Science and Habitat Restoration in the Delta

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Delta Independent Science Board Workshop, January 2013

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Overview

- Current and prior restoration efforts
- Delta ISB questions
  - How are we using science in projects?
  - What are the sources of science?
  - How is modeling incorporated into habitat restoration efforts?
  - How are habitat restoration efforts likely to be affected by climate change?
- Preliminary thoughts for discussion

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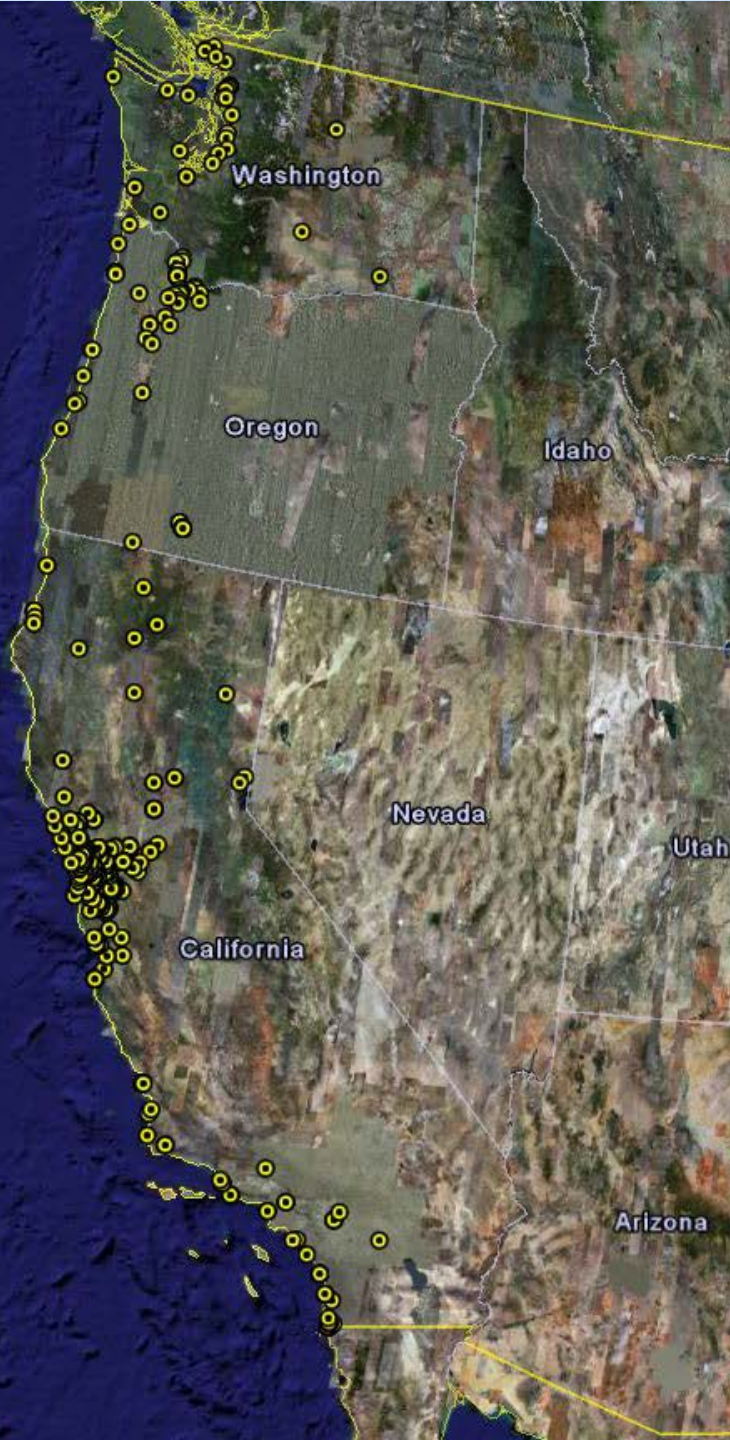
formerly Philip Williams & Associates

- 35+ years of restoration experience
- Plans developed for all major Estuaries on west coast of the US
- Long-term marsh monitoring, since 1986



Delta Habitat Restoration Projects

Delta-Wide Studies

- (A) BDCP (Bay Delta Conservation Plan)
  Delta Regional Ecosystems Restoration Implementation Plan (DRERIP)
  Central Valley Flood Management Plan
  CVPIA b2 Water

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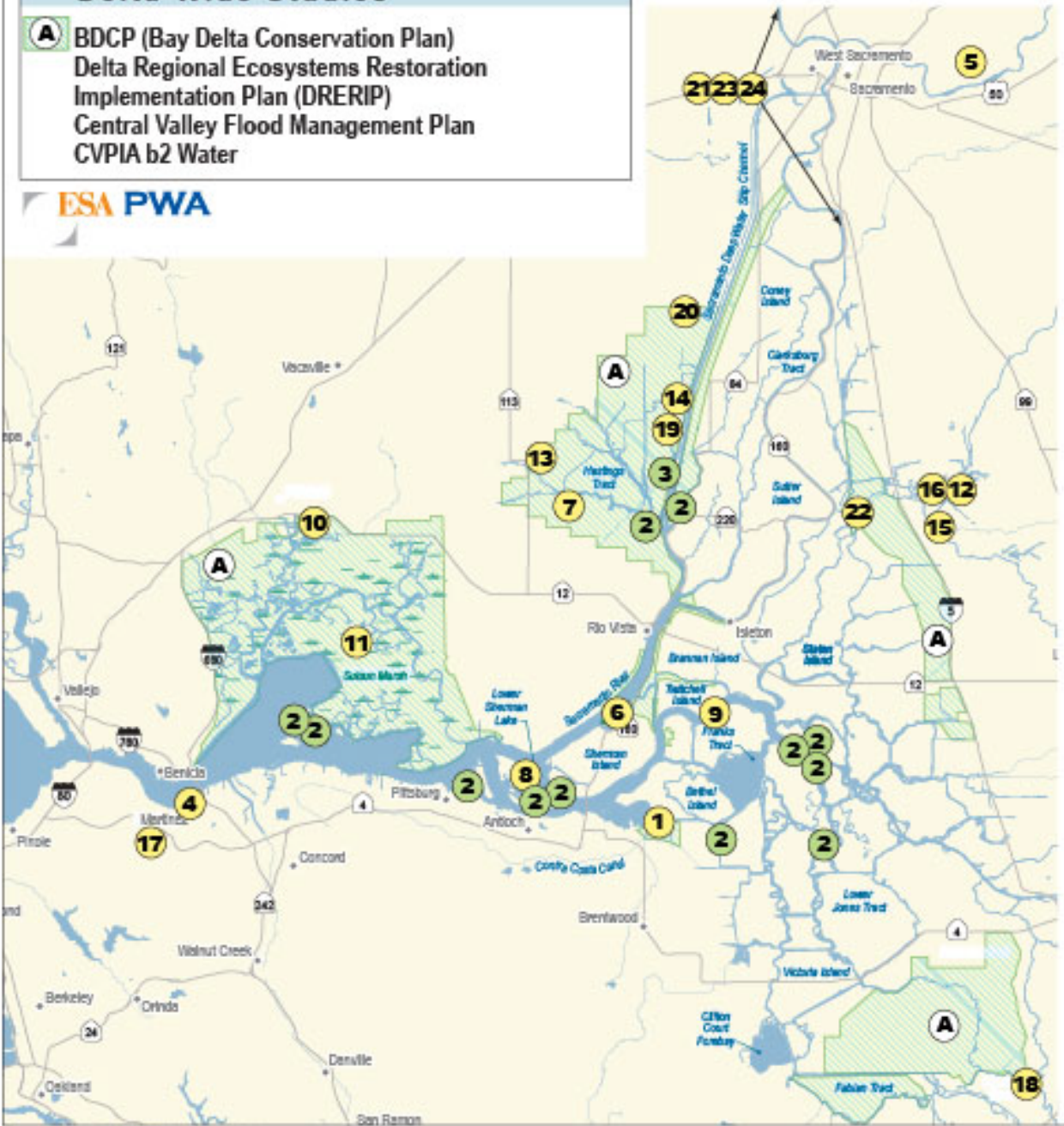


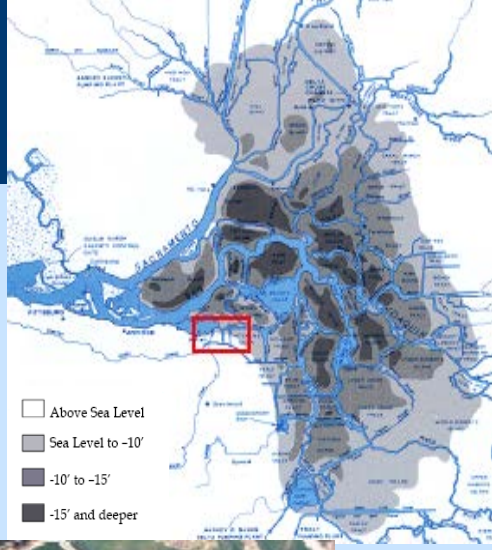
1. Dutch Slough Restoration
2. BREACH 1 & 2 (multiple locations)
3. BREACH 3 (at Liberty Island)
4. Martinez Regional Shoreline Park Marsh Restoration
5. American River Sunrise Side Channel
6. Decker Island Wetland Restoration
7. Lindsey Slough / Calhoun Cut Restoration
8. Lower Sherman Island Wildlife Management Area LMP
9. Delta Subsidence Reversal Project
10. Hill Slough Restoration
11. Rush Ranch Restoration (Goat Island)
12. Cosumnes River Mitigation Bank
13. North Bay Aqueduct Dissolved Organic Carbon Modeling
14. Liberty Island Restoration (Kerry Property)
15. Grizzly Slough Restoration
16. Lower Cosumnes Floodplain Restoration
17. Pacheco Marsh Restoration
18. South Delta Restoration and Flood Protection
19. Lower Sacramento River Regional Project
20. Fremont Landing Conservation Bank Modeling
21. Sacramento River Bank Protection Environmental Support, Restoration
22. McCormack-Williamson Tract
23. Sacramento River Ecological Flows
24. Frequently Activated Floodplain Analysis - Yolo Bypass

