Design Guidelines for the Enhancement and Creation of Estuarine Habitats in the Middle Reaches of the Lower Columbia River

US Army Corps of Engineers
Portland District

INCA ENGINEERS INC.
A Tetra Tech Company

ESA PWA

PC TRASK AND ASSOCIATES

Astoria, May 16, 2012

Outline

I. Nature of Project/Background

II. Approach to Guideline Development
  A. Conceptual Model
  B. Data Collection

III. Design Guideline Q & A

Nature (or Nexus?) of Interest:
Regional Sediment Management-Ecosystem Restoration

•Phase 1-4 Channel Improvement Project-22.7 million cu. yards

•O & M Volumes (projected)=16.1 million cu. Yards

•Need for a "coordinated regional sediment management plan to: encourage the beneficial use of sediment; restore healthy ecosystems; protect (coastal) beaches; maintain safe navigation; improve efficiency of decision-making; and rely on scientific data and methods for modeling, monitoring and adaptive management" (Lower Columbia Solutions Group, 2010)

Background: Past Efforts

•159 Plan(2002)-Habitat Creation-1 of 5 restoration strategies

•LCREP Report (2007)-Proposed a range of experimental restoration techniques related to manipulation of dredge material to promote estuarine wetland development

- •Investigated success/"lessons learned" from SF Bay and Frazier River systems
- •Introduced need to broaden restoration measures (i.e."scrape down";pile modification)

Prepared for the

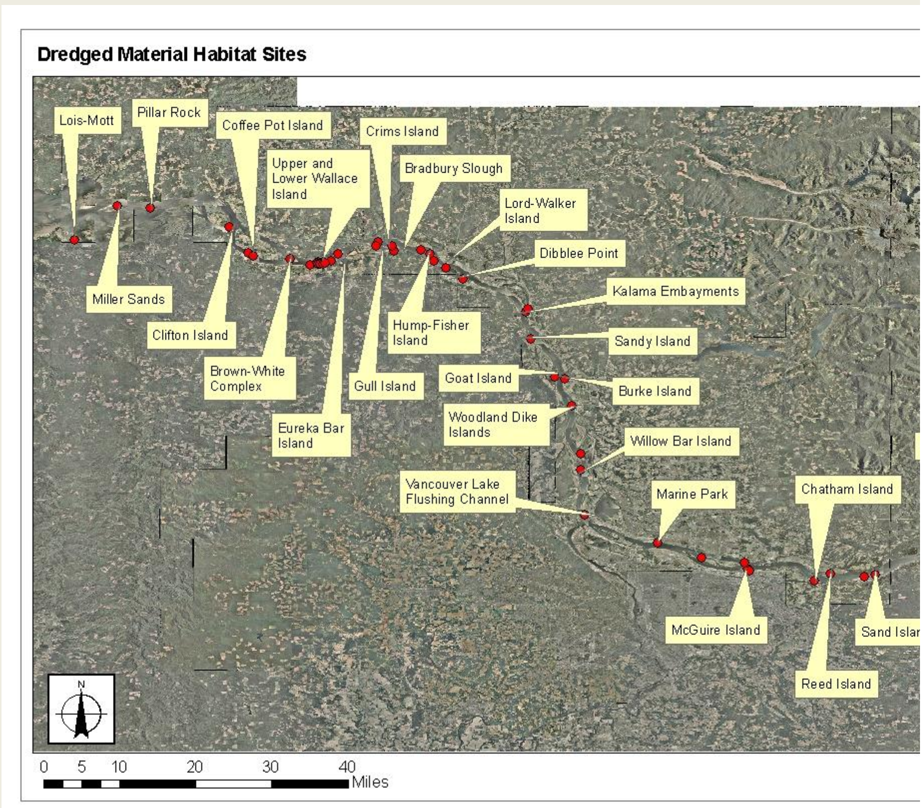
Lower Columbia River Estuary Partnership

