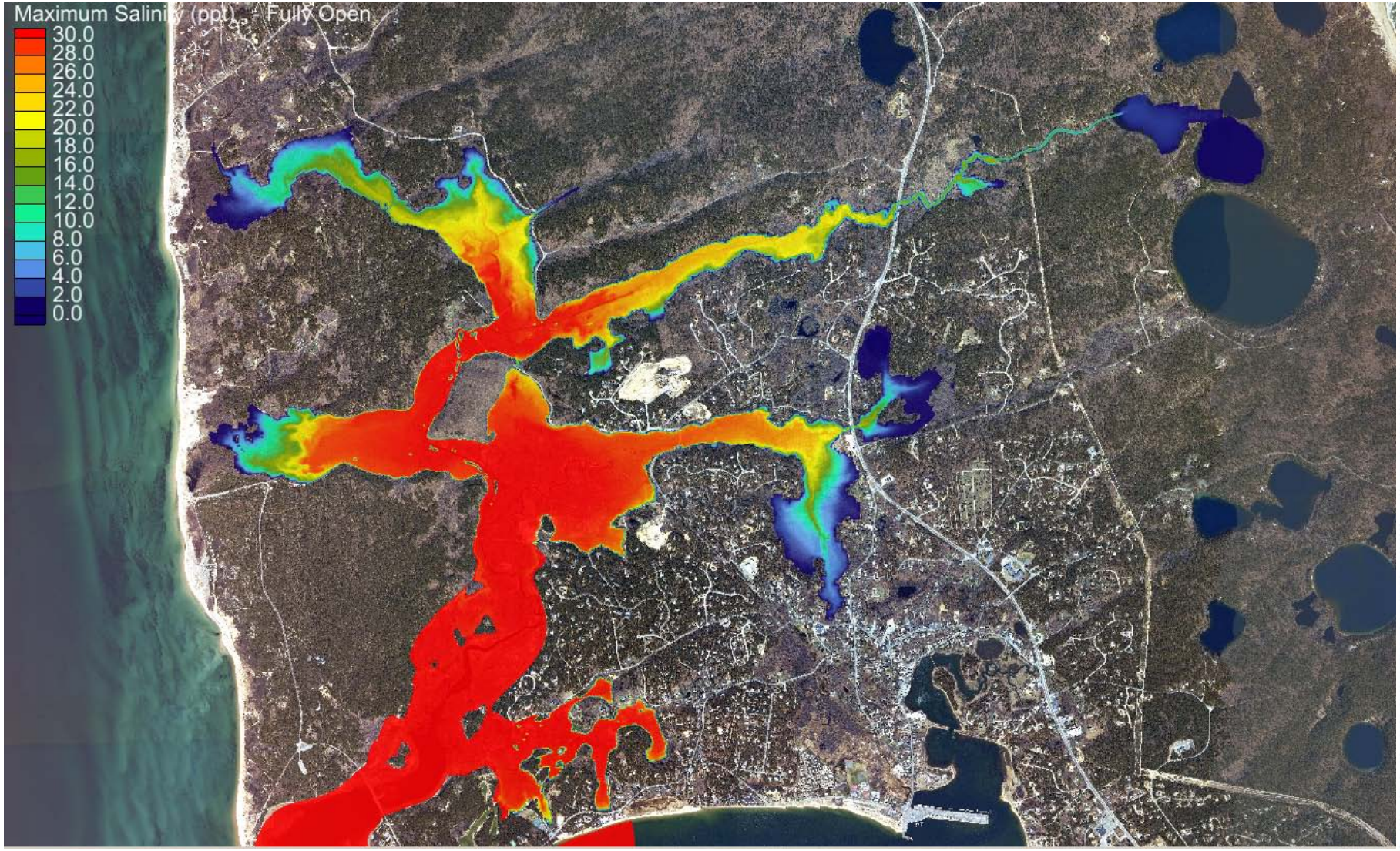