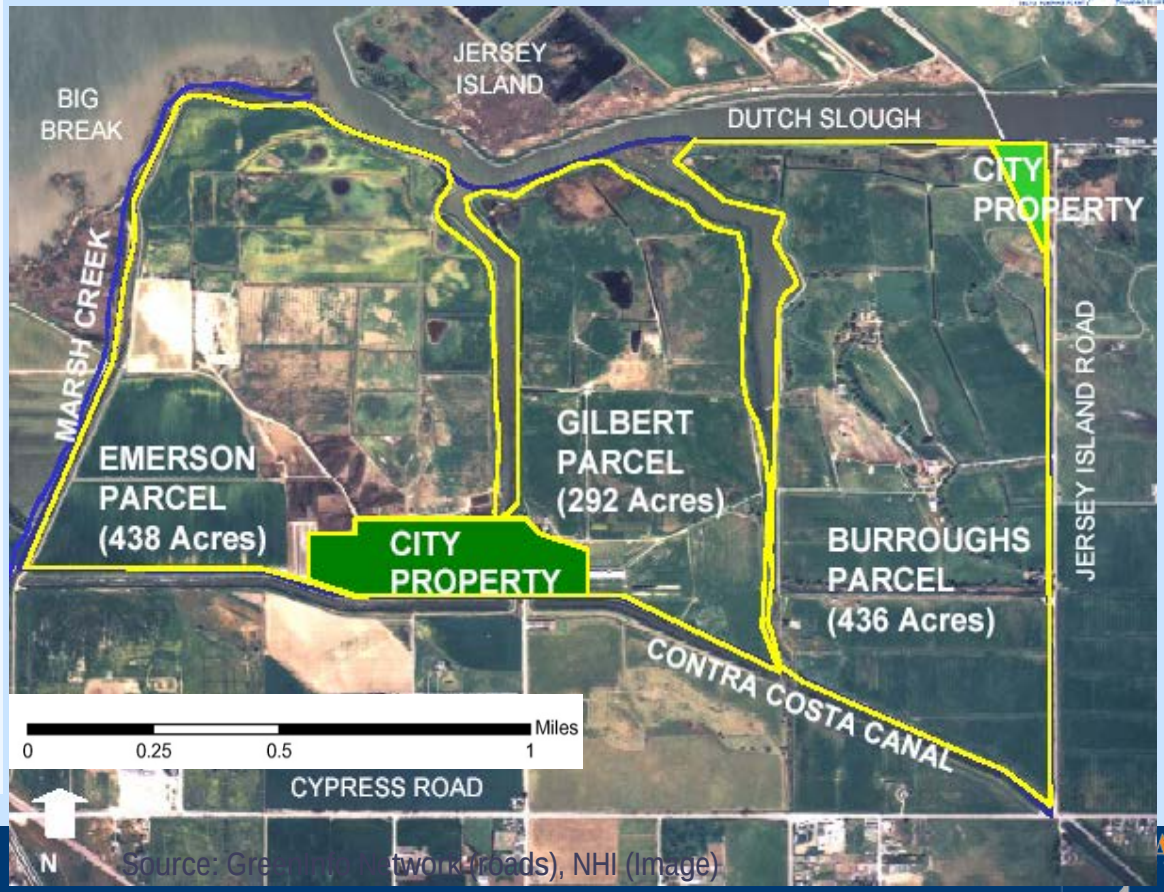
Delta ISB questions

- How are we using science in projects?
- What are the sources of science?

Dutch Slough Tidal Wetland Restoration

- 1166 acres
- Funding: CALFED & Conservancy
- Project Partners: DWR, Conservancy, RD 2137
- Goals
  - Habitat restoration
  - Adaptive management
  - Public access

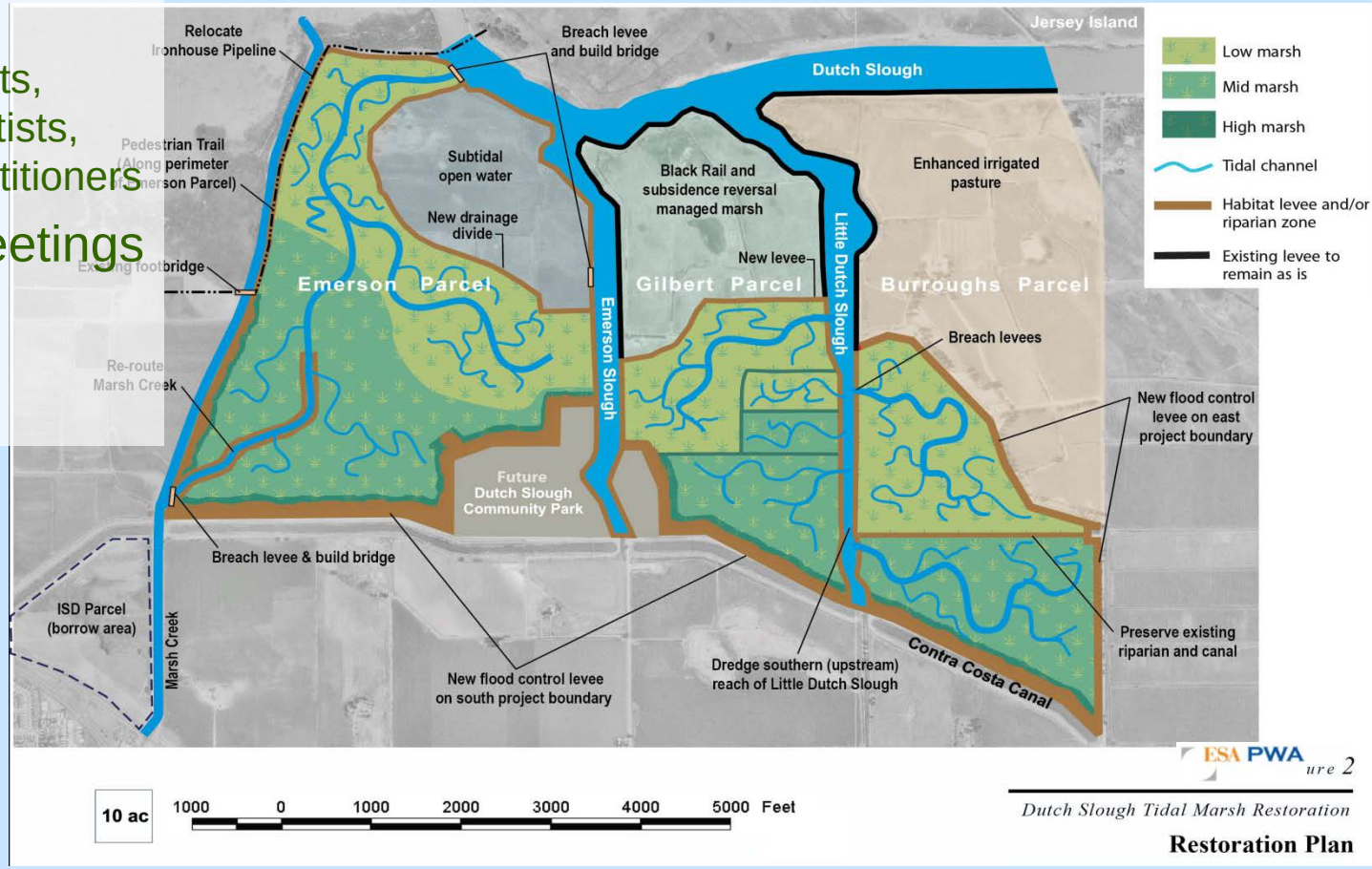




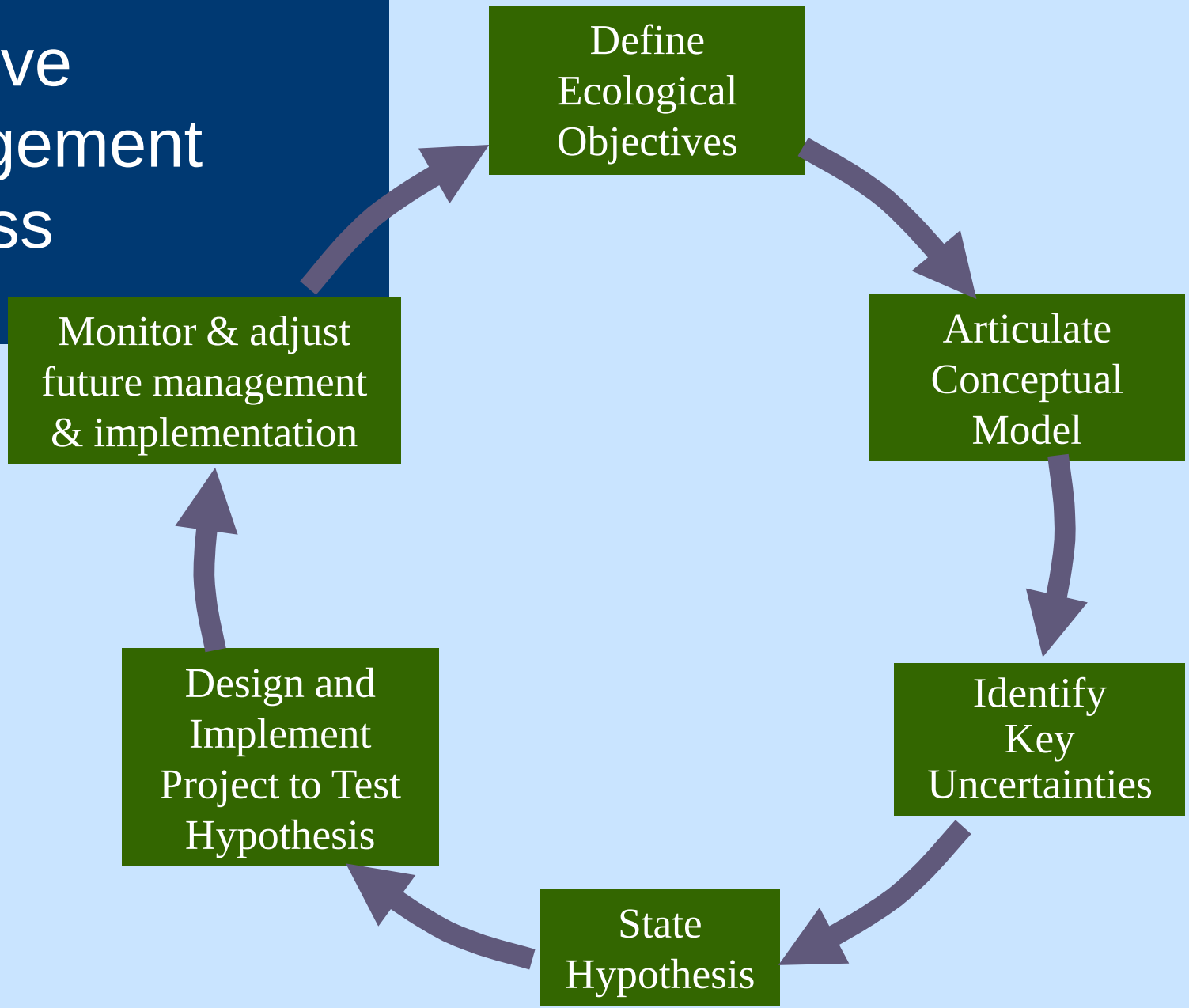
Source: Greenprint Network (roads), NHI (Image)