Prepared by

PC Trask & Associates

August 15, 2007

Background: Past Efforts



REVIEW DRAFT

Habitat Creation and Enhancement Feasibility Investigation

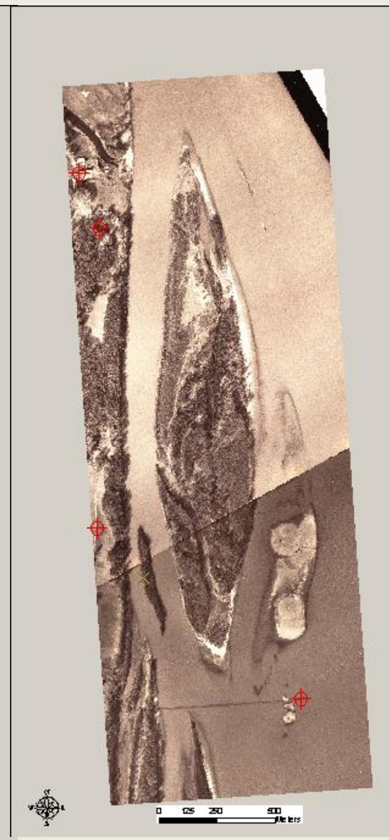
for the Lower Columbia River Ecosystem Restoration General Investigation Feasibility Study

Prepared for Portland District, U.S. Army Corps of Engineers
by PC Trask & Associates, Inc.

