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science for a changing world

Implications of (1) the historic delta, (2) existing habitat, and (3) restoration on hydrodynamics and transport in the delta

- A Virtual Tour -

J.R. Burau, USGS

4/16/2014

SWRCB Interior flows workshop

U.S. Department of the Interior
U.S. Geological Survey

Acknowledgements

Dave Osti (34north) – Animations

Steve Wessels (USGS) - Videography

Outline

Three related short stories

1 Transport characteristics in the historical delta as a guide to marsh restoration

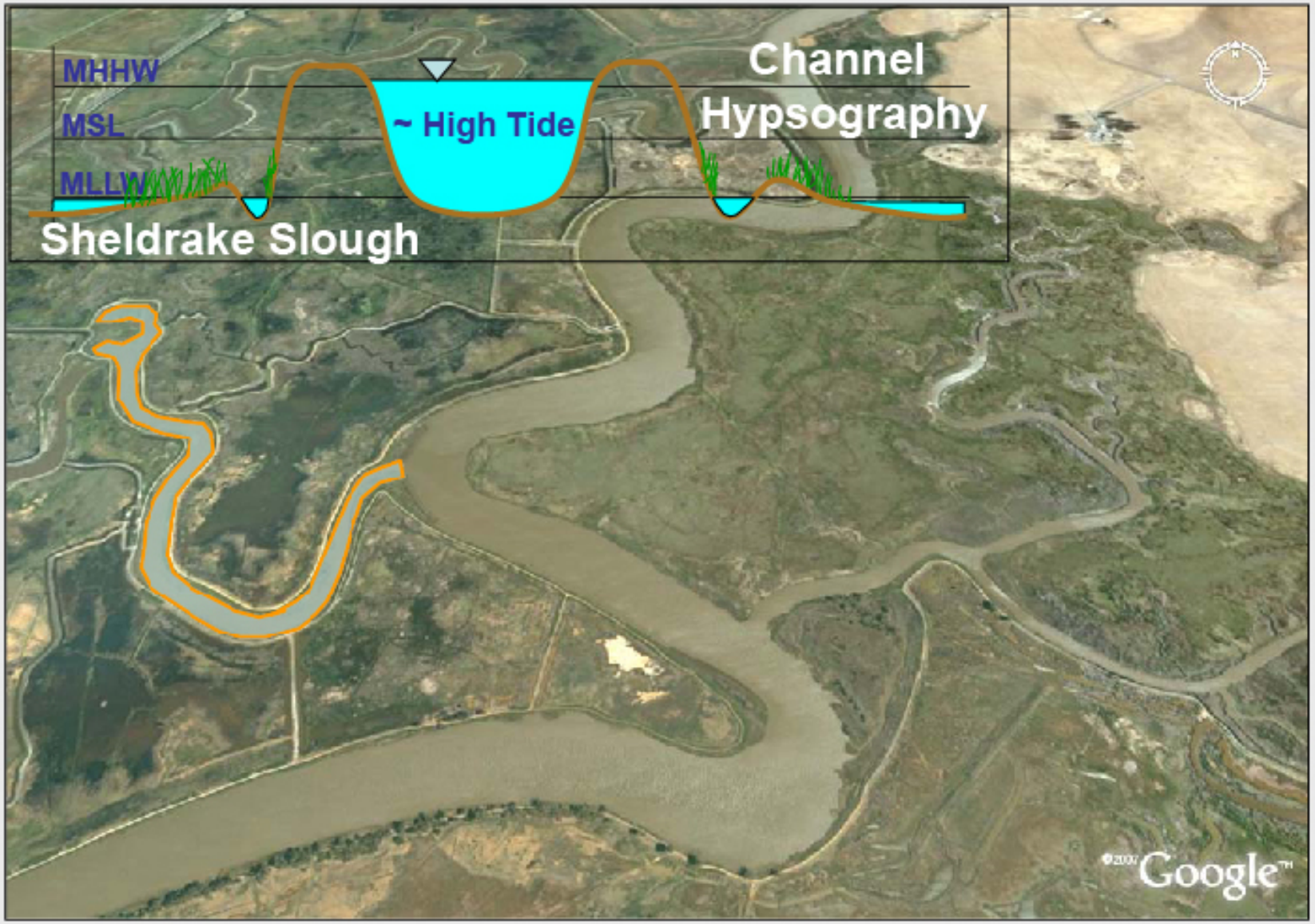
2 The modern delta as a network of canals: the need for setback levees to increase juvenile salmon survival

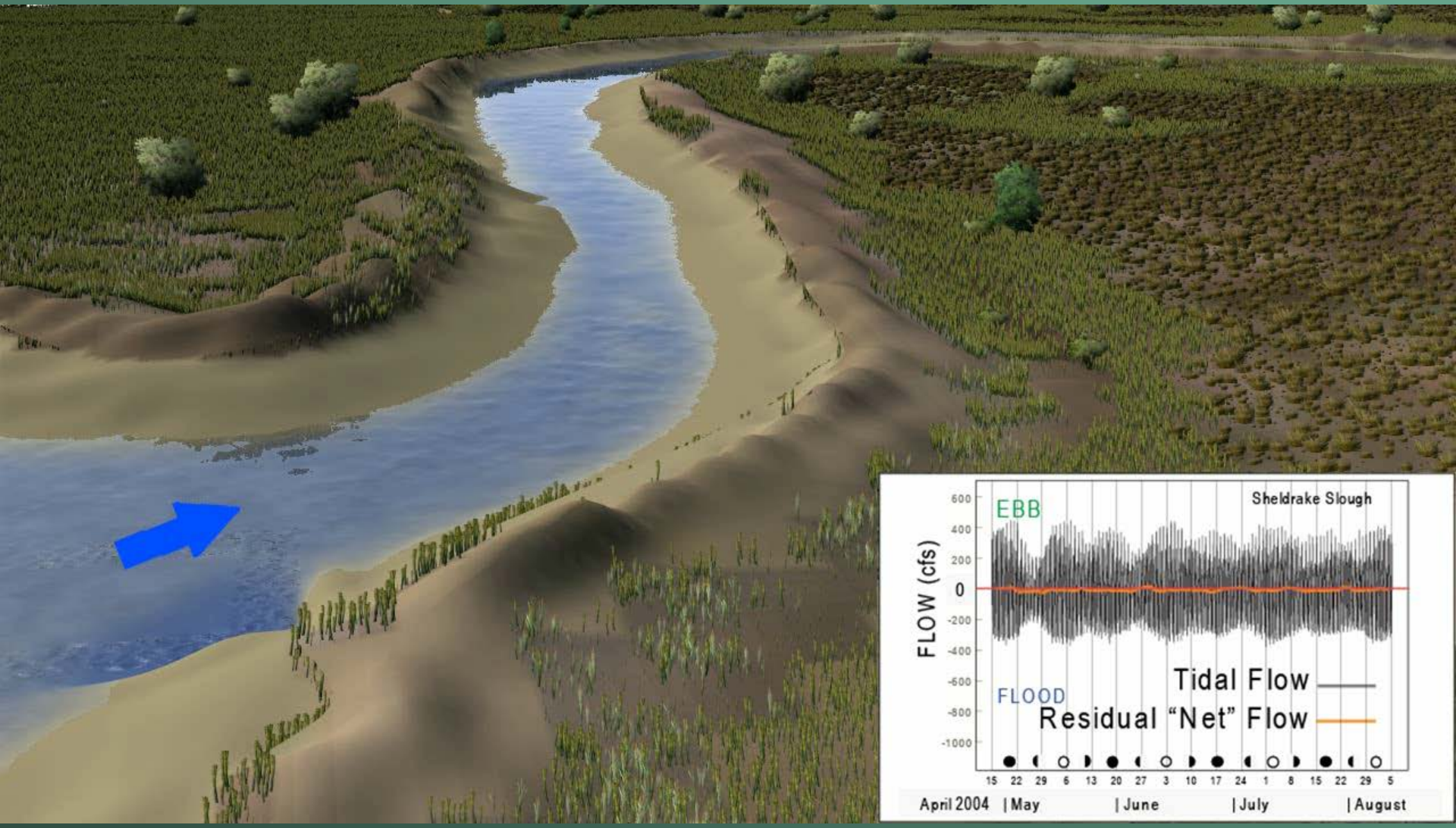
(3) Implications of restoration on hydrodynamic and transport processes in the delta