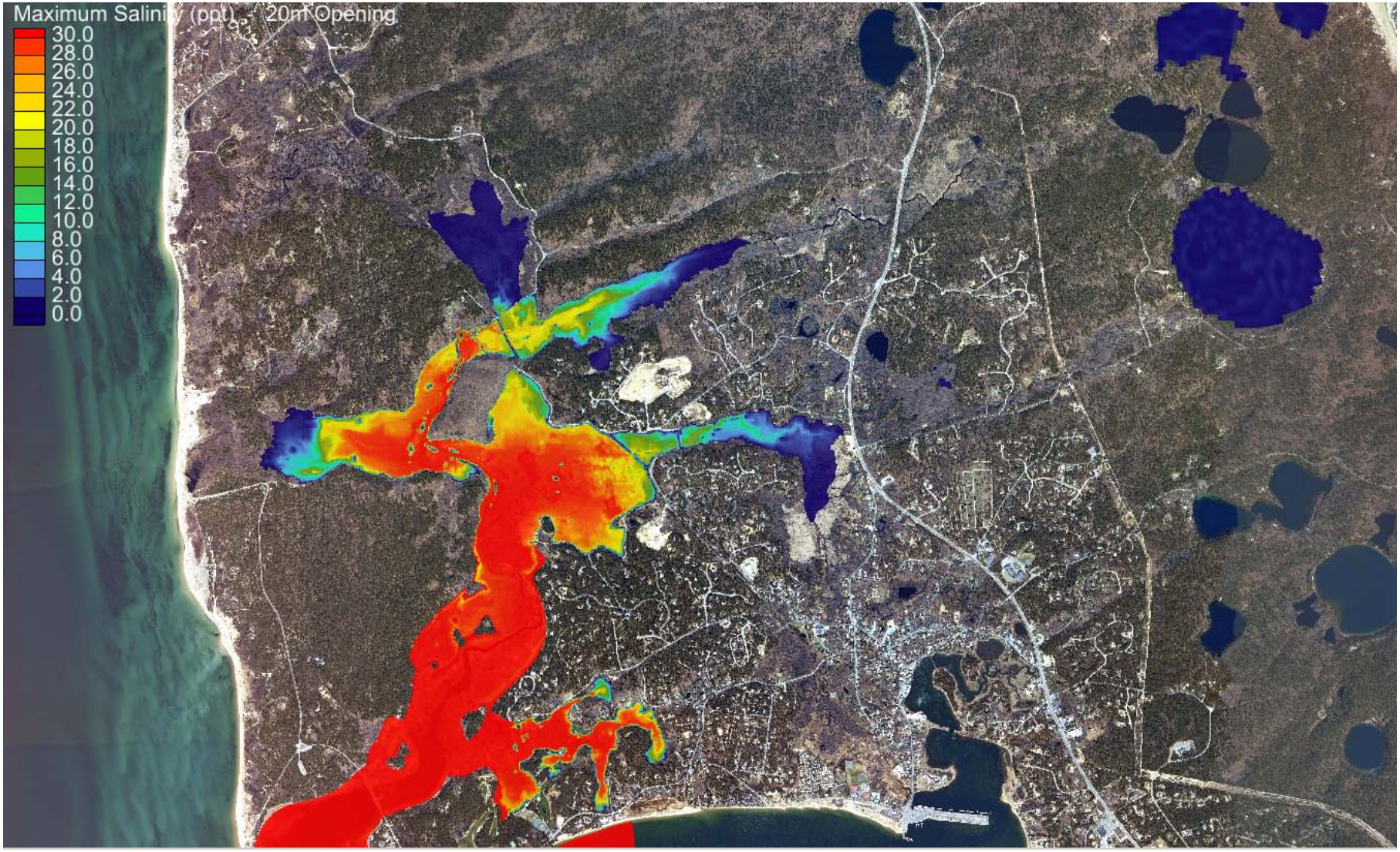