Dutch Slough use and sources of science

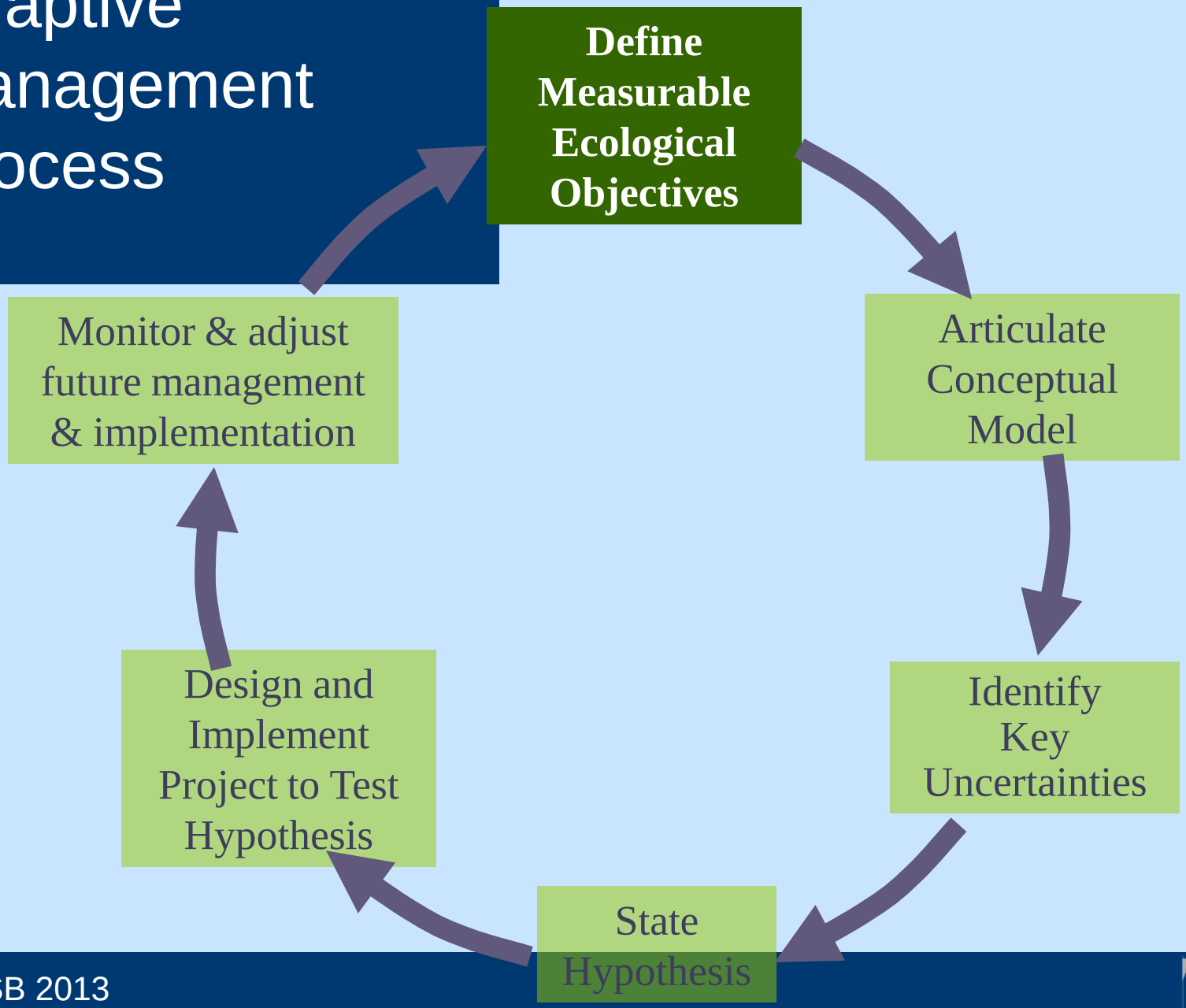
- Adaptive Management Work Group
  - Led by Bruce Herbold, EPA
  - Agency scientists, university scientists, restoration practitioners
- CALFED ISB meetings



Adaptive Management Process



Adaptive Management Process



Ecological objectives

1. Reestablish hydrologic, geomorphic, and ecological processes for long-term sustainability.
2. Restore wetland and upland habitats.
3. Contribute to the recovery of endangered and other at-risk species and native biotic communities.
4. Minimize establishment of non-native invasive species.
5. Avoid impacts to drinking water quality
6. Minimize potential for mercury methylation

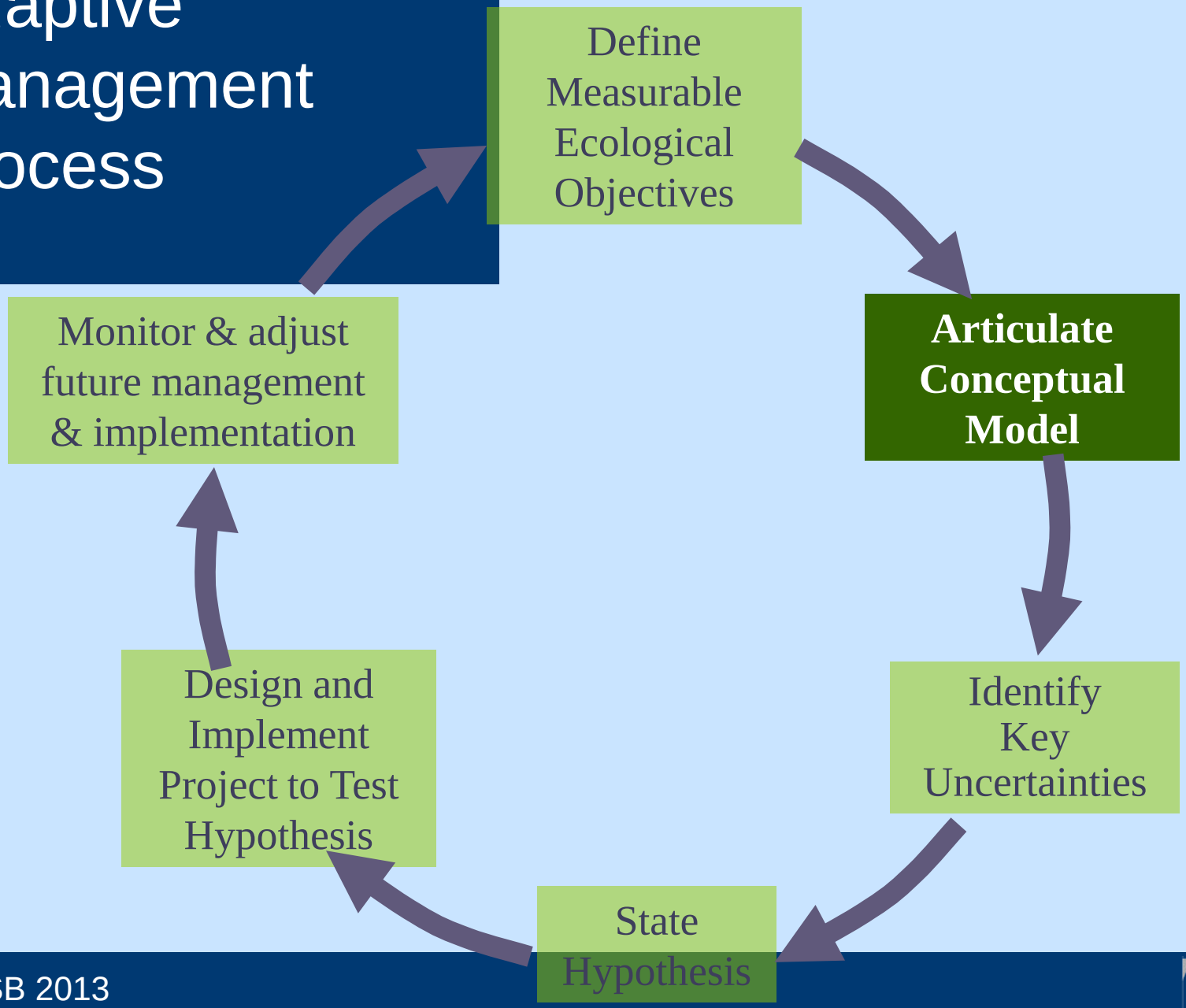
Target Species

- Chinook Salmon Juvenile Rearing

- Splittail Spawning and Rearing

- Delta smelt spawning (if possible)