1 Transport characteristics in the historical delta as a guide to marsh restoration

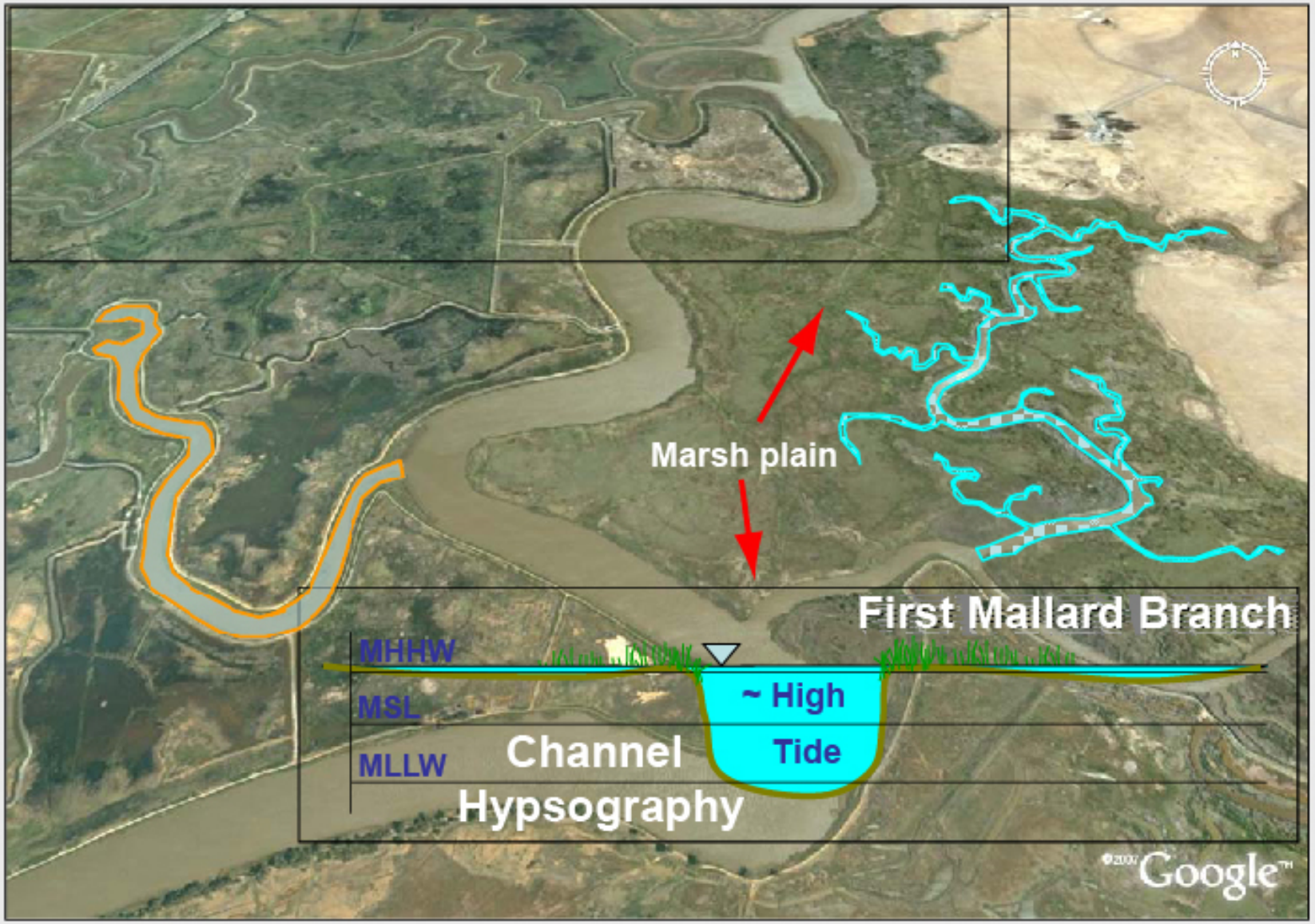
Ref: Enright, Culbertson, Burau, 2013, Broad Timescale Forcing and Geomorphic Mediation of Tidal Marsh Flow and Temperature Dynamics, Estuaries and Coasts

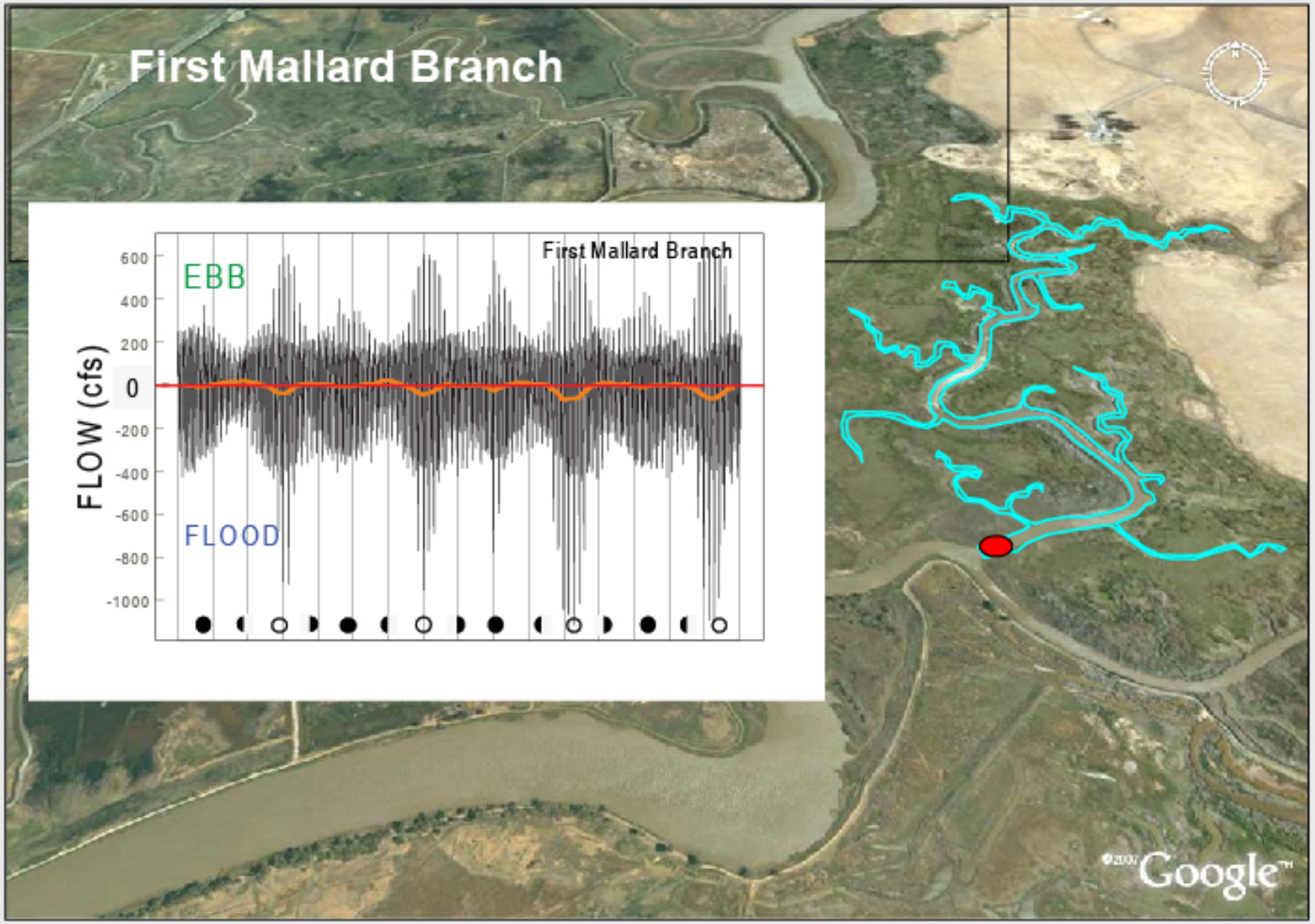
Different Geomorphology and Land-Water Interface




Sheldrake Slough
EBB
FLOOD
FLOW (cfs)
600
400
200
0
-200
-400
-600
-800
-1000
Tidal Flow
Residual "Net" Flow
15 22 29 6 13 20 27 3 10 17 24 1 8 15 22 29 5
April 2004
May
June
July
August

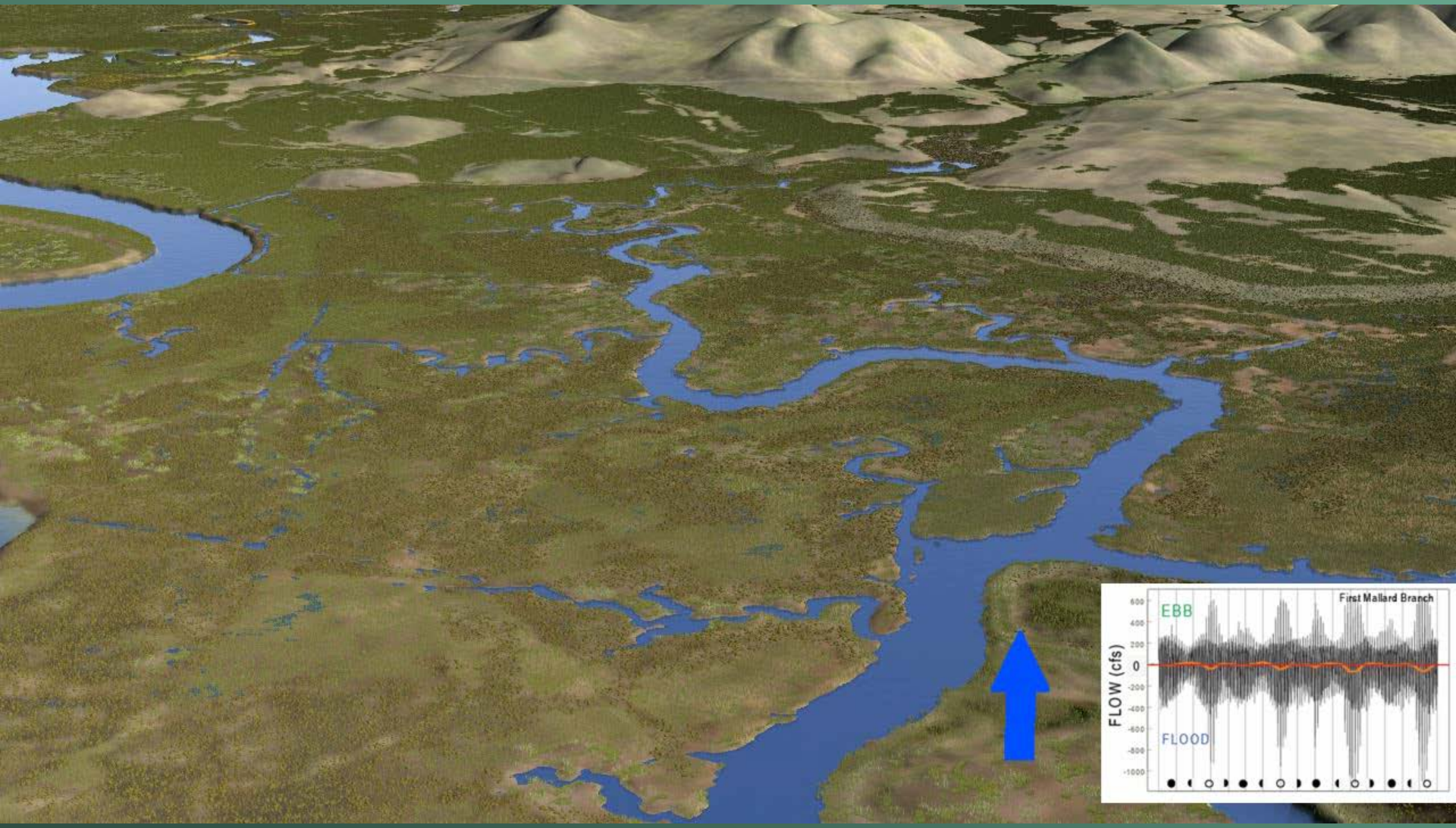
Different Geomorphology and Land-Water Interface