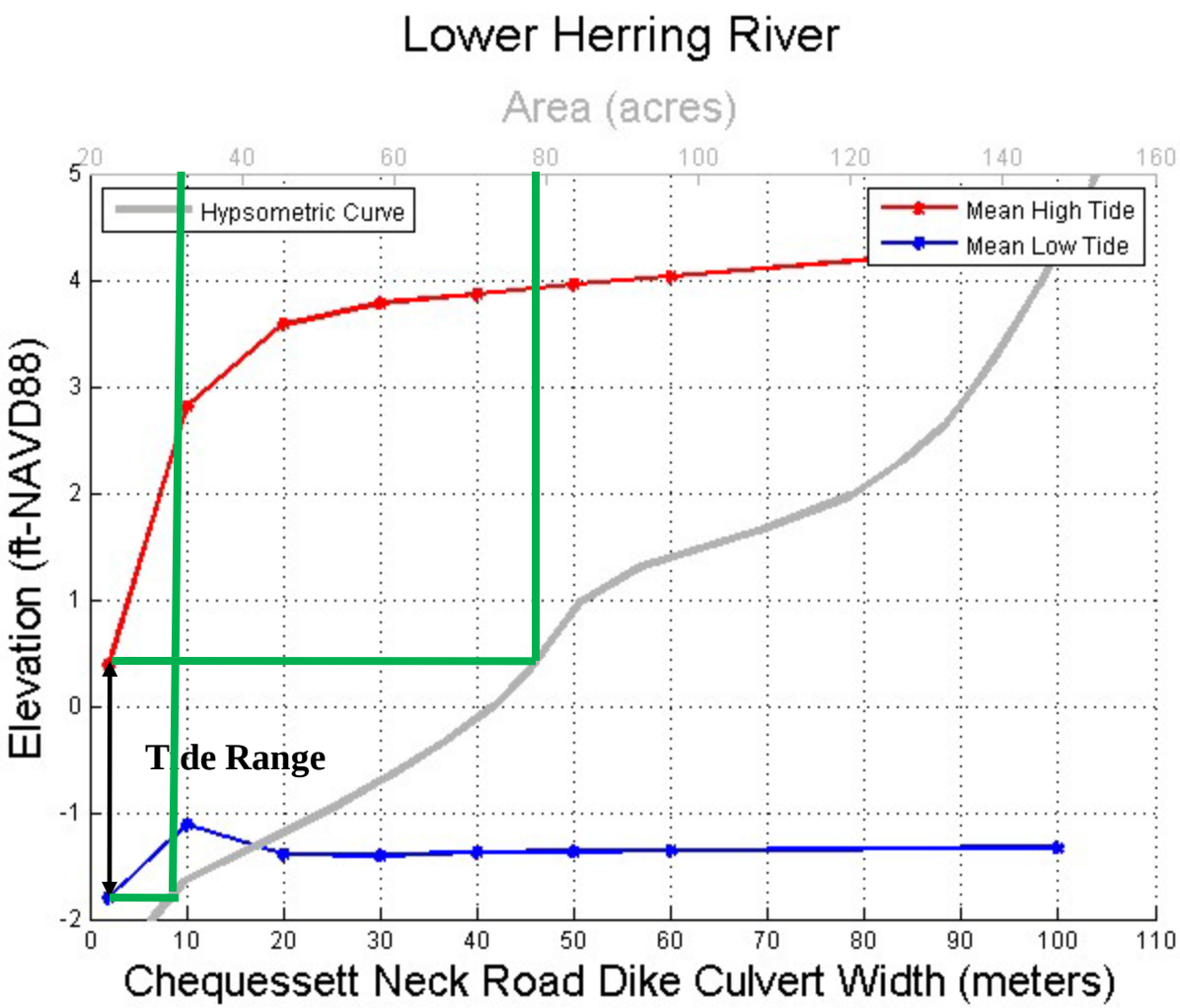