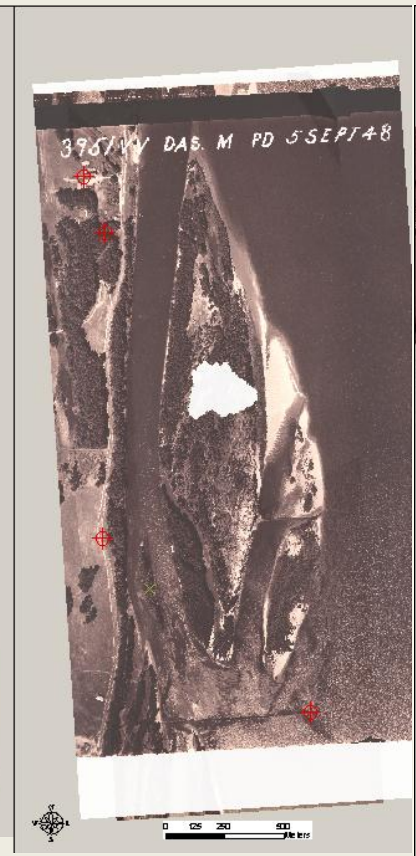
SEPTEMBER 2009

Historic Analysis Goat Island 1929-1957

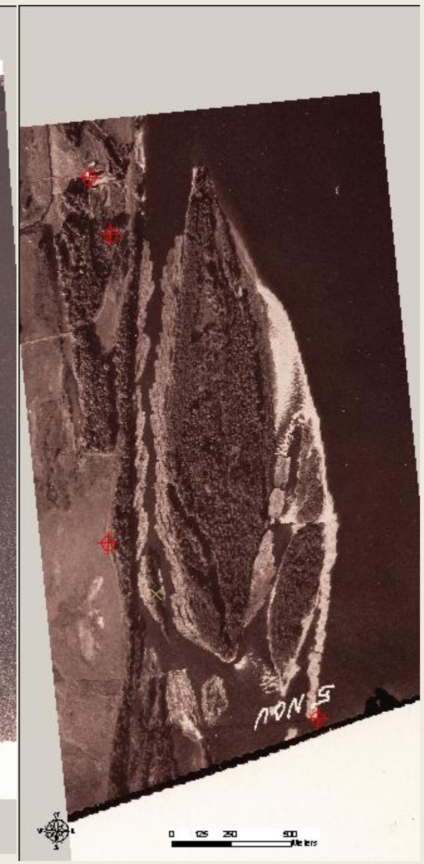
1929



1939

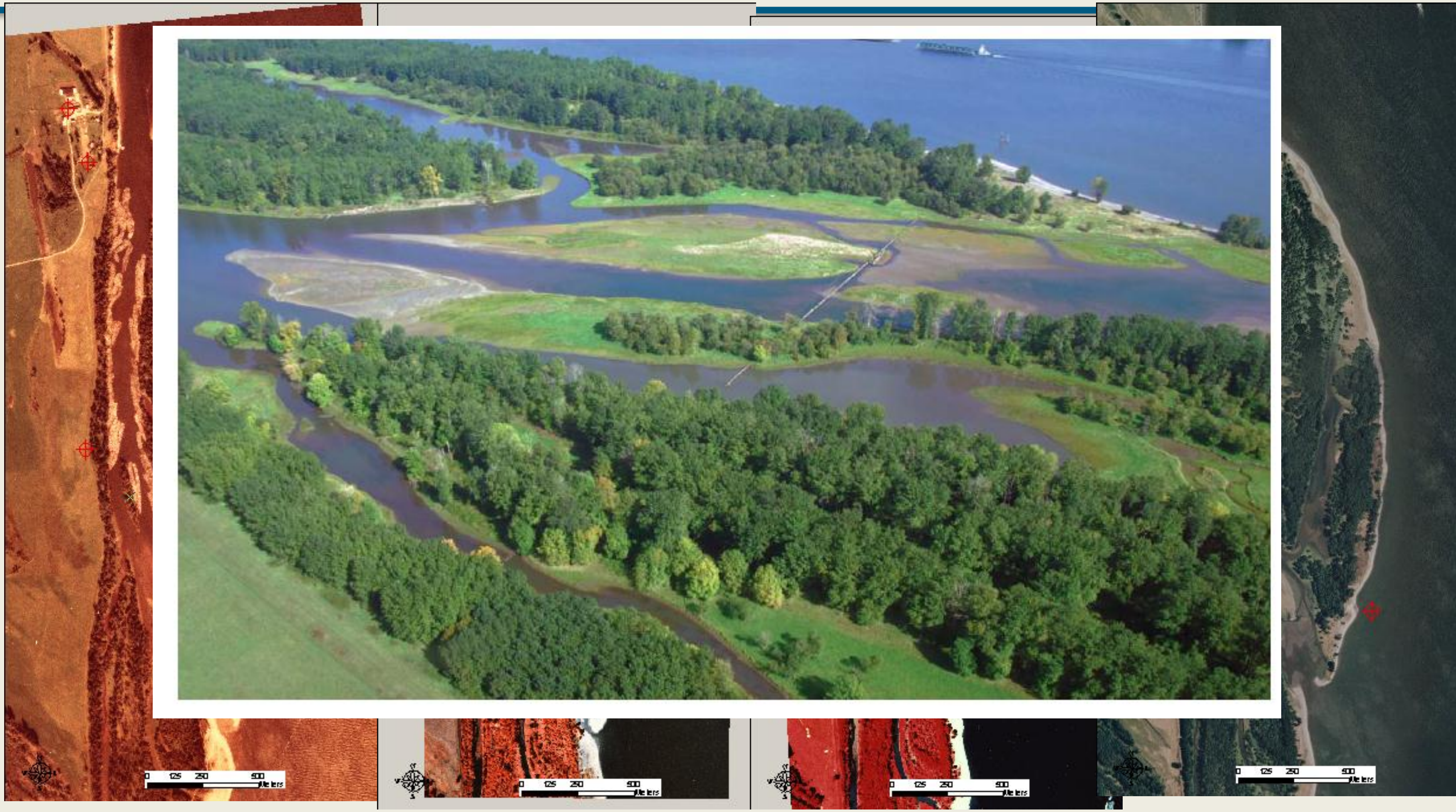


1948



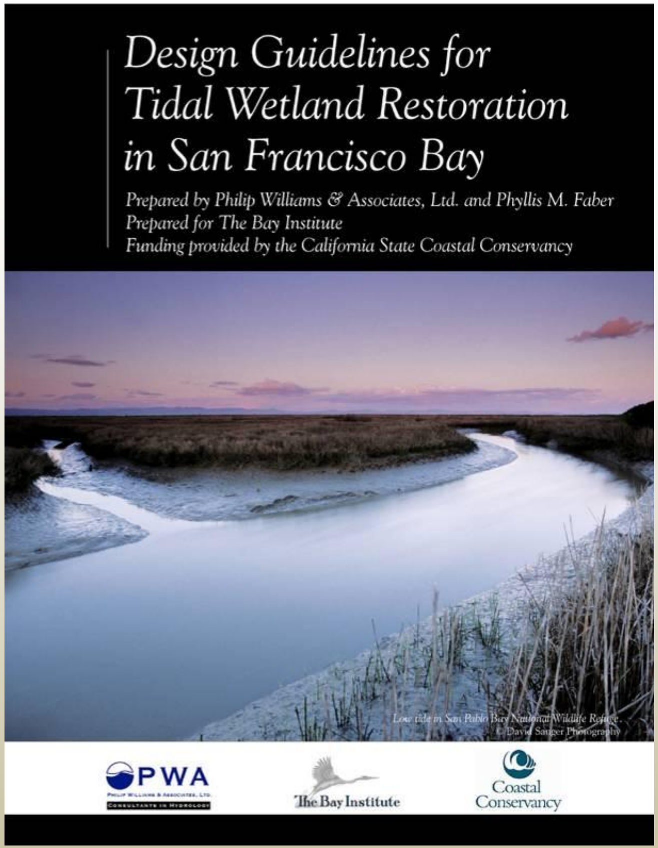
1957

Goat Island 1977-Present



1977 1989 2001 2008

Key recommendation: Apply existing planning templates (SF Bay/Puget Sound)



Approach-Design Guideline Development

- **Phase 1**
  - **1: Existing Data Collection**
  - **2: Planning and Design Methodology**
  - **3: Conceptual Models**
  - **4: Historic Analysis of Habitat Evolution**
  - **5: Field Data Collection**
  - **6: Methodology and Field Data Report**
- **Phase 2**
  - **7: Design Criteria**