First Mallard Branch
First Mallard Branch
EBB
FLOOD
FLOW (cfs)
600
400
200
0
-200
-400
-600
-800
-1000
©2008 Google™

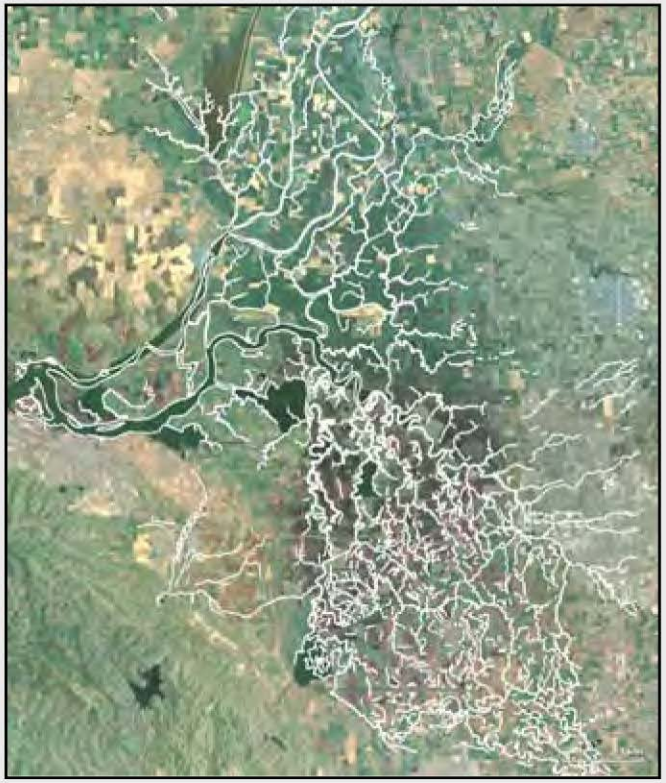
Clip 1: 1st Mallard Branch/Suisun Marsh

Courtesy of Steve Wessels, USGS


First Mallard Branch
EBB
FLOOD
FLOW (cfs)
600
400
200
0
-200
-400
-600
-800
-1000

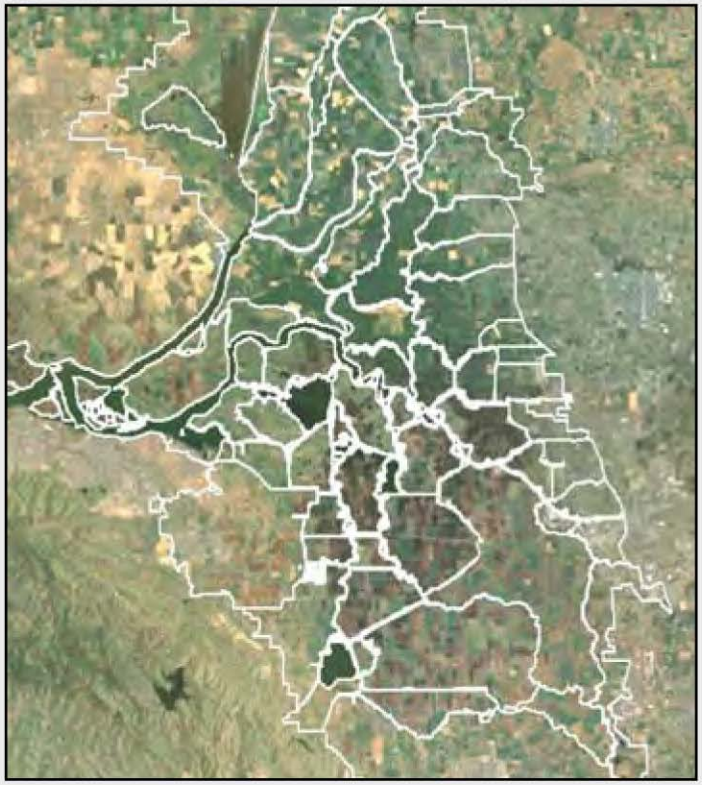
Massive Spring neap variability in transport and constituents in historical Delta

Delta Geometry Changed



Historical Delta

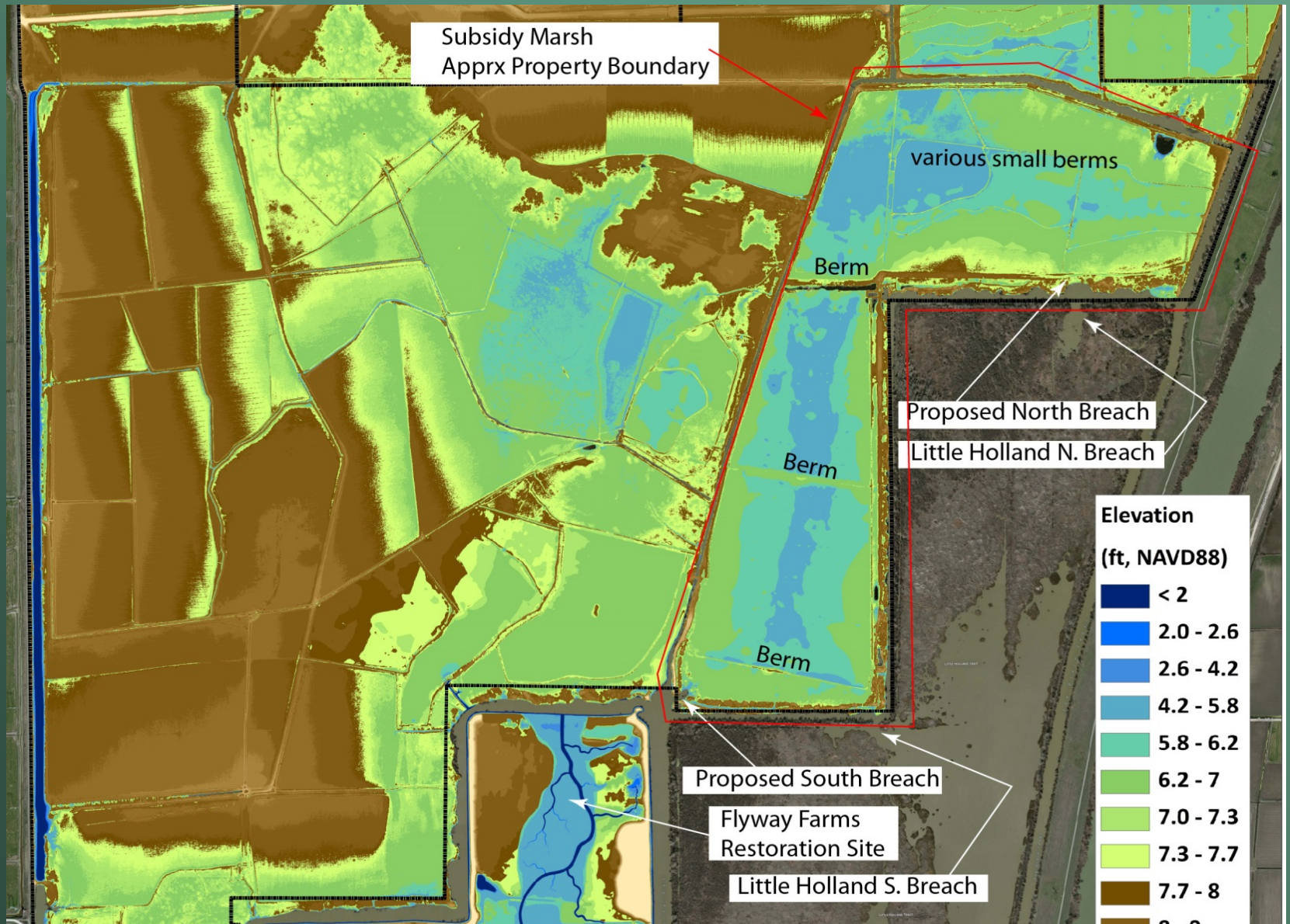
Complex dendritic structure



Modern Delta

Network of conveyance canals

Lower Yolo Marsh restoration



Conclusion

- Modern Delta is massively different from a transport-terrestrial-aquatic coupling perspective.

GEOMETRY MATTERS BIG TIME!

Ecosystem function is not all about inflows/exports and internal flow distributions

- The Board and BDCP should initially promote restoration of a variety of habitats that function differently from a transport perspective to see what works.