Alternative Simulations – 20 m Dike



Dike Openings



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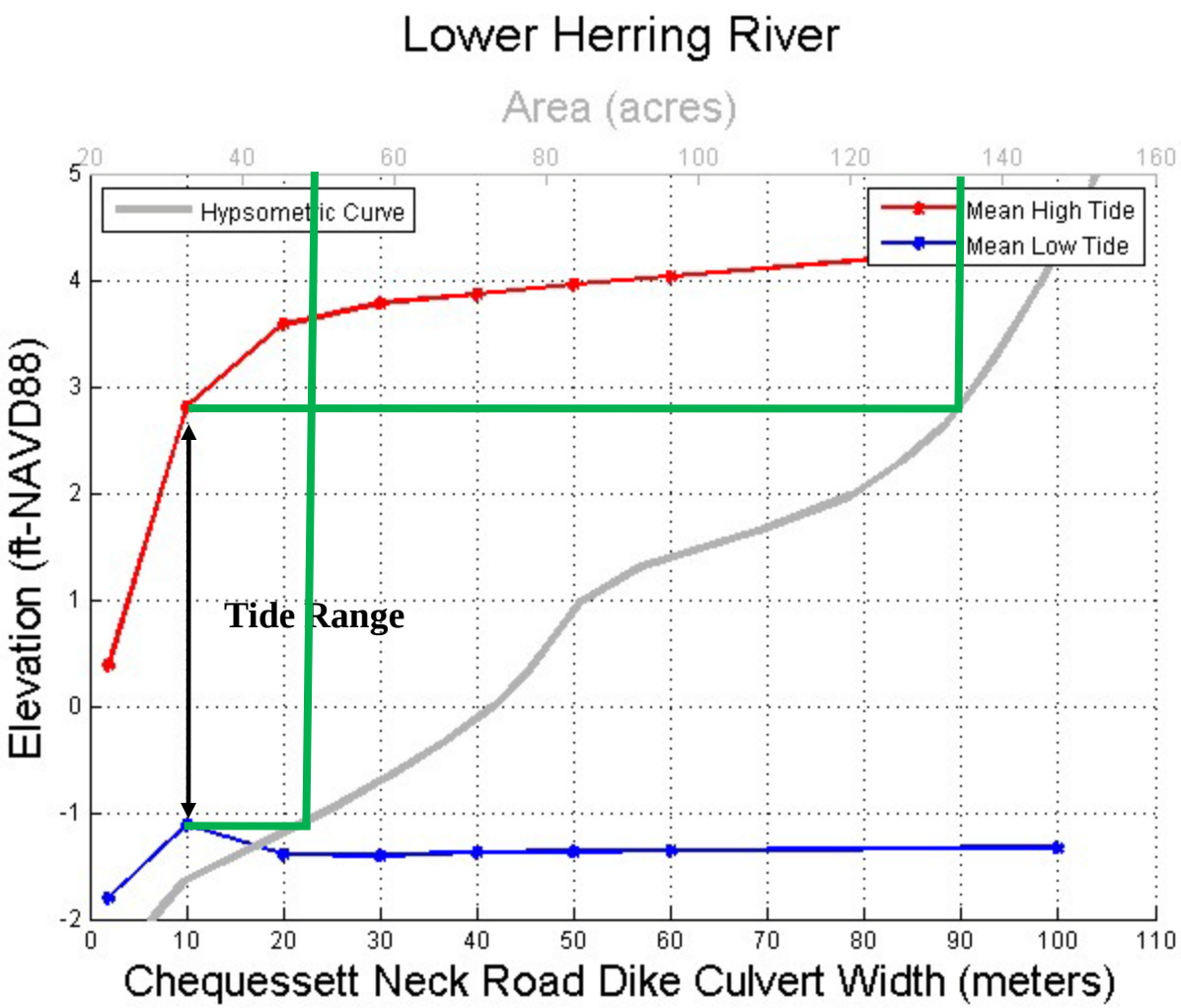