Adaptive Management Process

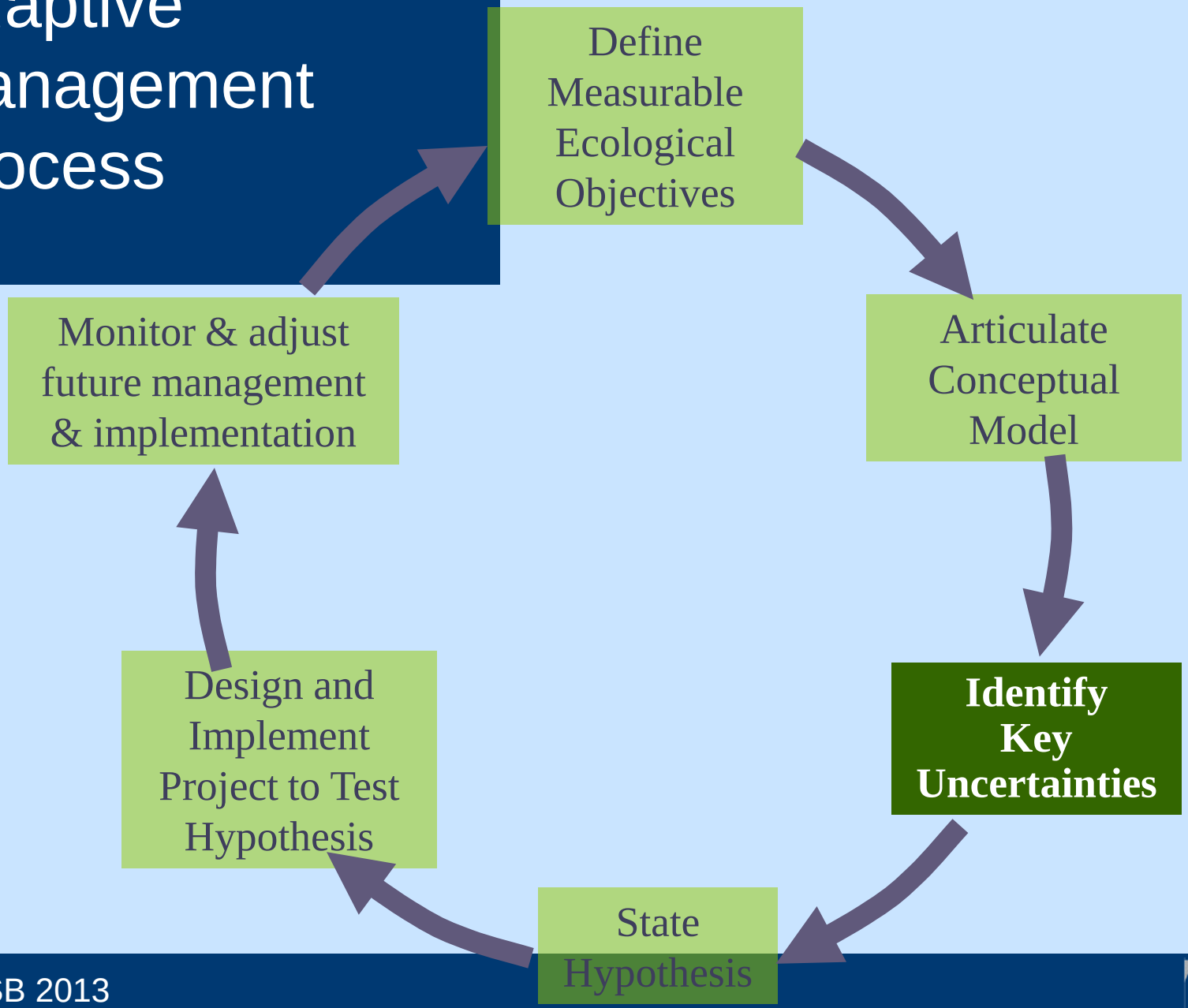


How Restoration Actions Affect Functional Response at Dutch Slough

Restoration Action	Physical & vegetative processes	Habitat Structures	Ecological Processes	Functional Response
Breach levees Fill and grade Excavate channels Reroute creek Plant Manage	Sediment deposition Erosion Tidal inundation Heating/ Cooling Vegetation colonization	Channel Marsh Shallow subtidal Floodplain Riparian Uplar Trans Soil F & chemistry Water chemistry	Change in metabolism Foraging Access Carbon processing to support Fish predation	Salmon growth Salmon survival Delta Smelt & Splittail spawning

External factors:
- Regional salinities
- Urban and agricultural pollutants
- Factors limiting other life stages
- Other offsite factors

Adaptive Management Process



Uncertainties Selected for Testing

Large-scale

- Tidal marshplain elevation

  How high should subsided areas be filled to create an ecologically functional marsh?

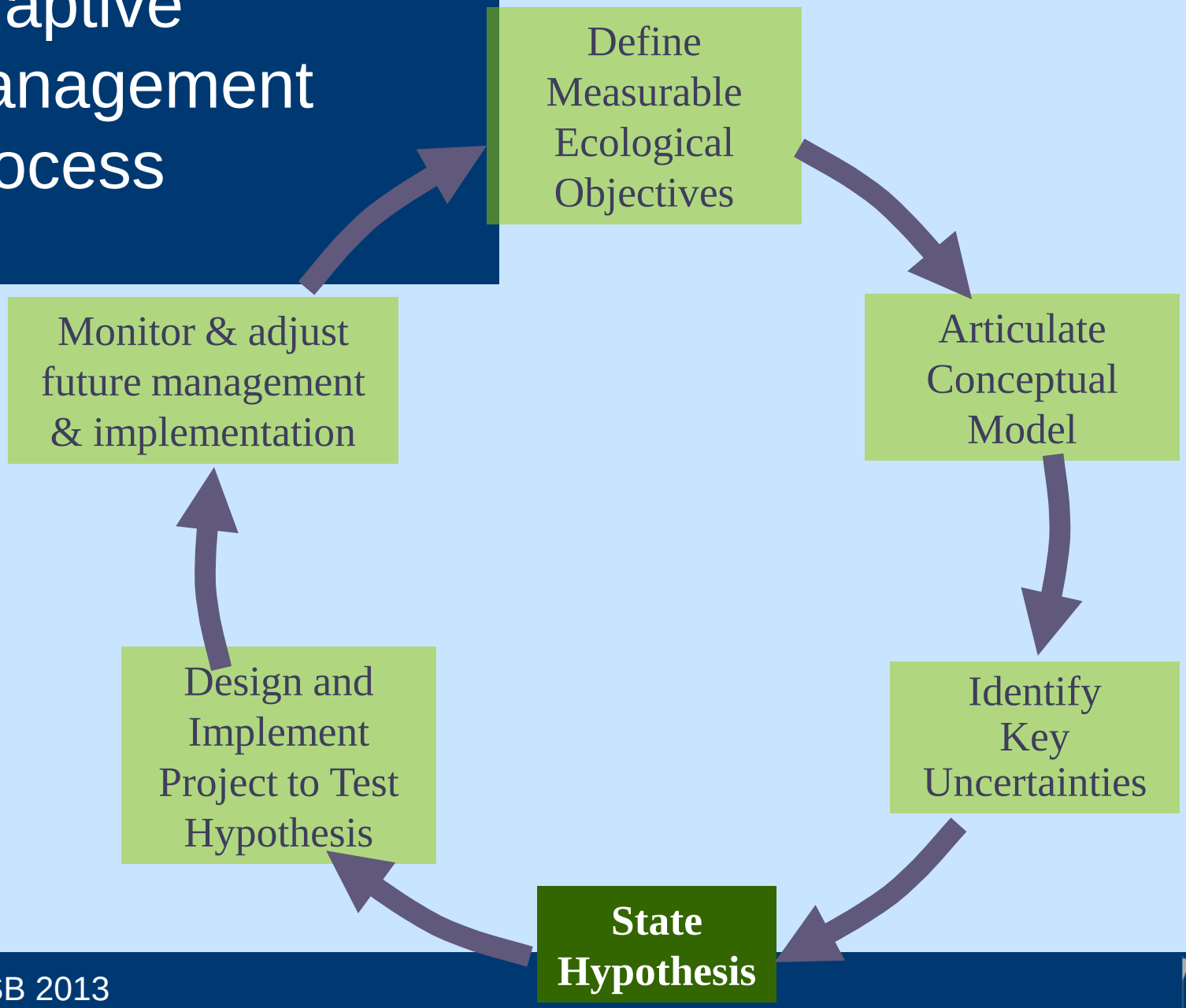
- Marsh scale

  Importance of prioritizing large sites for restoration versus proceeding opportunistically with multiple smaller sites?

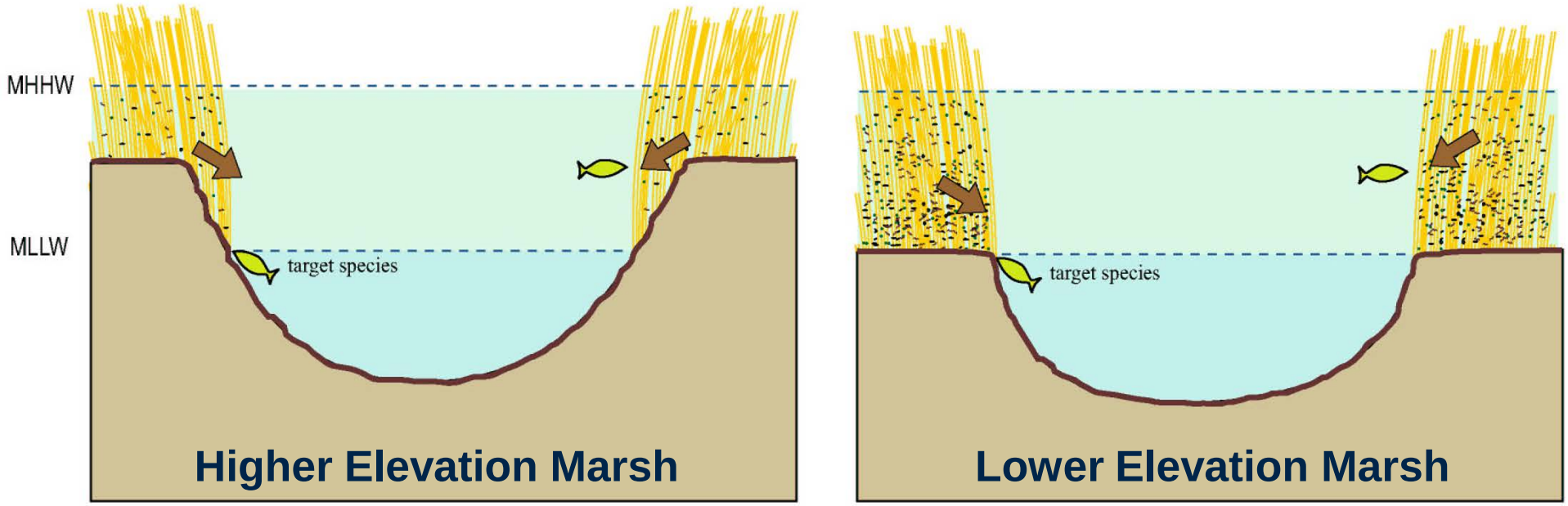
Small-scale (<1-2 acres)

- Water quality (DOC, mercury bioaccumulation)
- Techniques for building up peat soils
- Extent of channel formation through tidal scour