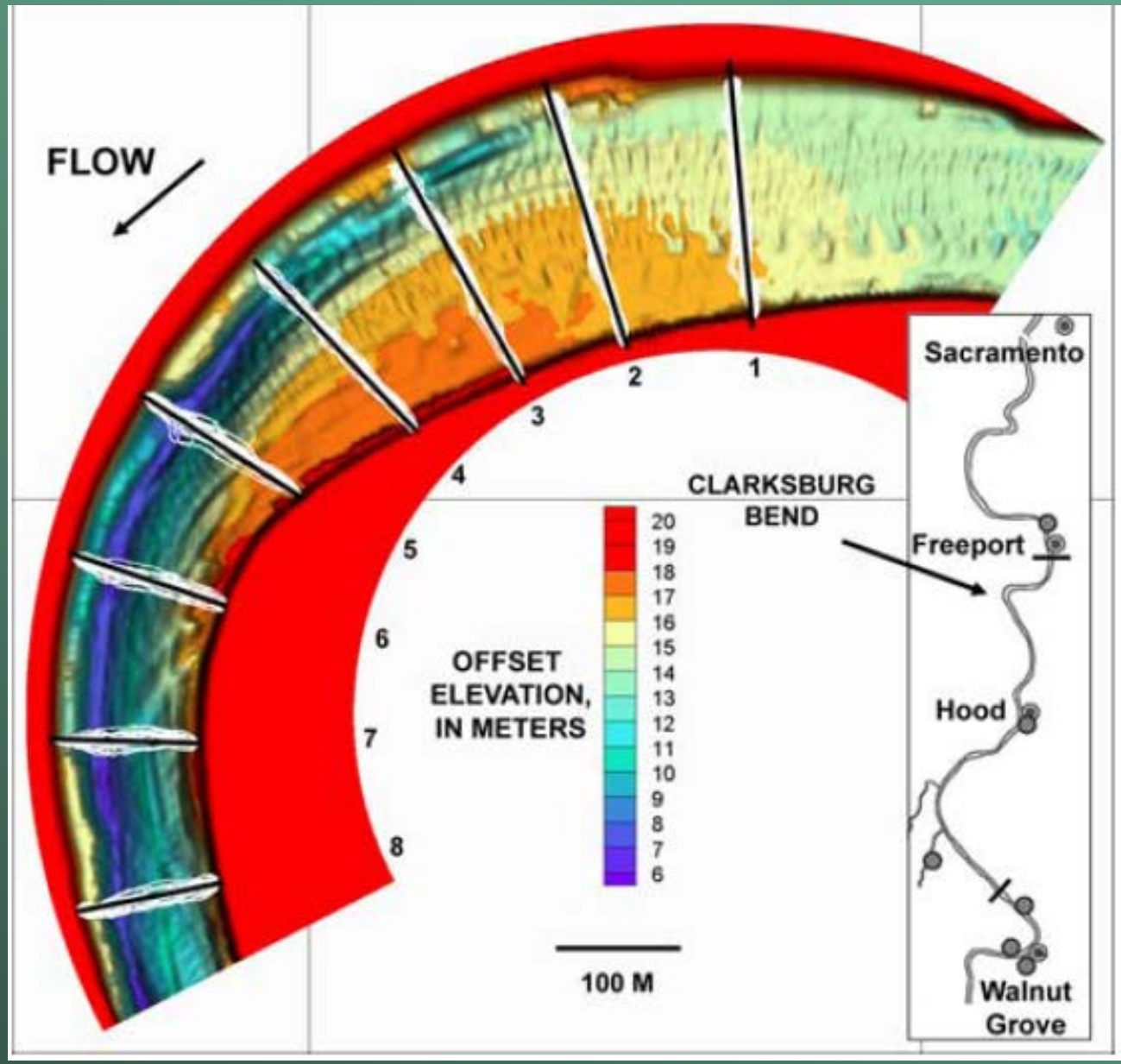
2 The modern delta as a network of canals: the need for setback levees to increase juvenile salmonid survival

Why Study Salmon movements in Clarksburg Bend?

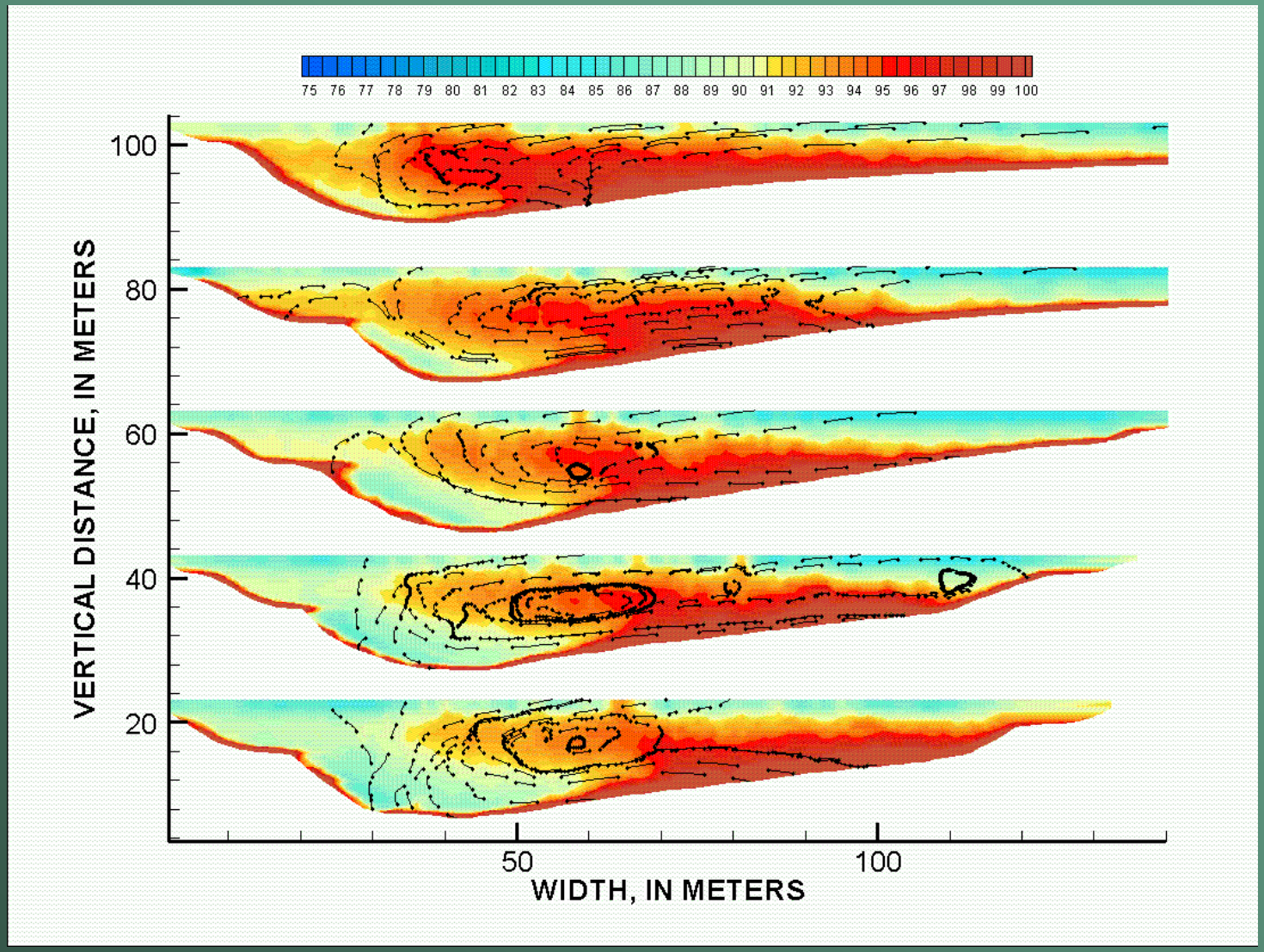
(1) Very tight radius (secondary currents scale with the radius)

(2) Contraction of cross sectional area

(3) No junction to confuse the results



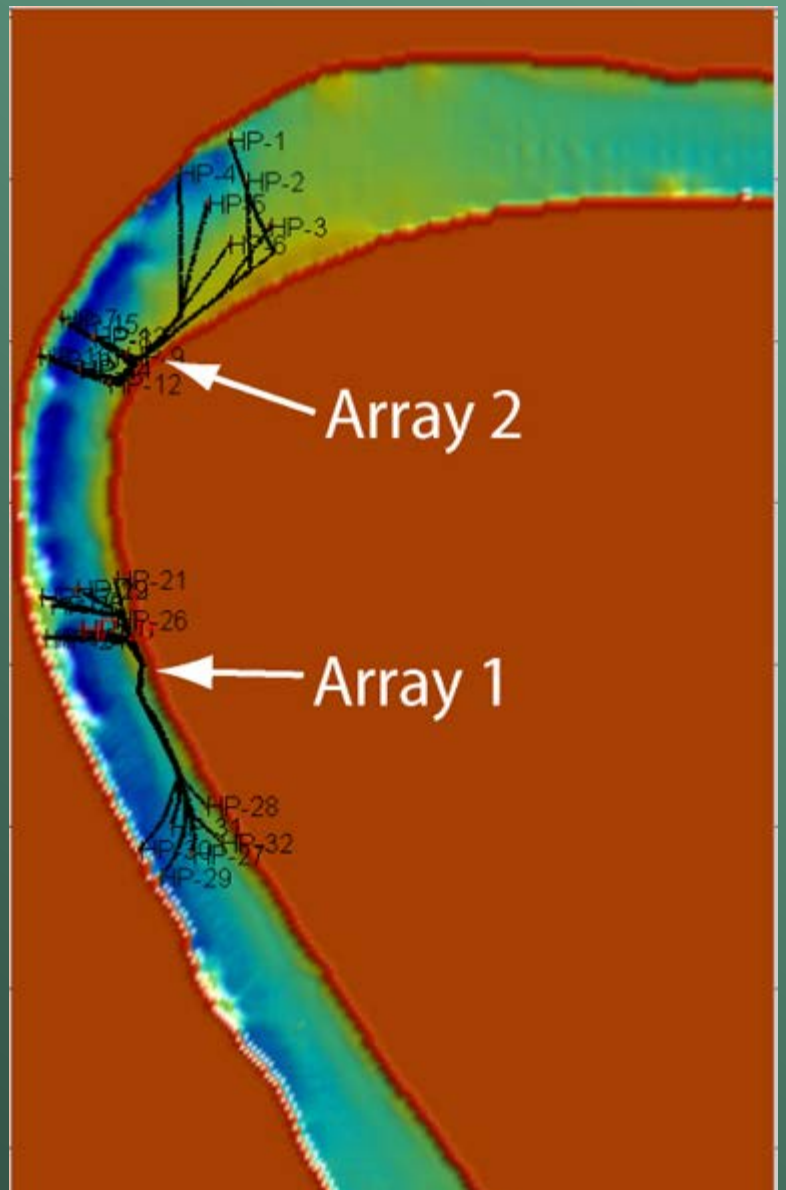
Measurements of Secondary currents in Clarksburg Bend