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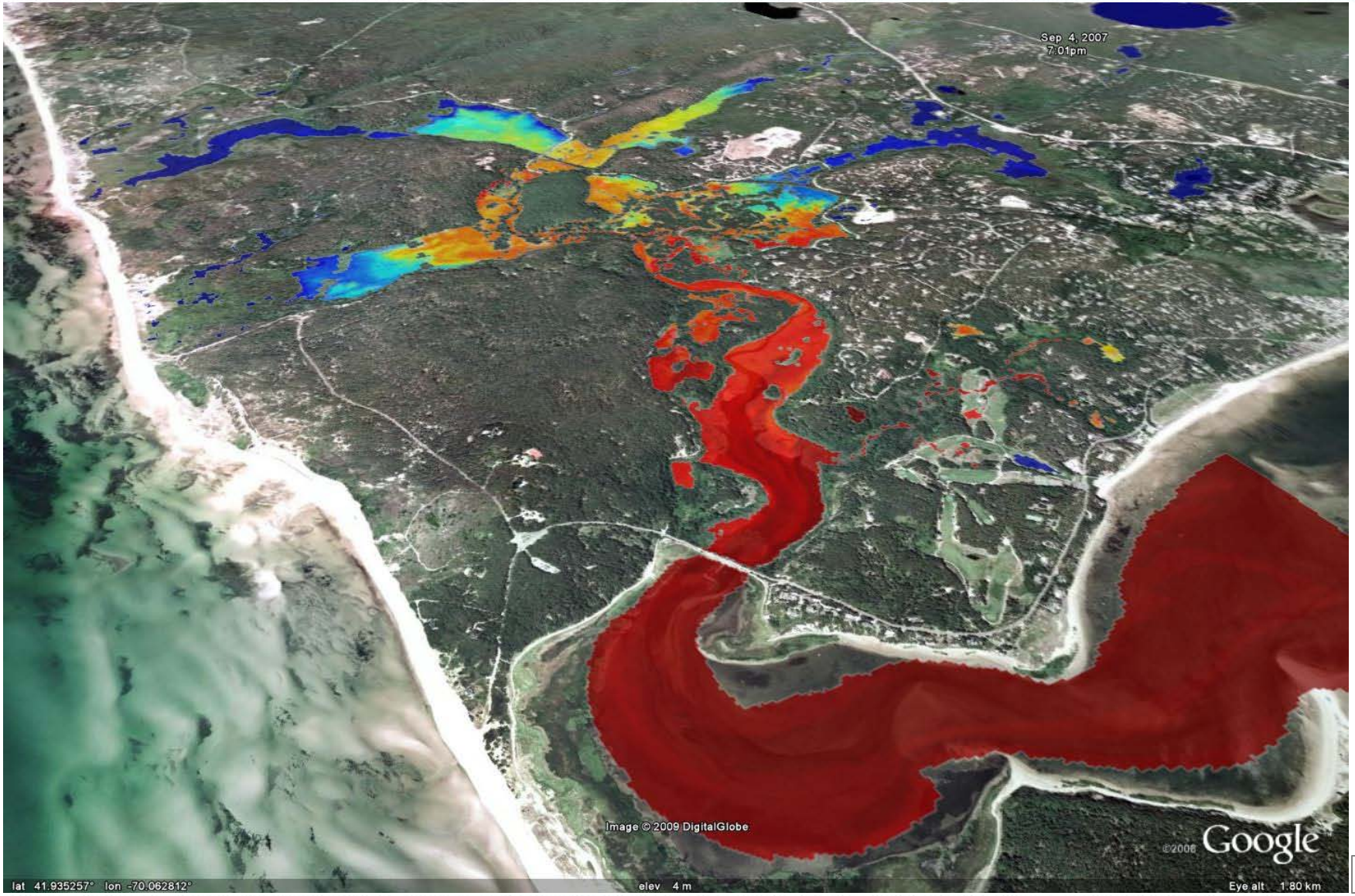