  - **8: Final Design Guidelines Report**

Approach-Design Guideline Development

- **Phase 1**
  - **<u>1: Existing Data Collection:</u>**
    - ✓ Ongoing research:
      - Cumulative Effects Project
      - Reference Site Study
      - Hydraulic geometry reports
      - Fish use monitoring
    - ✓ Water Level
    - ✓ Classification System
    - ✓ ACOE Pile Dike/Dredging Reports
    - ✓ Historical Photos
    - ✓ LIDAR
    - ✓ ACOE Flood Profiles

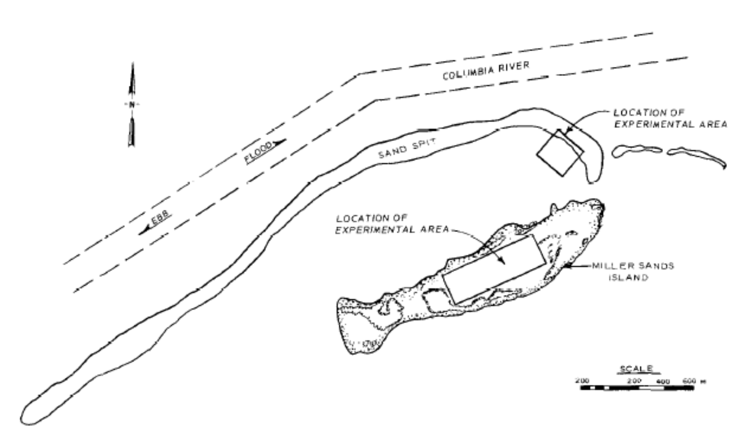


Figure 2. Miller Sands Island and sand spit after dredged material disposal in July 1975

Approach-Design Guideline Development

- **Phase 1**
  - **1: Existing Data Collection**
  - **2: Planning and Design Methodology**