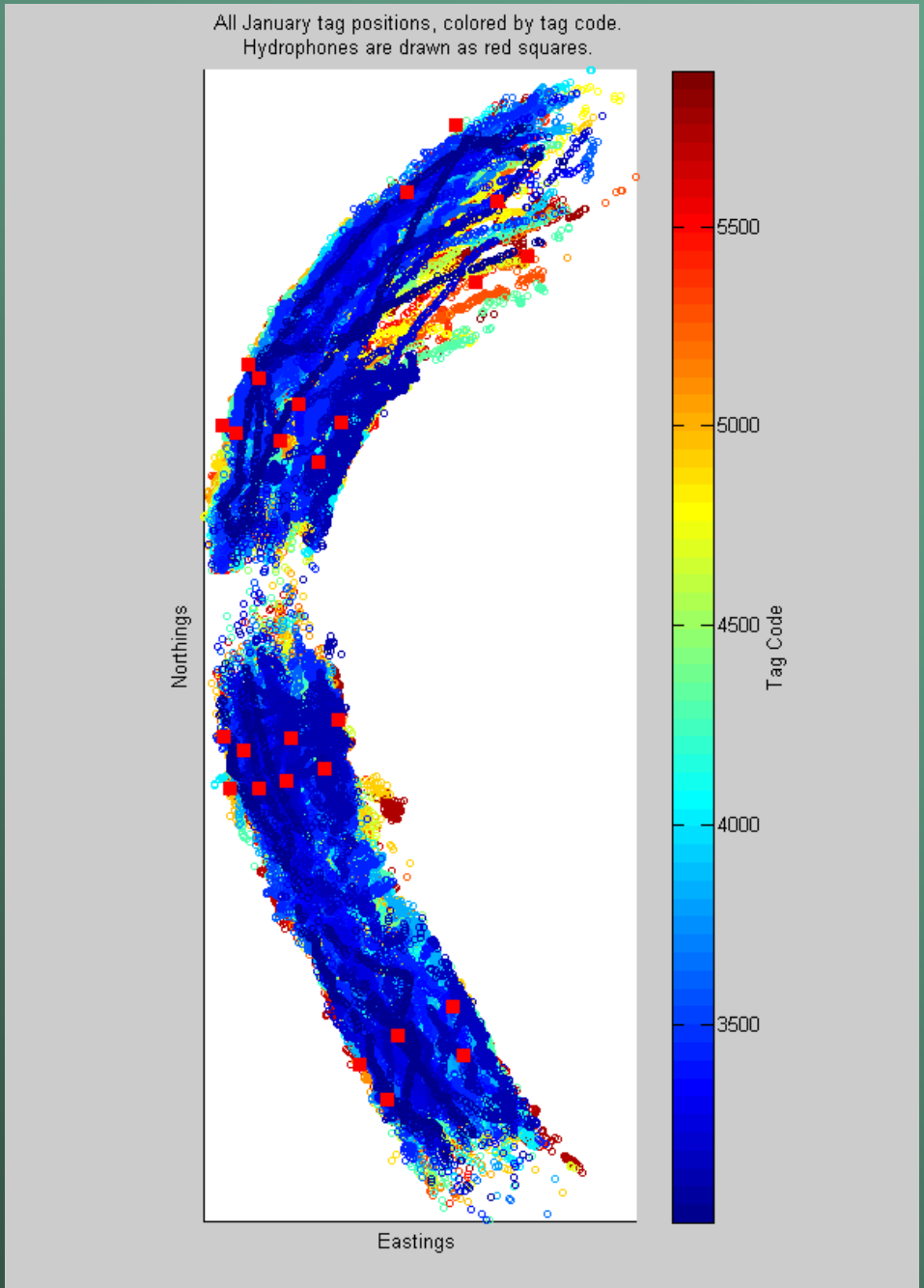
Dinehart, R. and J. Burau, 2005, Averaged indicators of secondary flow in repeated acoustic Doppler current profiler crossings, Water Resources Research

2006 Pilot Experiment

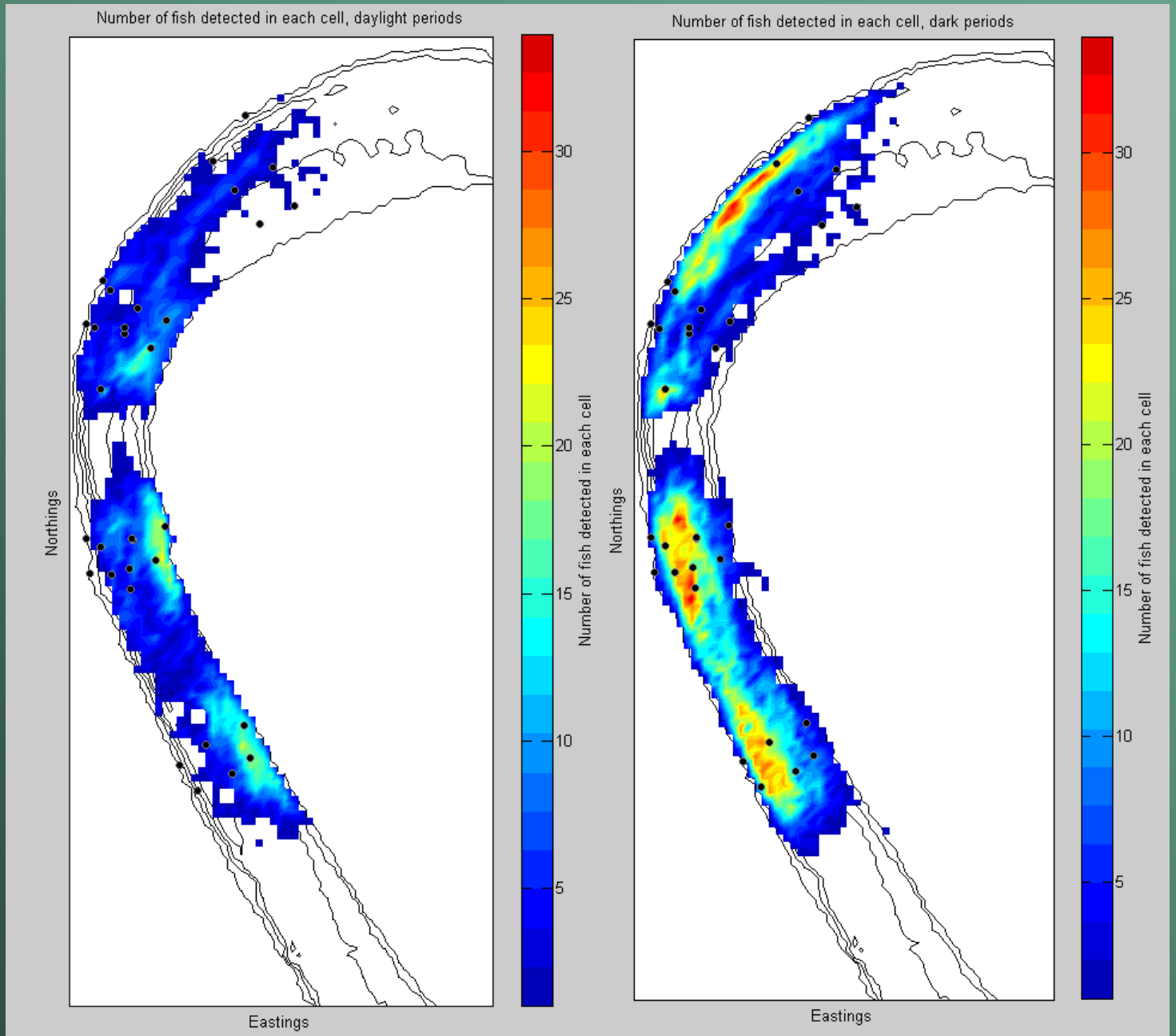
Fish Tracking and Hydrodynamics in Clarksburg Bend