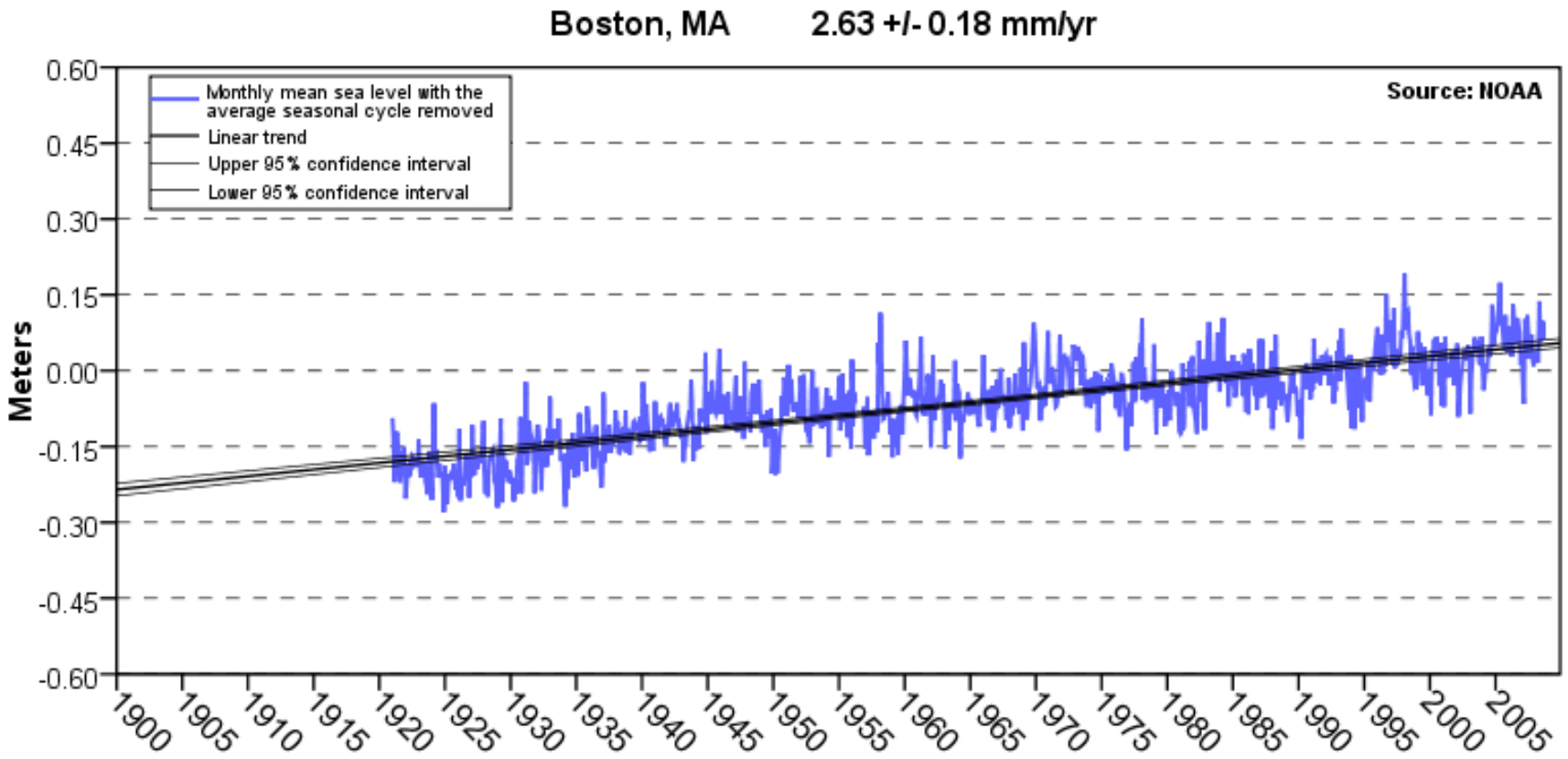
Importance of Sea Level Rise