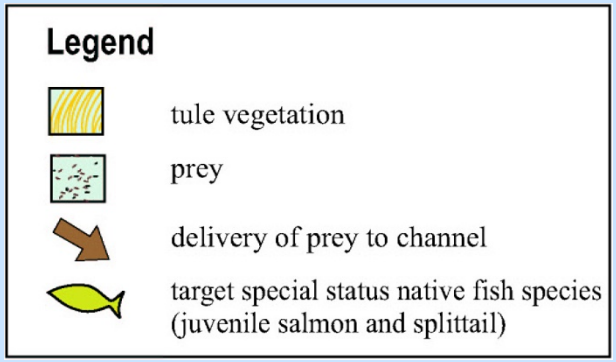
Adaptive Management Process



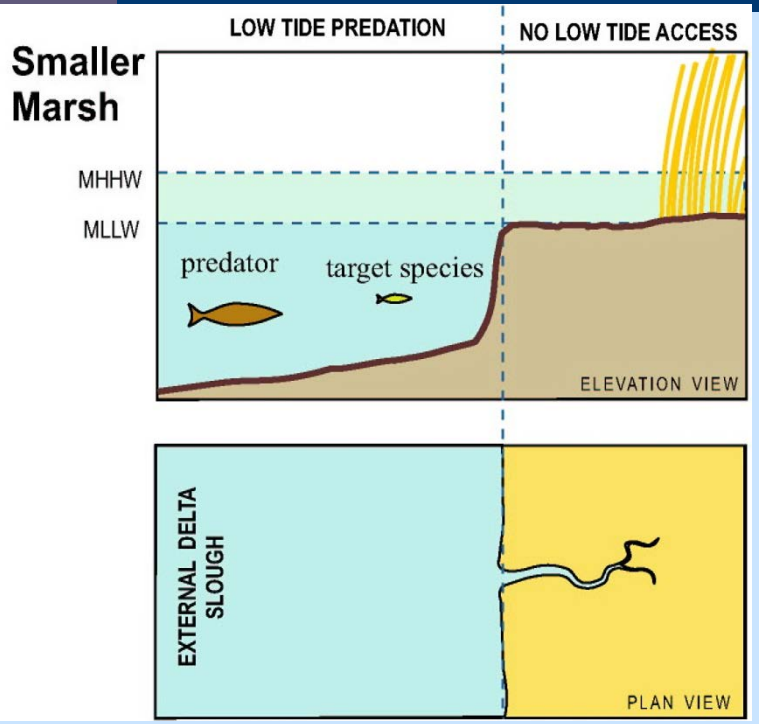
Marsh Elevation Experiment

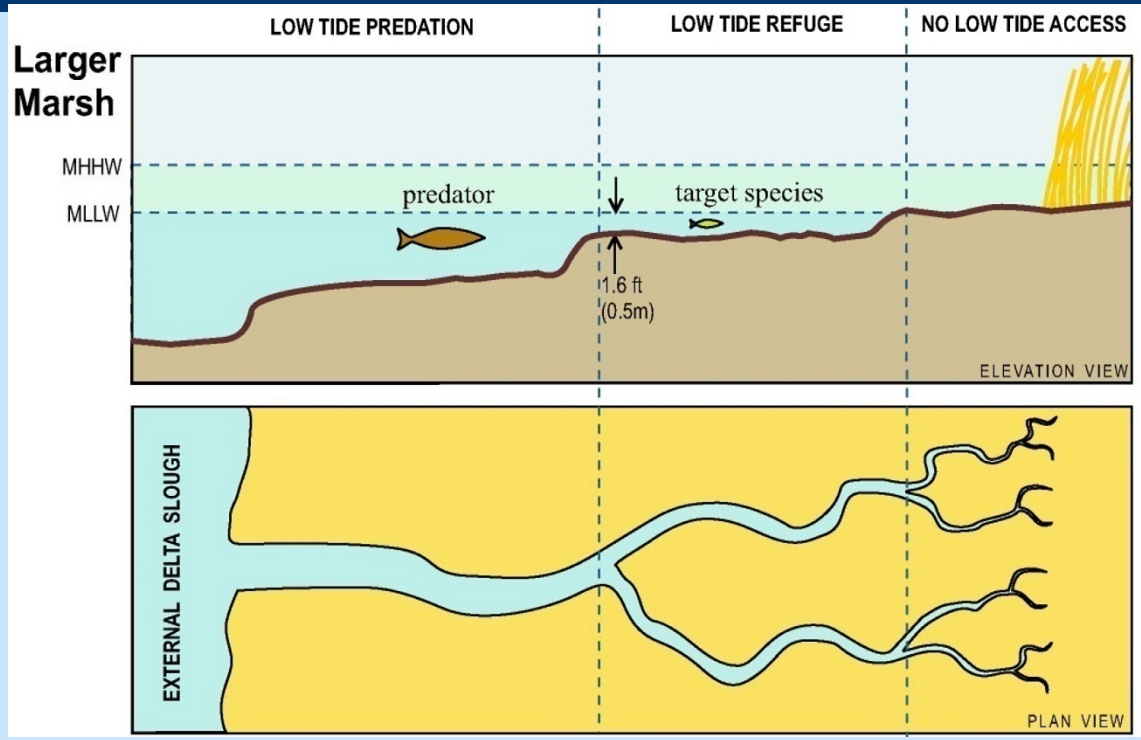


Hypothesis:
There is greater production of prey resources for juvenile salmon and splittail in lower marshes than higher marshes, and thus greater potential for feeding growth and survival.