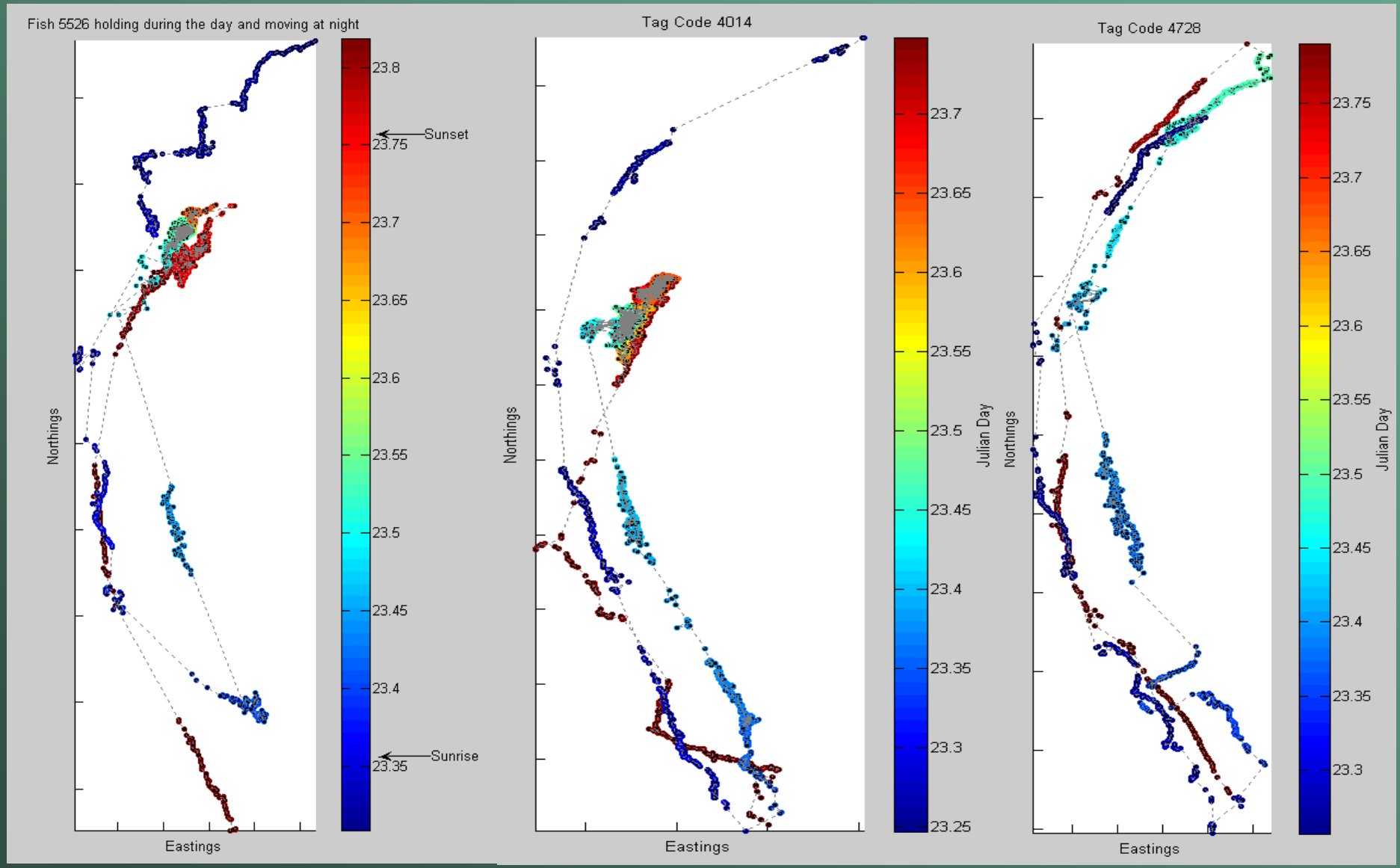
January Fish Tracks in Clarksburg Bend



Day and Night Fish Distributions in January



Example of Fish Holding During the Day



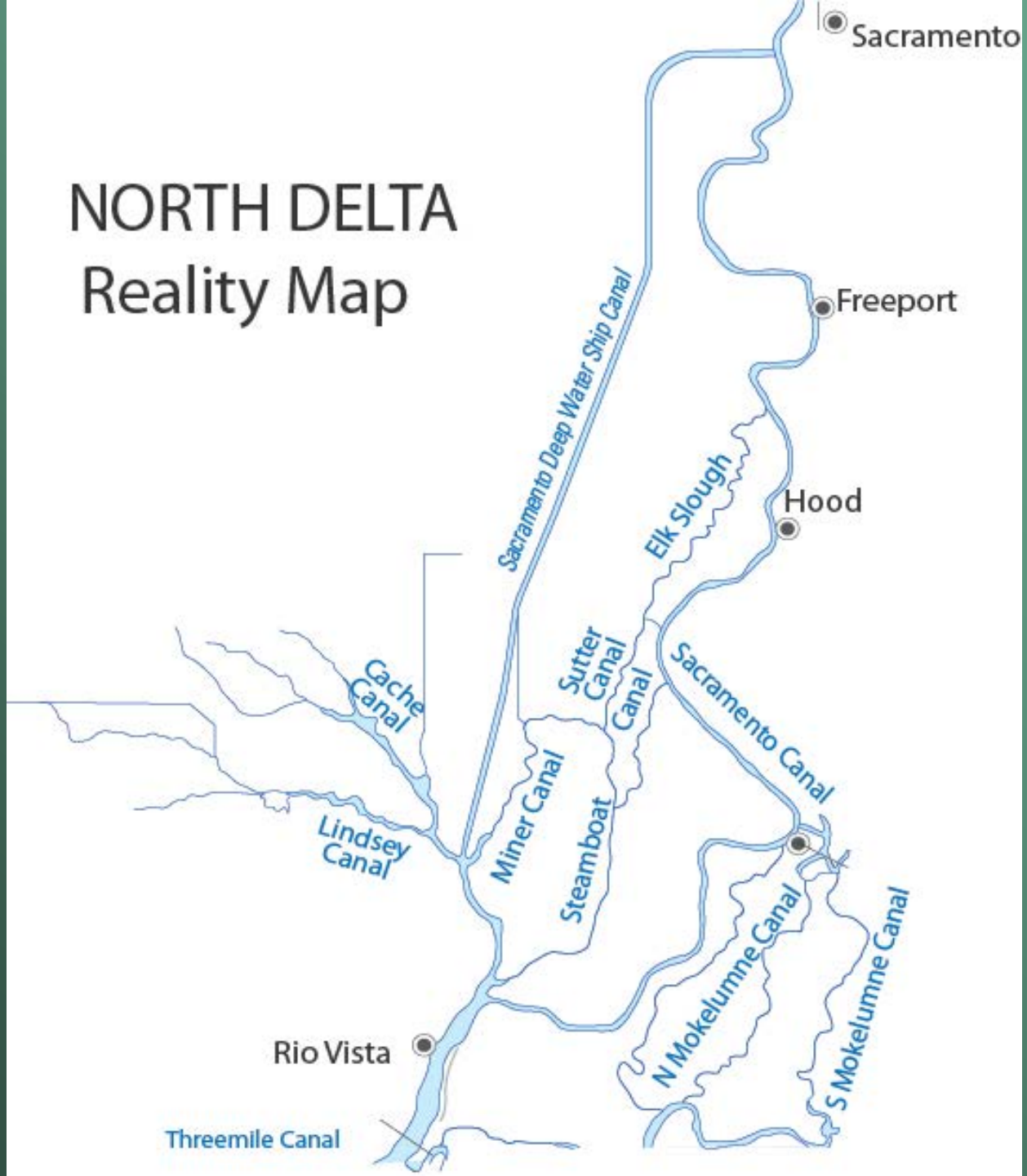

Small
Eddy
Daytime habitat utilization
Houseboat
Google earth
1993
Imagery Date: 8/13/2013 38° 25.823' N 121° 31.850' W elev 20 ft eye alt 2781 ft

Clip 2: Sacramento “River” upstream of Walnut Grove

Courtesy of Steve Wessels, USGS

Clip 3: Clips of rip-rap (rock) at low water

Courtesy of Steve Wessels, USGS


NORTH DELTA
Reality Map
Sacramento
Freeport
Hood
Rio Vista
Sacramento Deep Water Ship Canal
Elk Slough
Sutter Canal
Cache Canal
Sacramento Canal
Miner Canal
Steamboat Canal
Lindsey Canal
N Mokelumne Canal
S Mokelumne Canal
Threemile Canal

Best example of setback levees - bottom of Miner Slough

Clip 4: Lower Miner Slough from the Levee

Courtesy of Steve Wessels, USGS

Conclusions (1)

A virtual complete lack of habitat is the greatest “related stressor” we have in the delta

The creation of geomorphic variability and habitat is needed now because these things are virtually absent in the delta.

Acoustic telemetry studies aimed at habitat utilization are needed (like Clarksburg bend)

Miner Slough setback levee a good place to start.

Conclusions (2)

For salmon: we have a predation problem that is really a habitat problem that we are trying to solve with water.