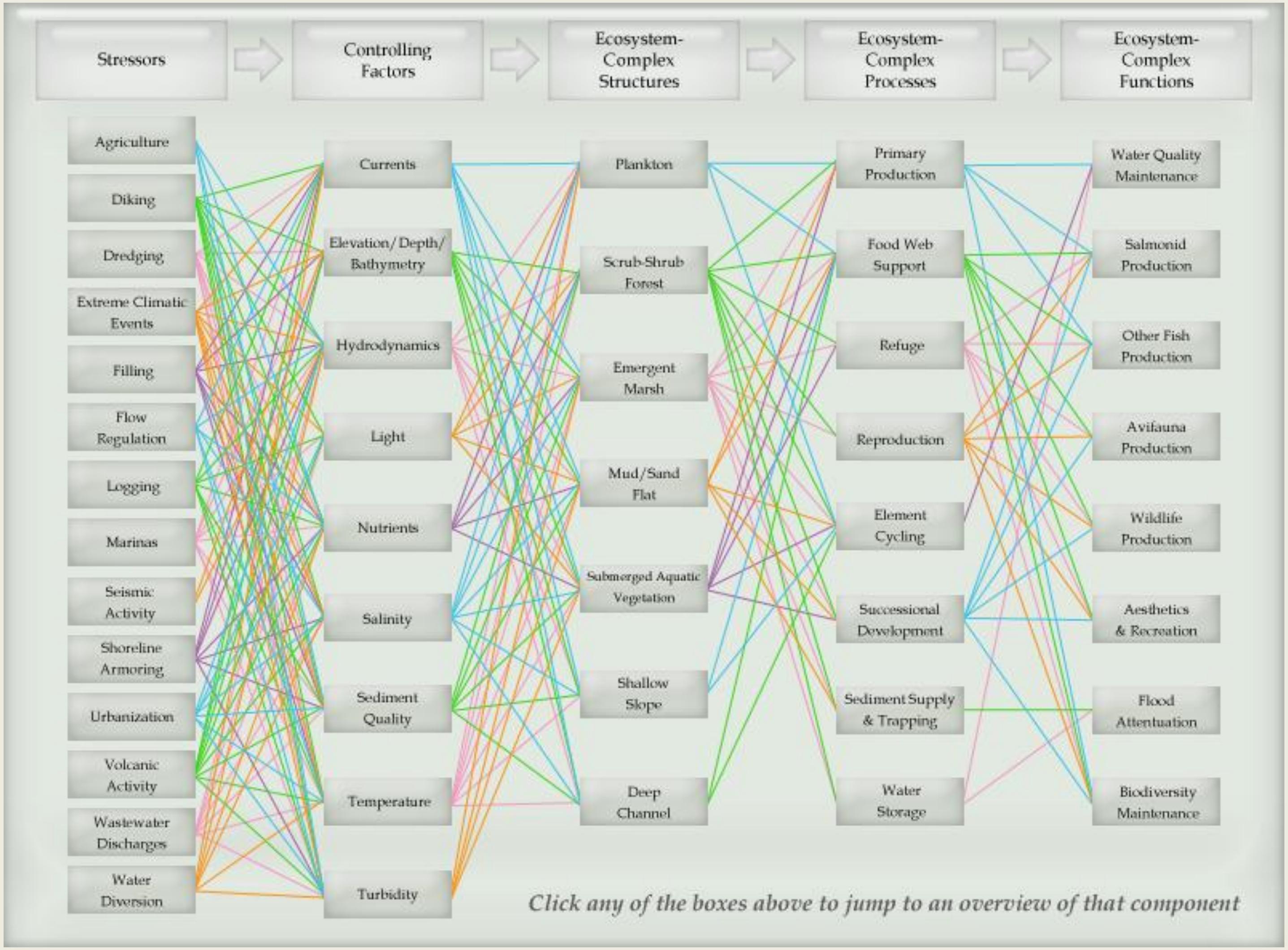
Goals:

- Support the design process for the creation, enhancement and expansion of wetland, floodplain and shallow water habitats to support juvenile salmonids;

- Develop guidance on the creation of a mosaic of wetland and floodplain habitats in the estuary that support juvenile salmon and steelhead;

- Develop recommendations on the restoration of estuarine processes that are supportive of wetland and floodplain habitats; and criteria for the creation of new habitat on future dredged material disposal locations or in the enhancement of habitat on existing dredged material islands.