Marsh Scale Experiment

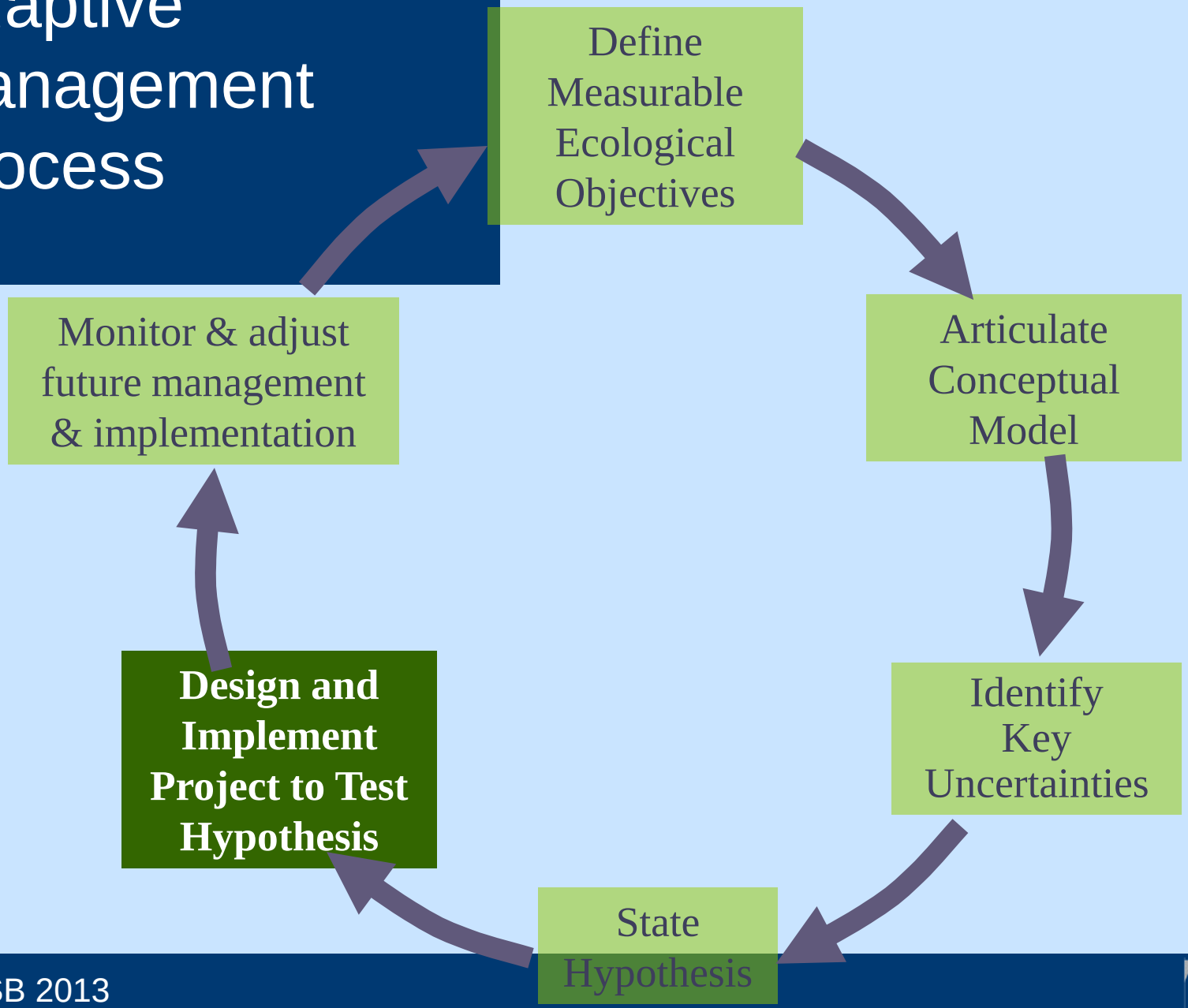




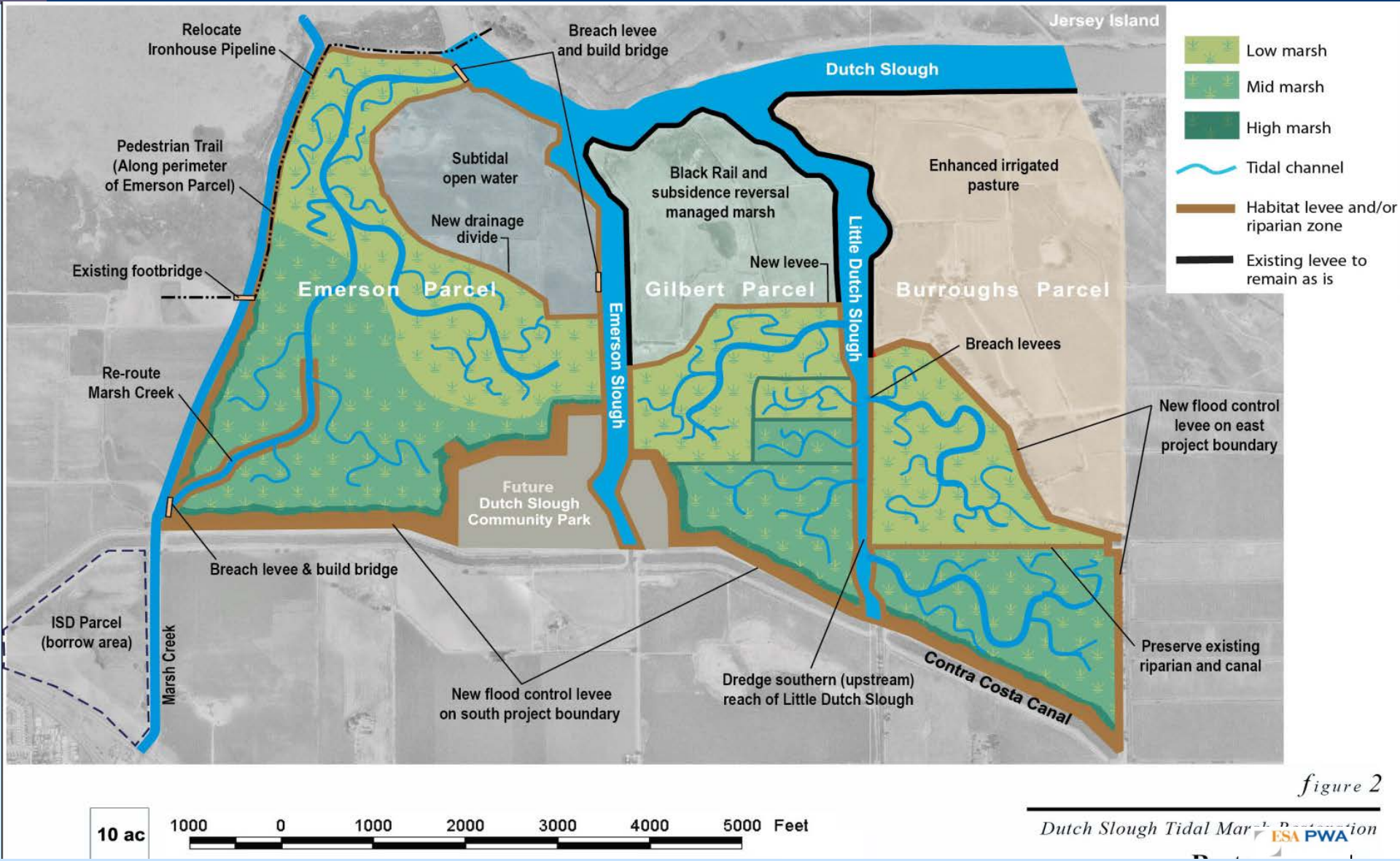
Hypothesis:

Tidal channel networks in larger marshes provide shallow water refuge from predation throughout the tide cycle, whereas smaller channel networks in smaller marshes do not. Thus, larger marshes are expected to provide greater survival opportunities for juvenile salmon and splittail than smaller marshes.

Adaptive Management Process



Restoration Plan



What are the sources of science?

- Use of existing science
  - Project staff experience
  - One-on-one meetings with scientists
  - Published literature
  - Gray literature (confidentiality issues)
  - DRERIP models
- Project structured

What are the sources of science?

9 Sample Projects

- BREACH 1, 2, 3
- Dutch Slough
- Hill Slough
- Lindsey Sl./Calhoun Cut
- BDCP
- Decker Island Phase 2
- Rush Ranch
- South Delta Restoration and Flood Protection
- Liberty Island (Kerry Property)

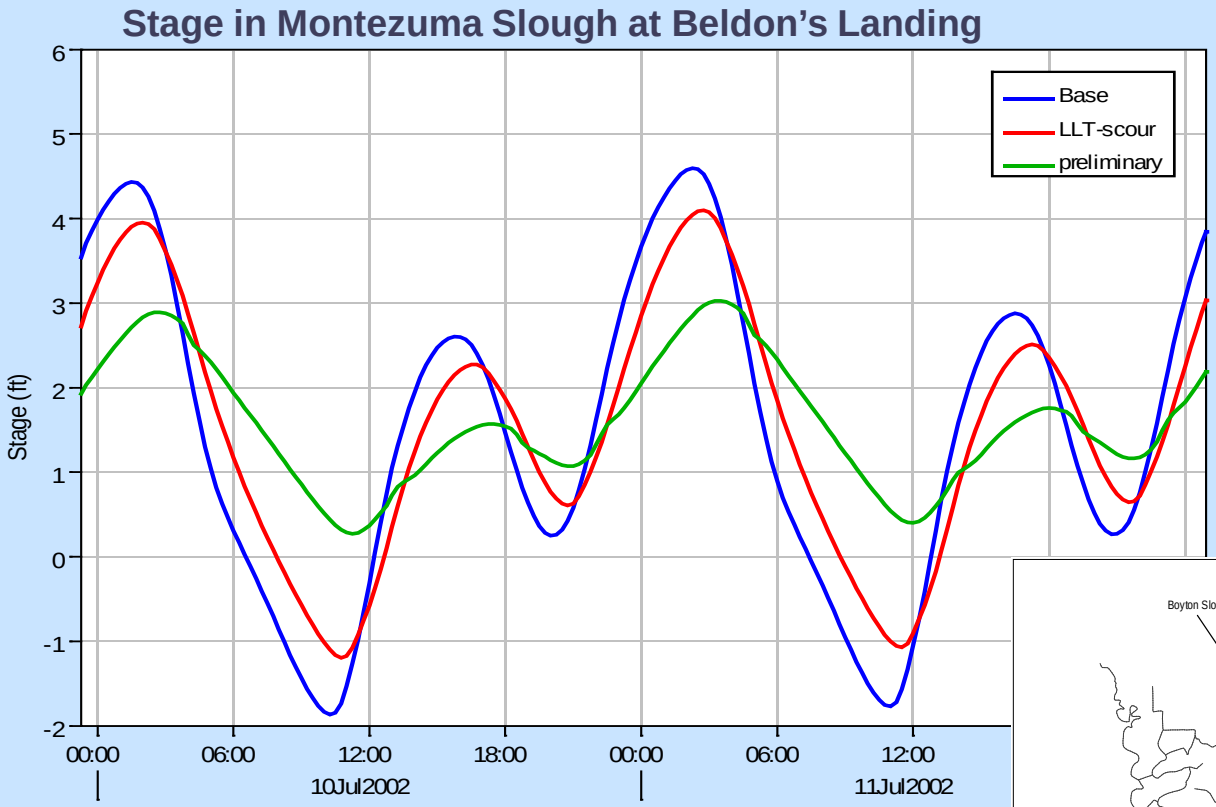
Sources of Science

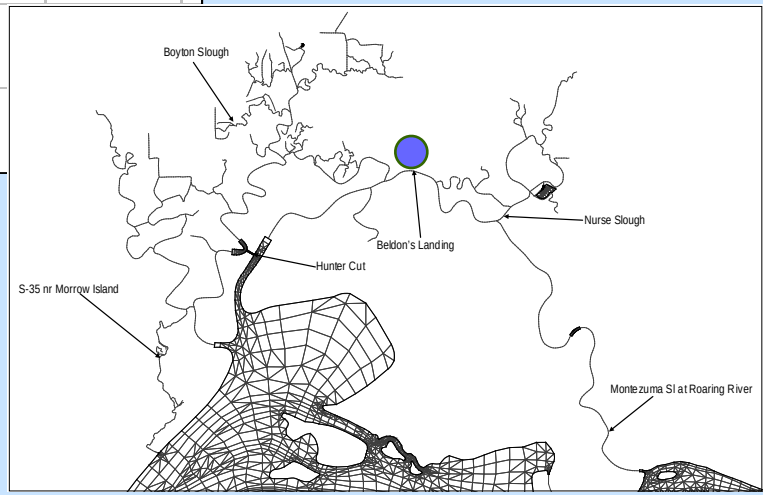
- TAC: 5 projects
- Independent science review: 4
- DRERIP-style eval.: 1
- University scientists on consultant team: 3
- Consider climate change and sustainability: all, 6 detailed
- Use conceptual models: 8
- Use historical ecology: all

Bay Delta Conservation Plan (BDCP)

- DISB questions:
  - How is modeling incorporated into habitat restoration efforts?
  - How are habitat restoration efforts likely to be affected by climate change?
- ESA PWA role
  - Tidal wetlands, seasonally-inundated floodplain, channel margin habitat
  - Refine restoration approach + Engineer's cost estimates
  - Tidal habitat evolution
  - South Delta