Trying to restore fish species of concern principally with water and its distribution within the delta is likely to fail – especially in a drought

(3) Implications of restoration on hydrodynamic and transport processes in the delta

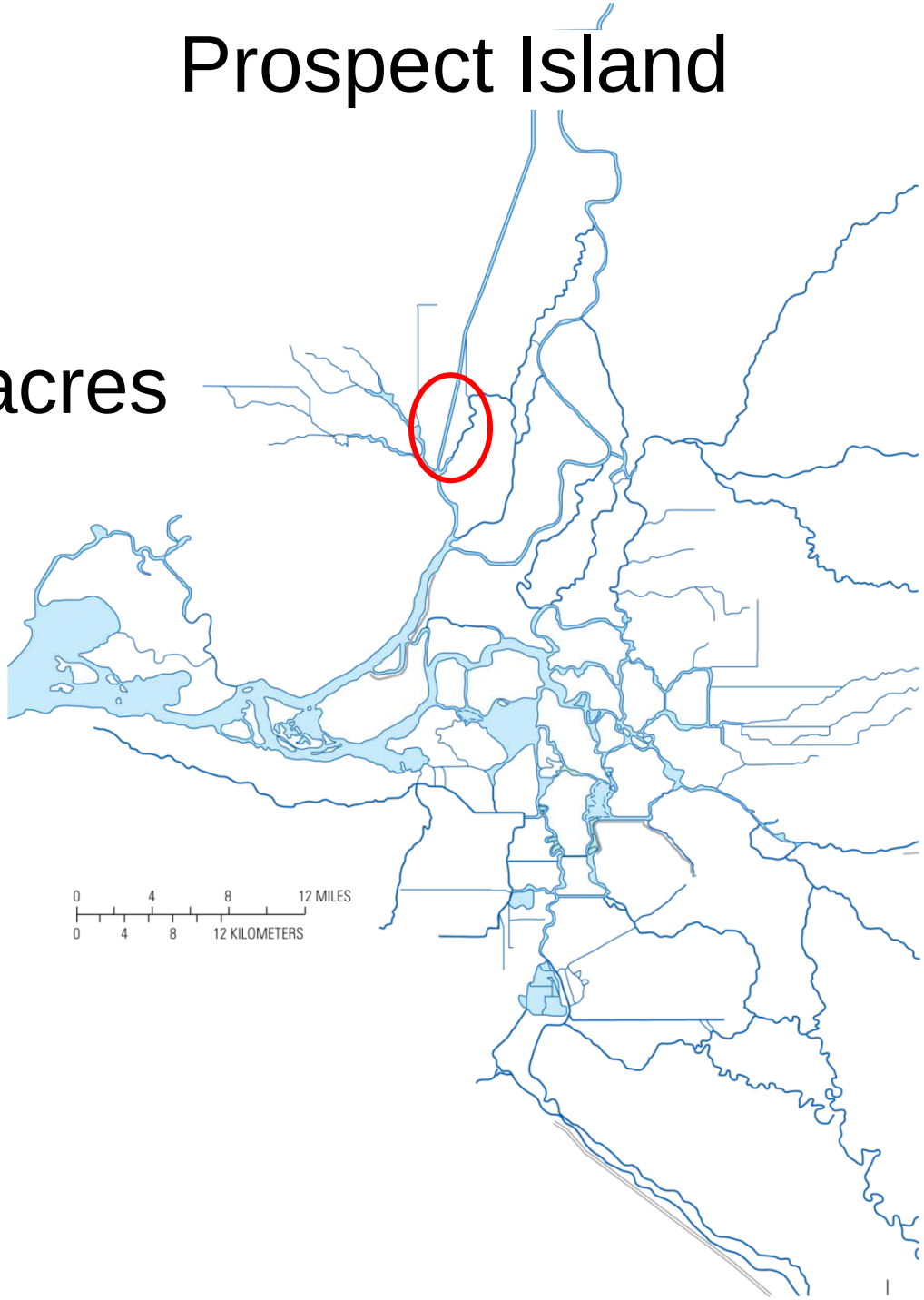
Case Study

Discuss REGIONAL SCALE implications of one restoration effort:

Prospect Island

Prospect Island

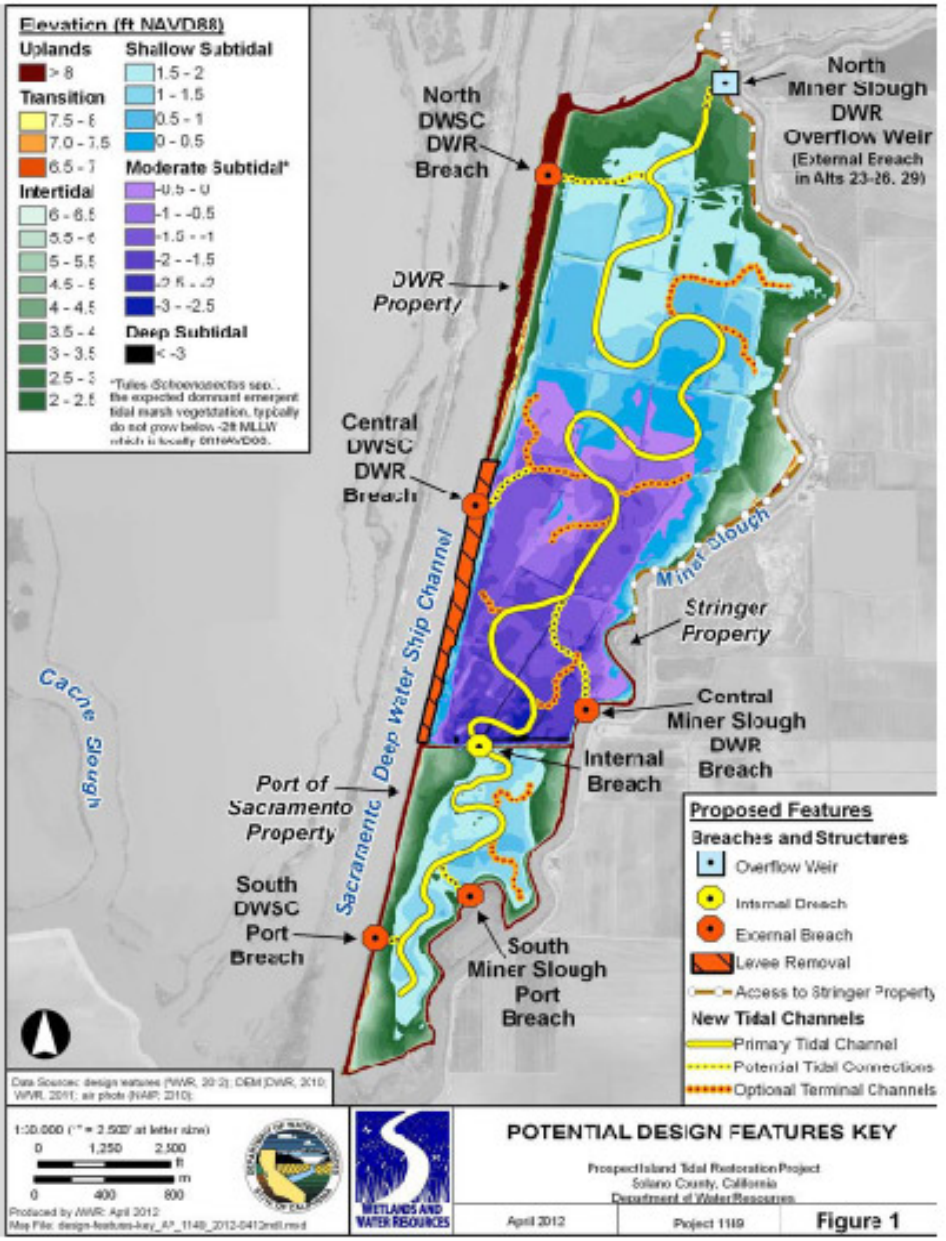
~1,300 acres



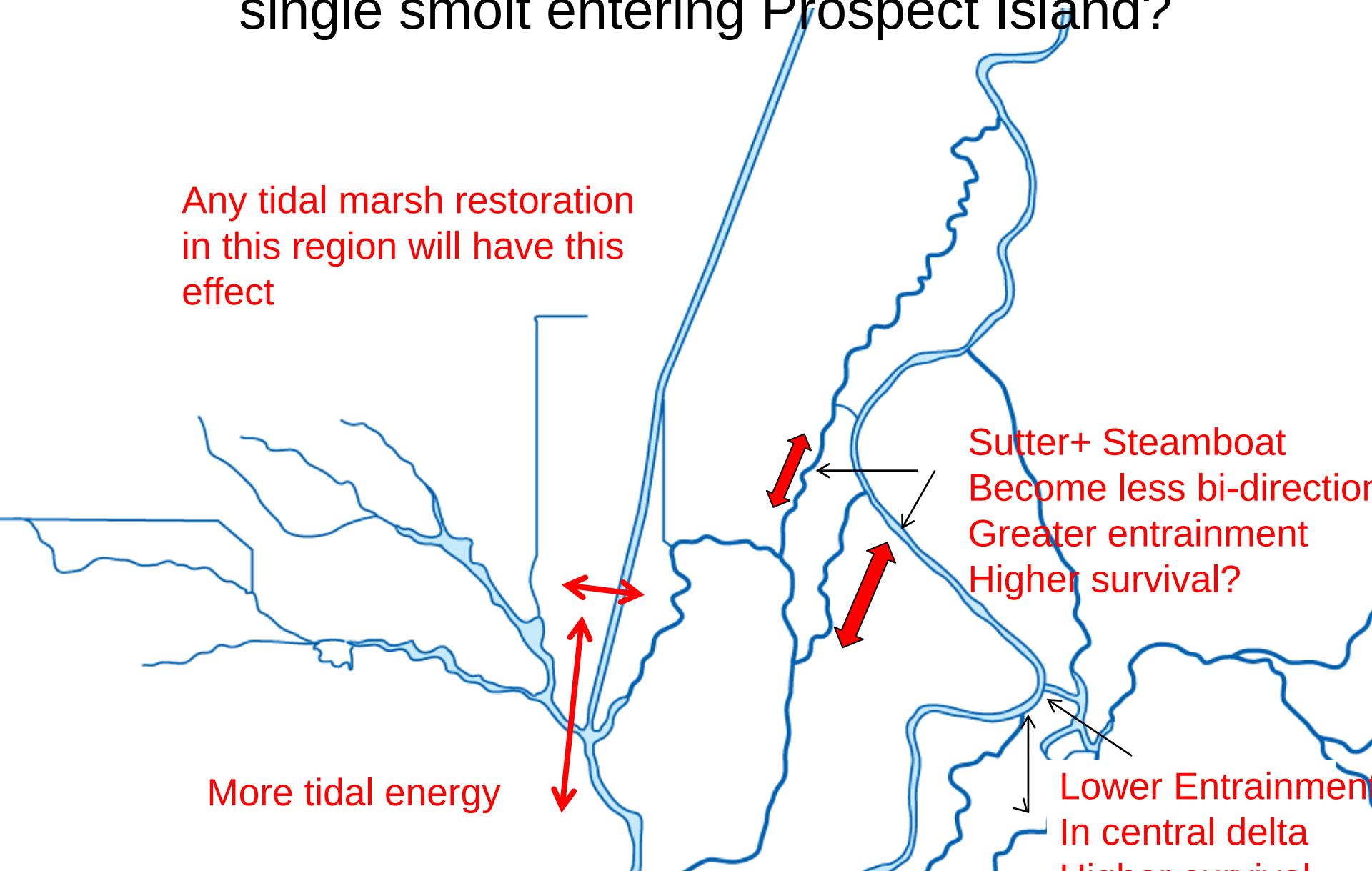
Prospect Island

Design Features Key

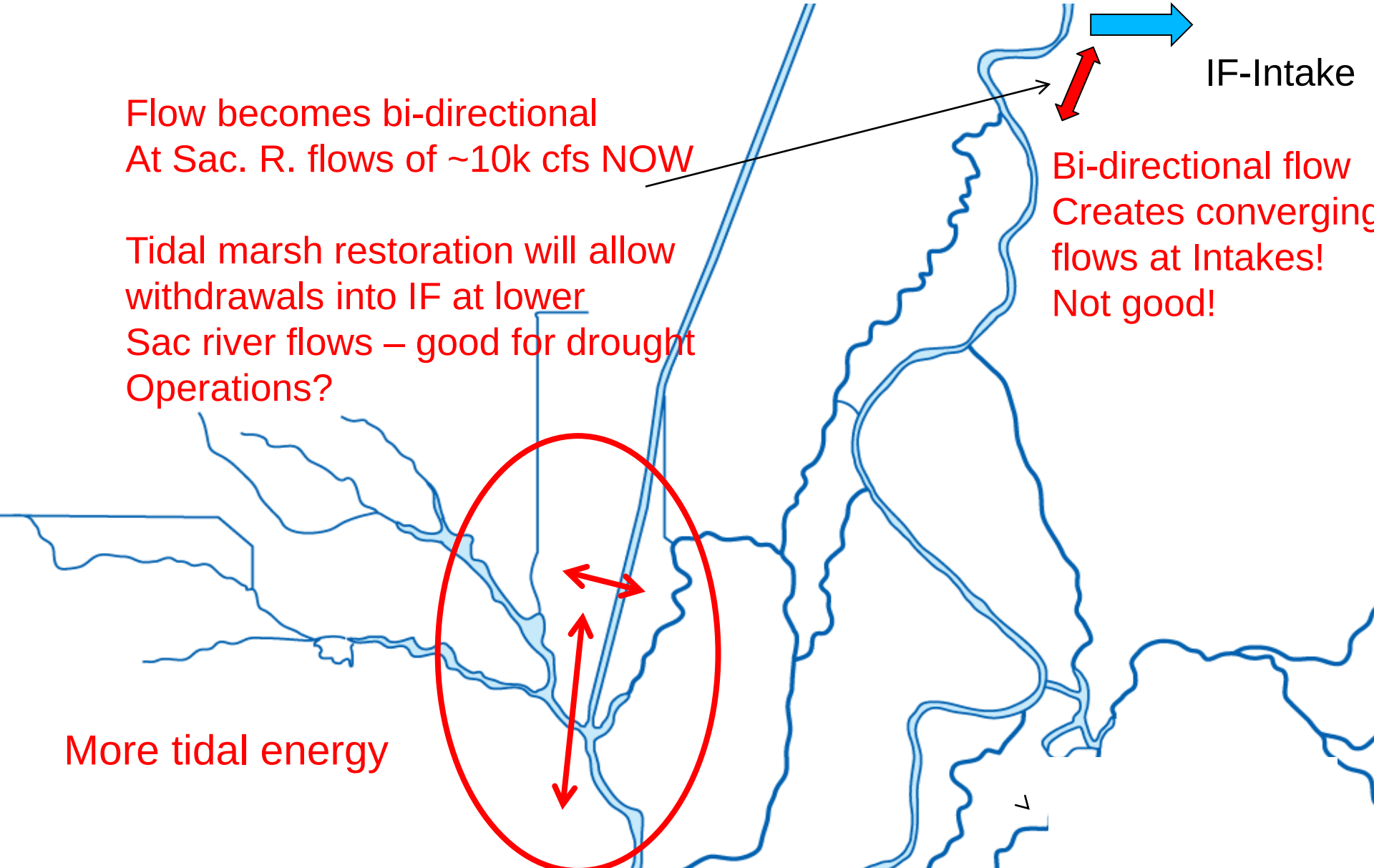
- Breaches
- Overflow weir
- Primary channels
- Secondary branch channels
- Connecting channels depending on selected breaches
- DWR and Port properties
- Adjacent property access



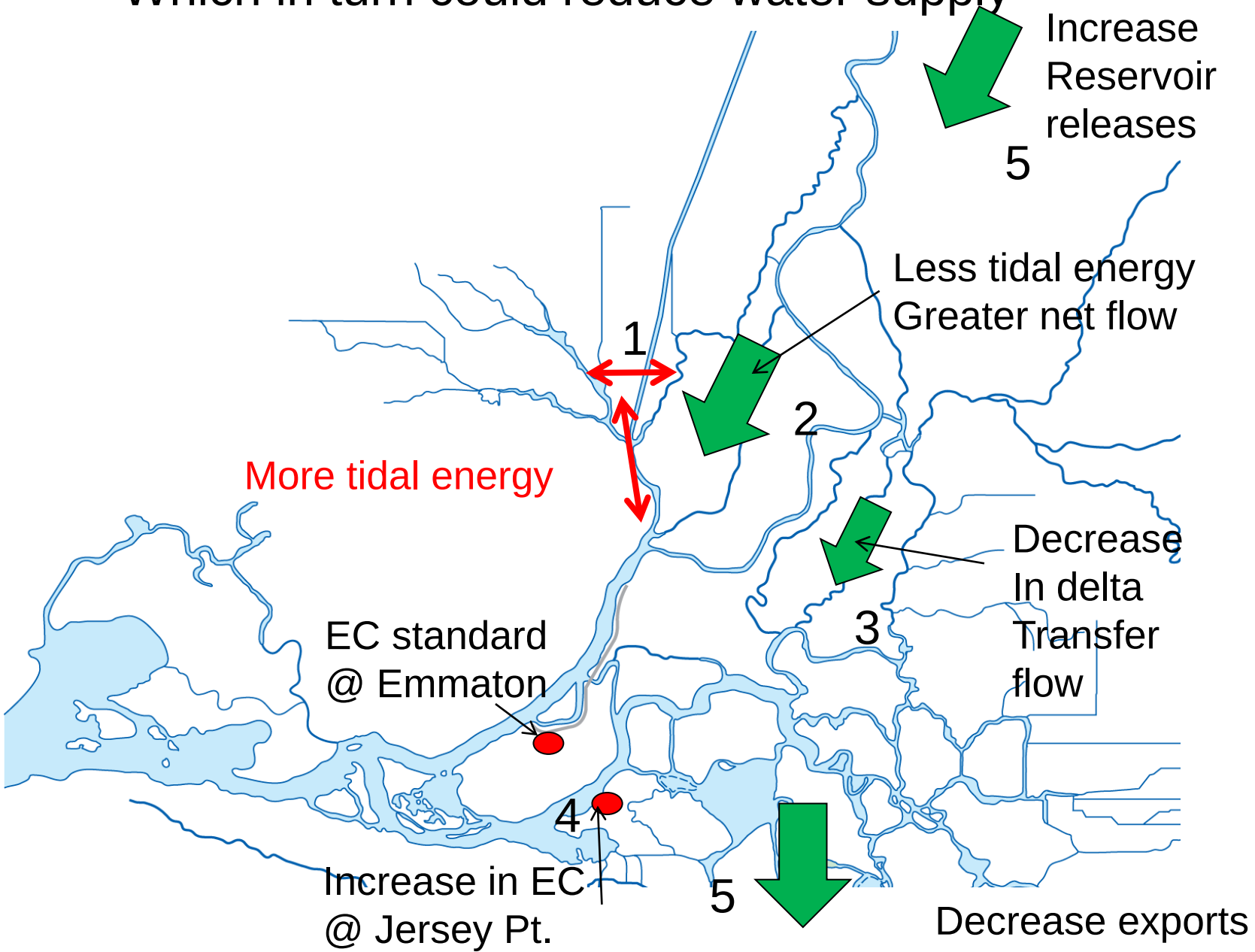
Effect on Salmon outmigration? Increased population level survival without a single smolt entering Prospect Island?



Greater water deliveries using Proposed Isolated Facility?



Effect on regional scale water quality?
Which in turn could reduce water supply



Conclusion

A restoration/conveyance/regulatory master plan is needed supported by a significant modeling capability to understand/predict their interactions