Utilize existing conceptual Models: USACE/PNNL



Conceptual Models: NOAA

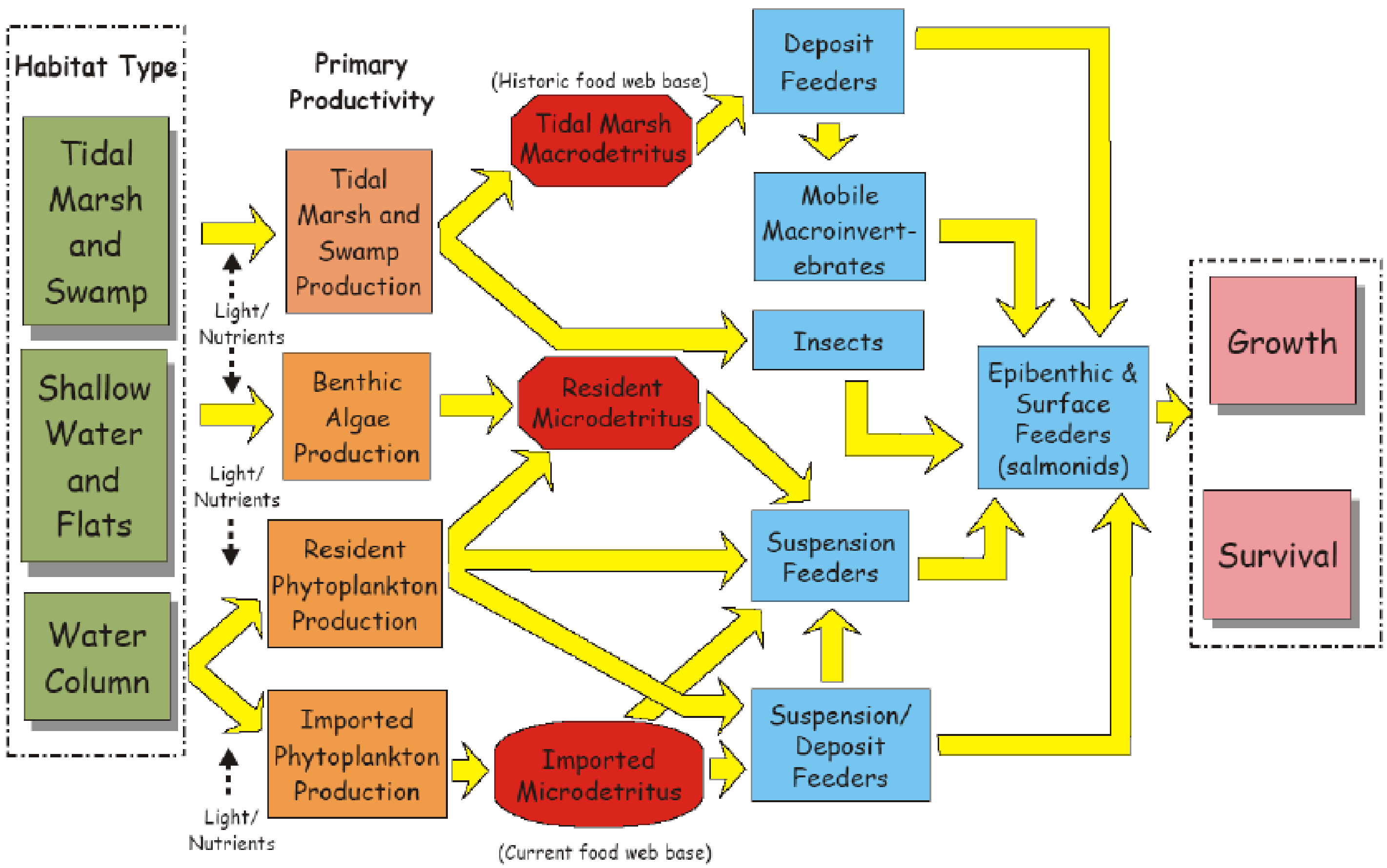
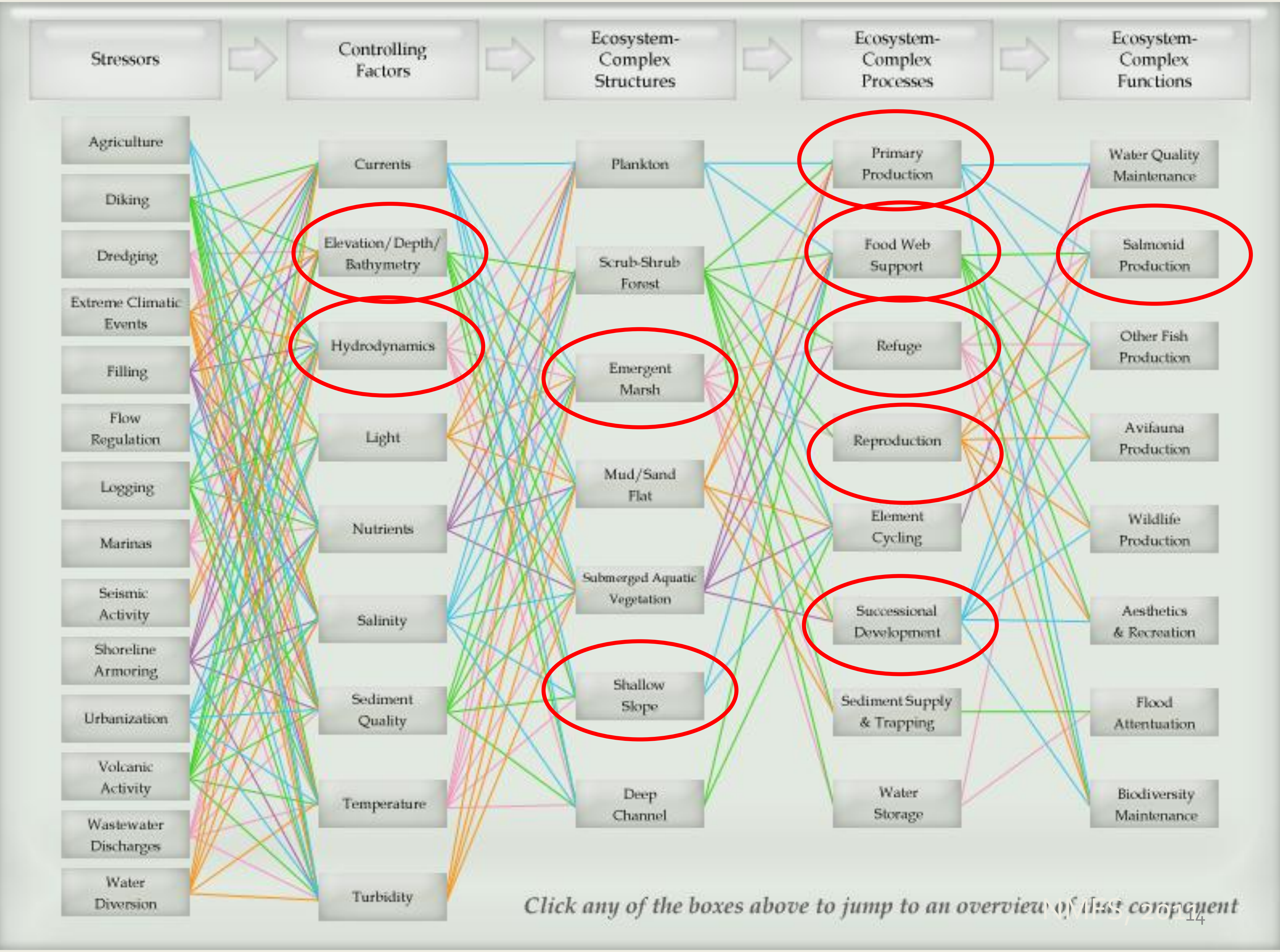