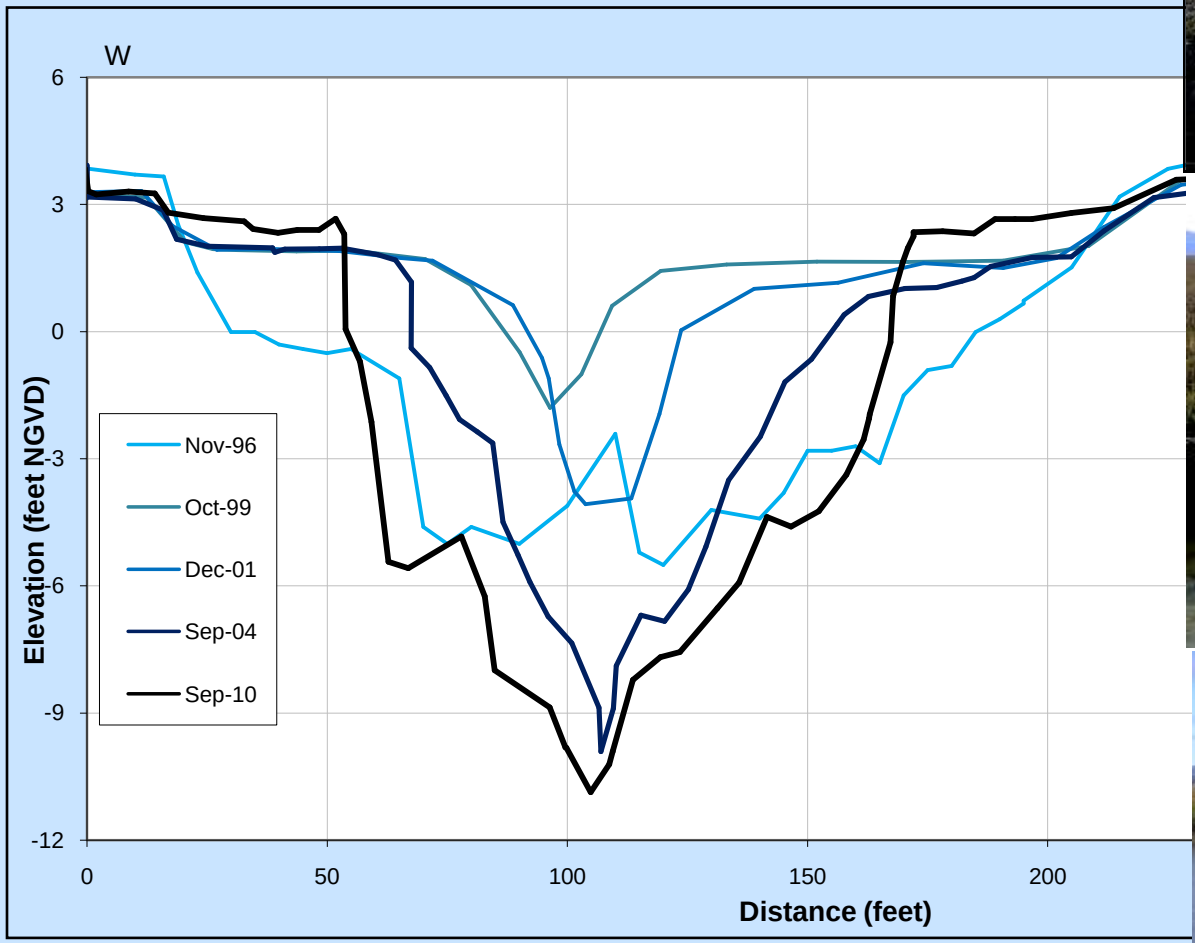
Effect of Restoration on Suisun Tides



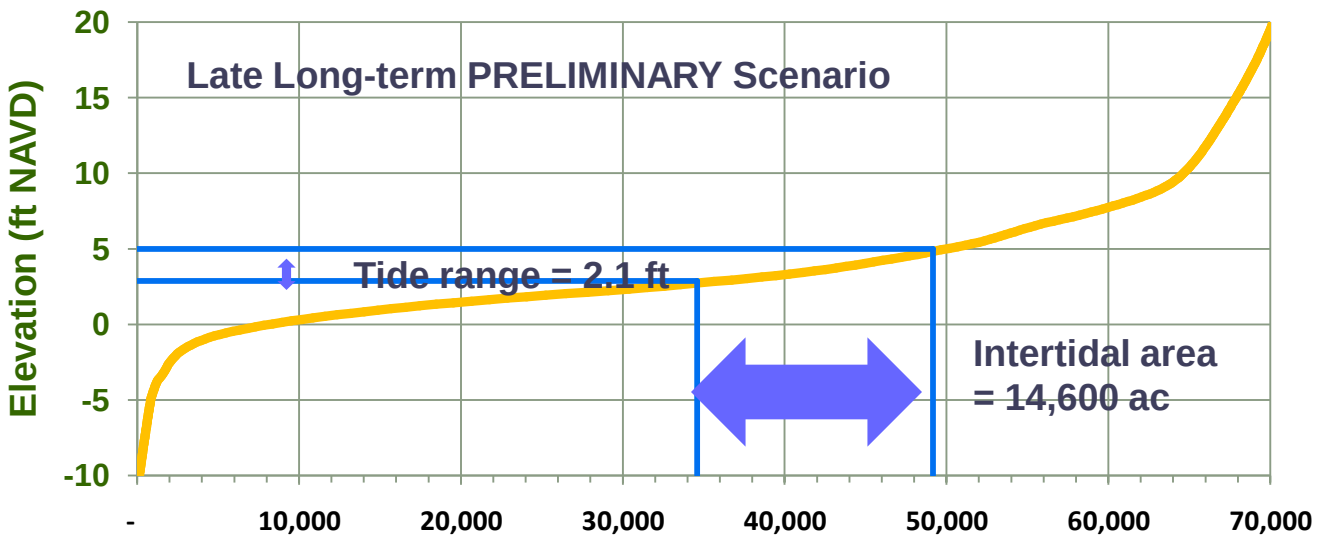


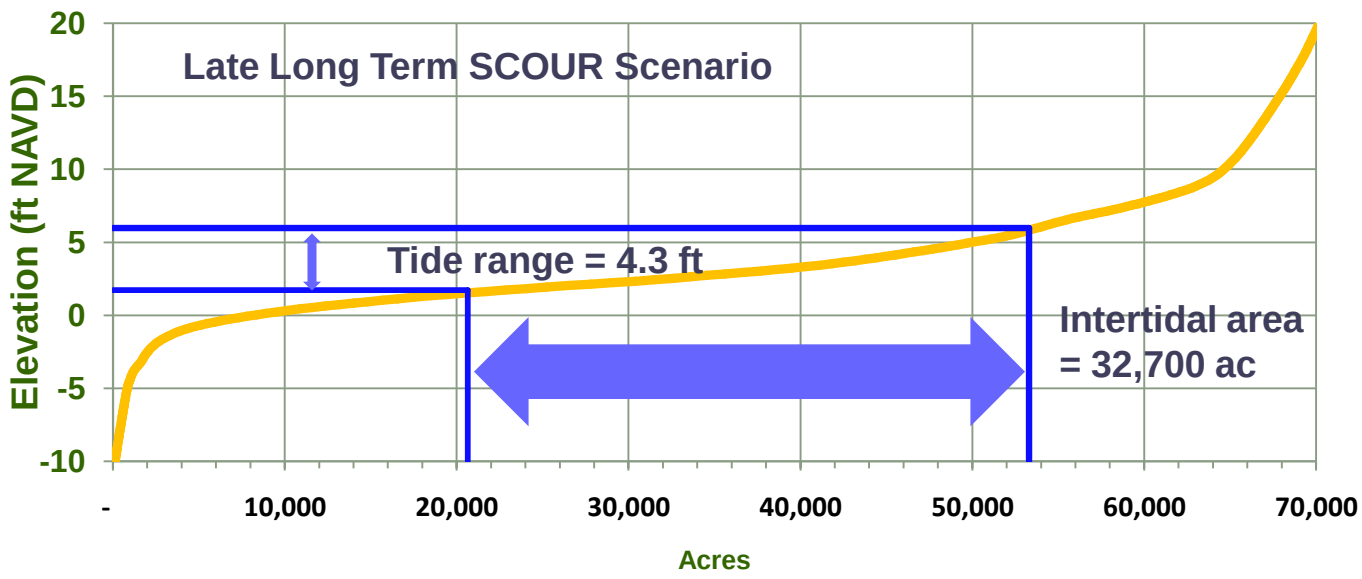
Sources: RMA hydrodynamic modeling and ESA PWA channel scour geometry.

Channel Scour
Sonoma Baylands Main Unit



Suisun Marsh Restoration Scenarios





Outcome sensitive to:

- Restoration locations
- Geomorphic changes
- Engineering /assumed constraints
  - Remove constrictions
  - Dredge
  - Railroad

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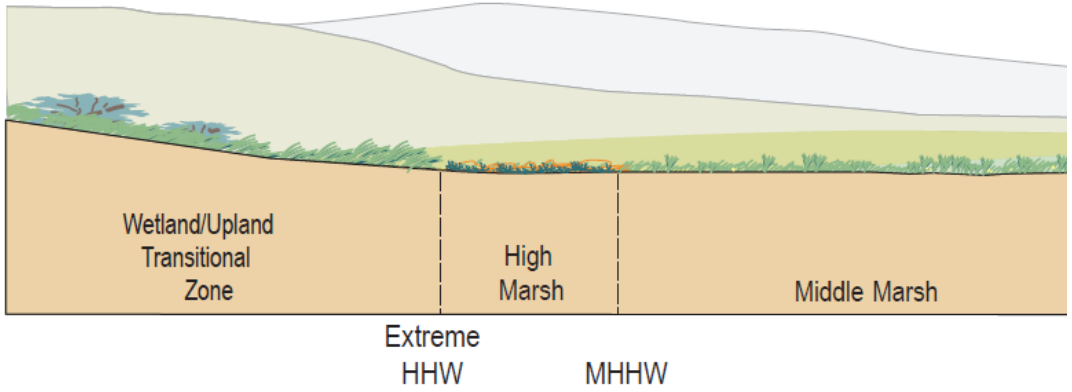
Sea Level Rise

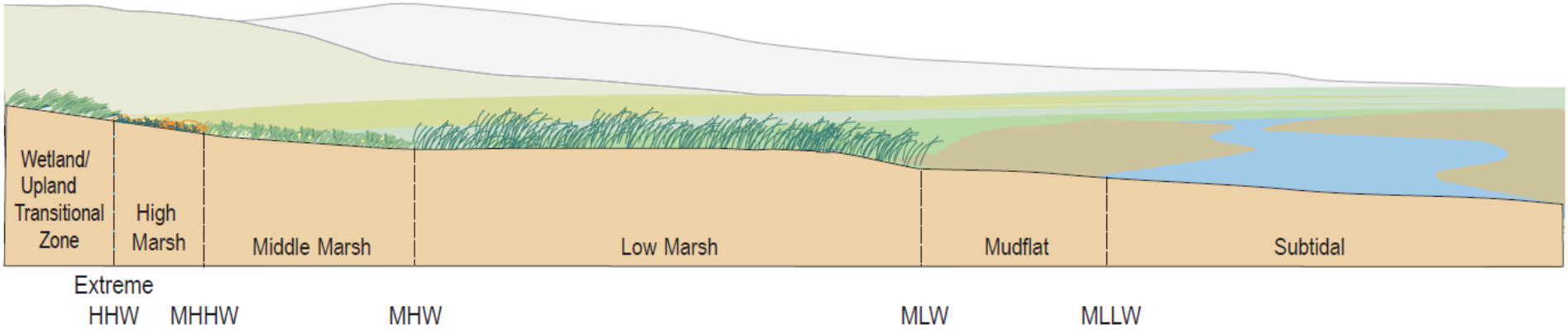
Transgression of Suisun Marsh Tidal Habitats with Sea Level Rise