Sea Level Rise

http://tidesandcurrents.noaa.gov/sltrends/sltrends.shtml



U.S. Army Corps of Engineers SLR

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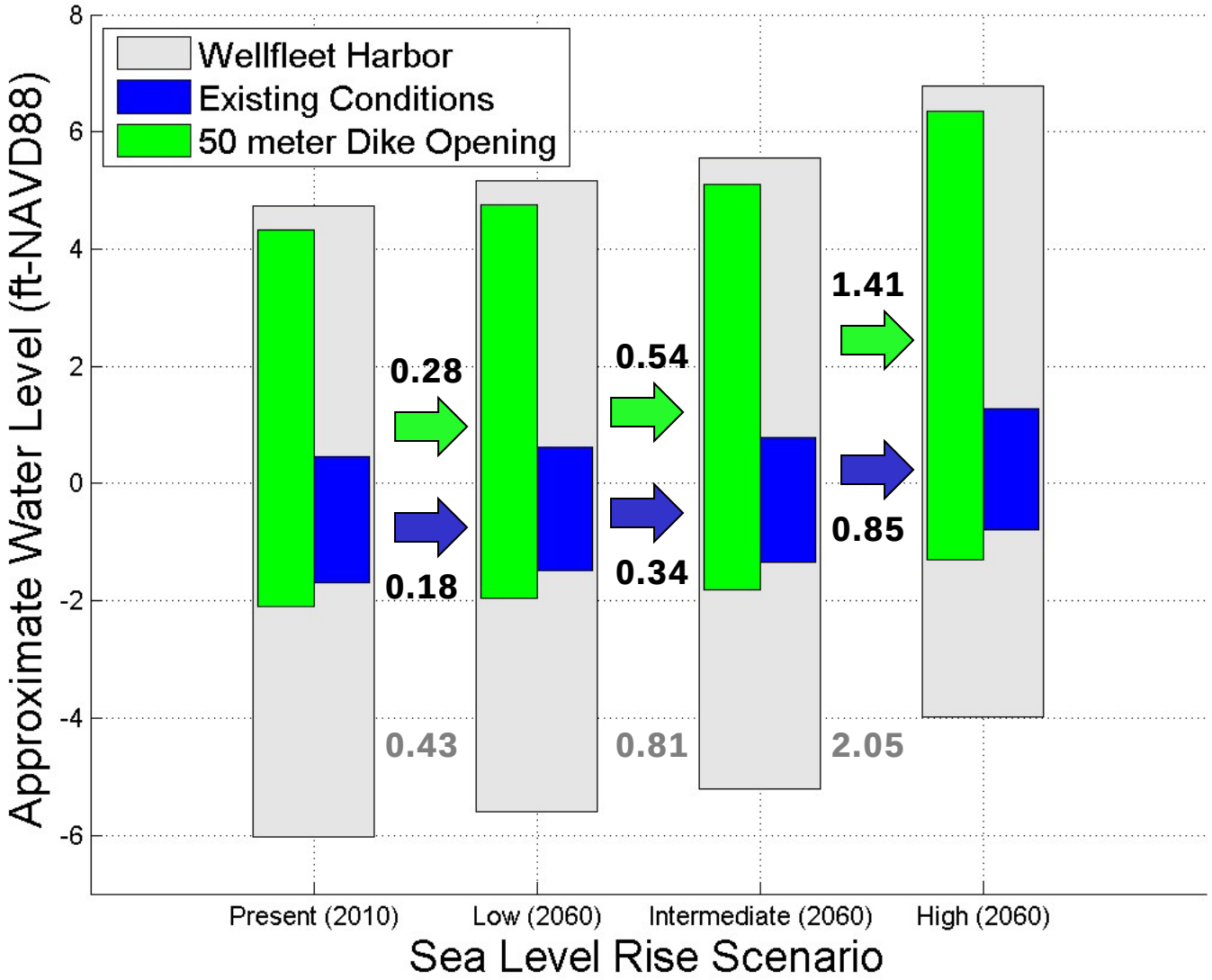
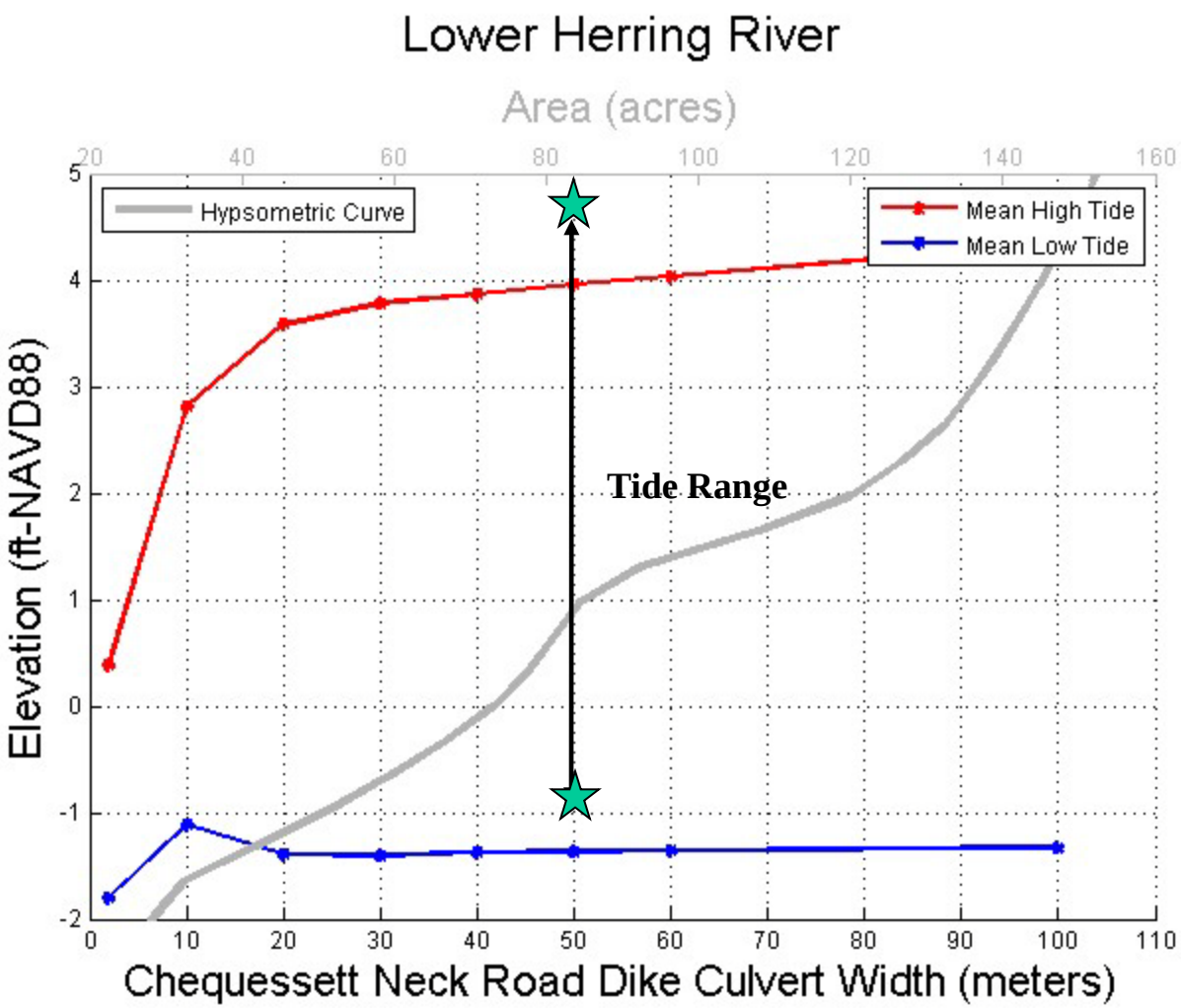
Sea Level Rise



Dike Openings



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Conclusions

- SLR considerations are important in planning and managing a marsh restoration project

- Hydrodynamic modeling is required in anthropogenically influenced systems to adequately assess SLR
  - Complexity of model dictated by system and other restoration needs

- Assess a range of SLR rates to evaluate present and future conditions
  - Reasonable selection of design scenario to optimize project and align with overall restoration goals
  - Consider importance relative to storm impacts

- Utilizing results of analysis to plan adaptive management and future adaptation approaches
  - Phased planning approach to adaptation management

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