EXISTING

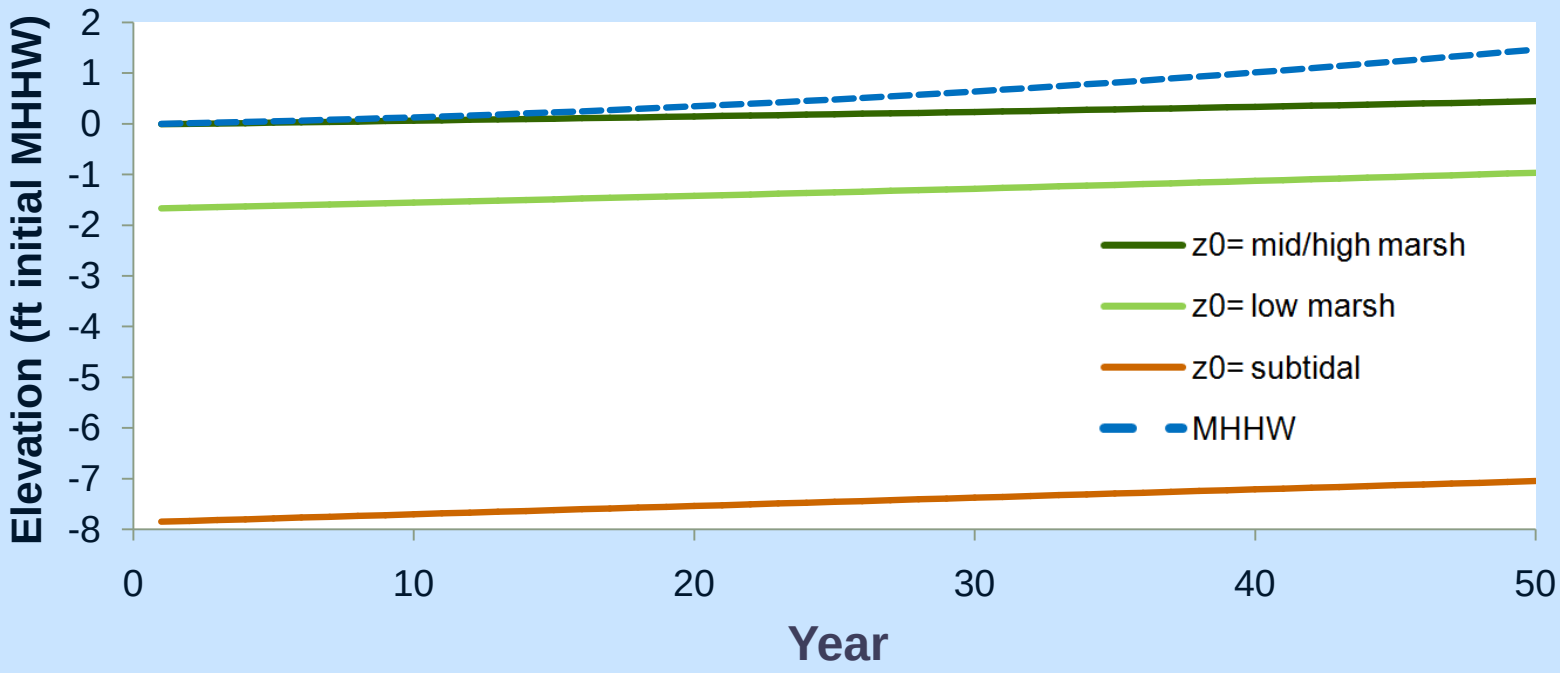


- Modeled water levels (RMA)
- Channel scour
- Existing land elevations
- Vegetation establishment rates and thresholds
- Accretion rates (variable by region and initial elevation)
- Scenarios of sea level rise

FUTURE WITH SEA LEVEL RISE

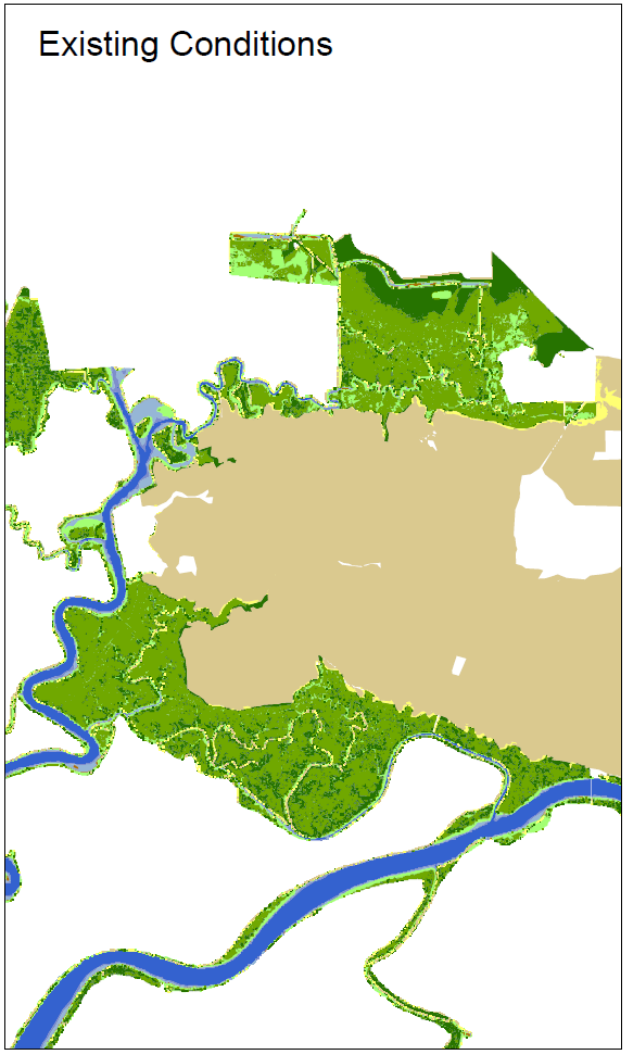


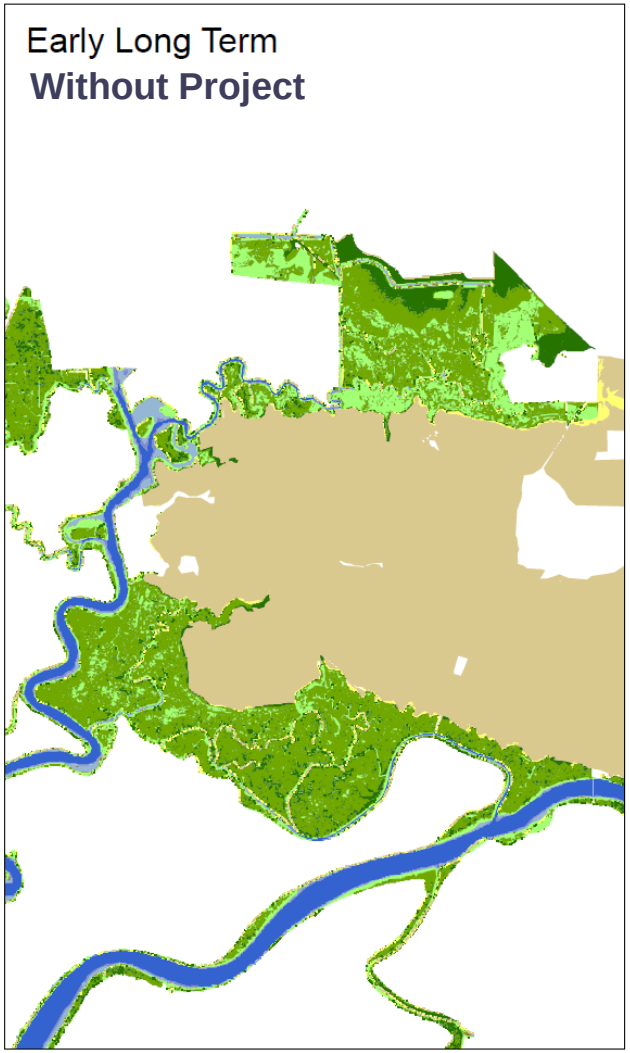
Sedimentation Curves for Suisun Marsh



Notes: MARSH98 Sedimentation Analysis
BDCP SLR Scenario = 15 cm in 25 years; 40 cm in 50 years
Suspended sediment concentration =50 mg/L.
Organic accretion rate=2.0 mm/yr for marsh.

Suisun Habitat Evolution Model Results





Source: From ESA PWA habitat evolution modeling

N

0 3,100 6,200 12,400 Feet

Upland
SLR Transition
High Tidal Brackish Marsh
Mid Tidal Brackish Marsh
Low Tidal Brackish Marsh
Intertidal Mudflat
Subtidal 1
Subtidal 2
Subtidal 3

Figure 16

BDCP

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What do we need to have an effective restoration program?

- Regional restoration blueprints
  - Where, when, and why
  - Think long-term, ensure future opportunities not precluded
  - Historic ecology perspective
  - Practical implementation perspective
  - Consider landscape-scale processes
  - Experimental design: what is important to test where?

What do we need to have an effective restoration program? (continued)

- Develop and use landscape-scale models
  - conceptual and numerical
  - considering future climate change
  - Model library
- Combine goals/objectives of multiple programs
  - Including flood management (CVFPP)
- Science collaboration and coordination
- Funding for monitoring + AM

Acknowledgements

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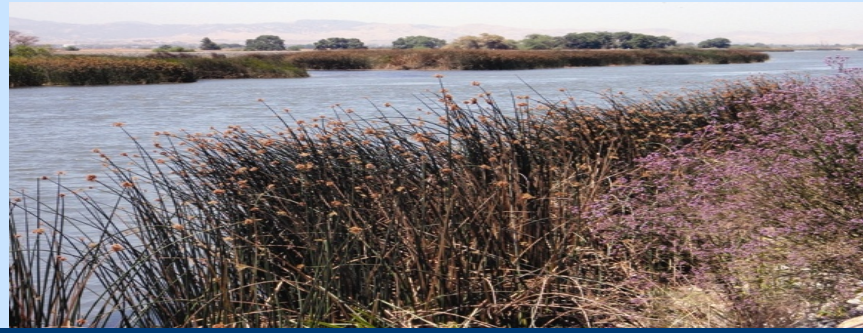
  ICF: Rebecca Sloan, Ellen Berryman, Chip McCannaha, PhD

  RMA Associates: John DeGeorge, Ph.D., Richard Rachiele, Stacie Grinbergs
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