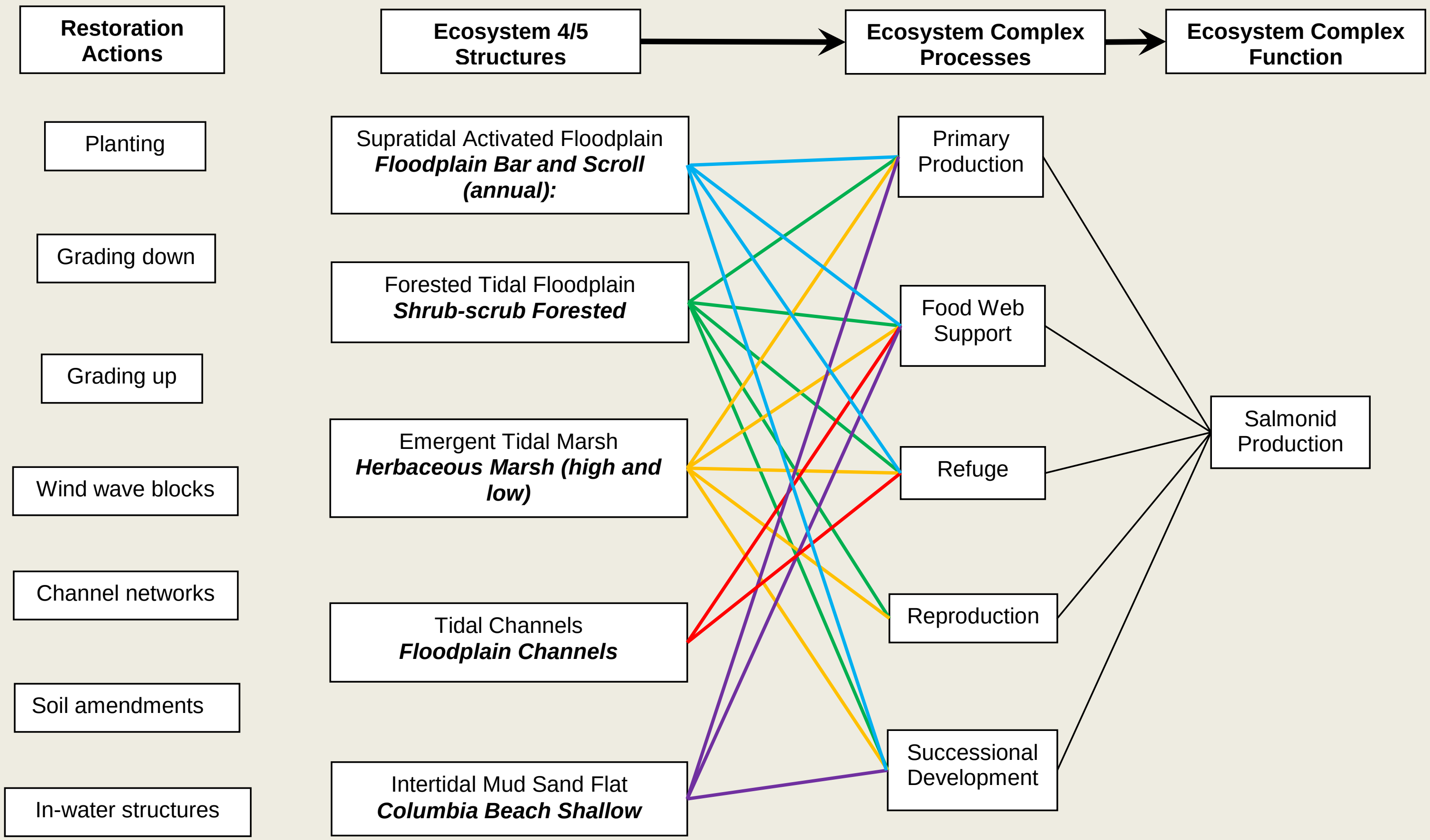
FIGURE 3-3
Conceptual Model of the Columbia River Estuary Food Web

NMFS, 2011

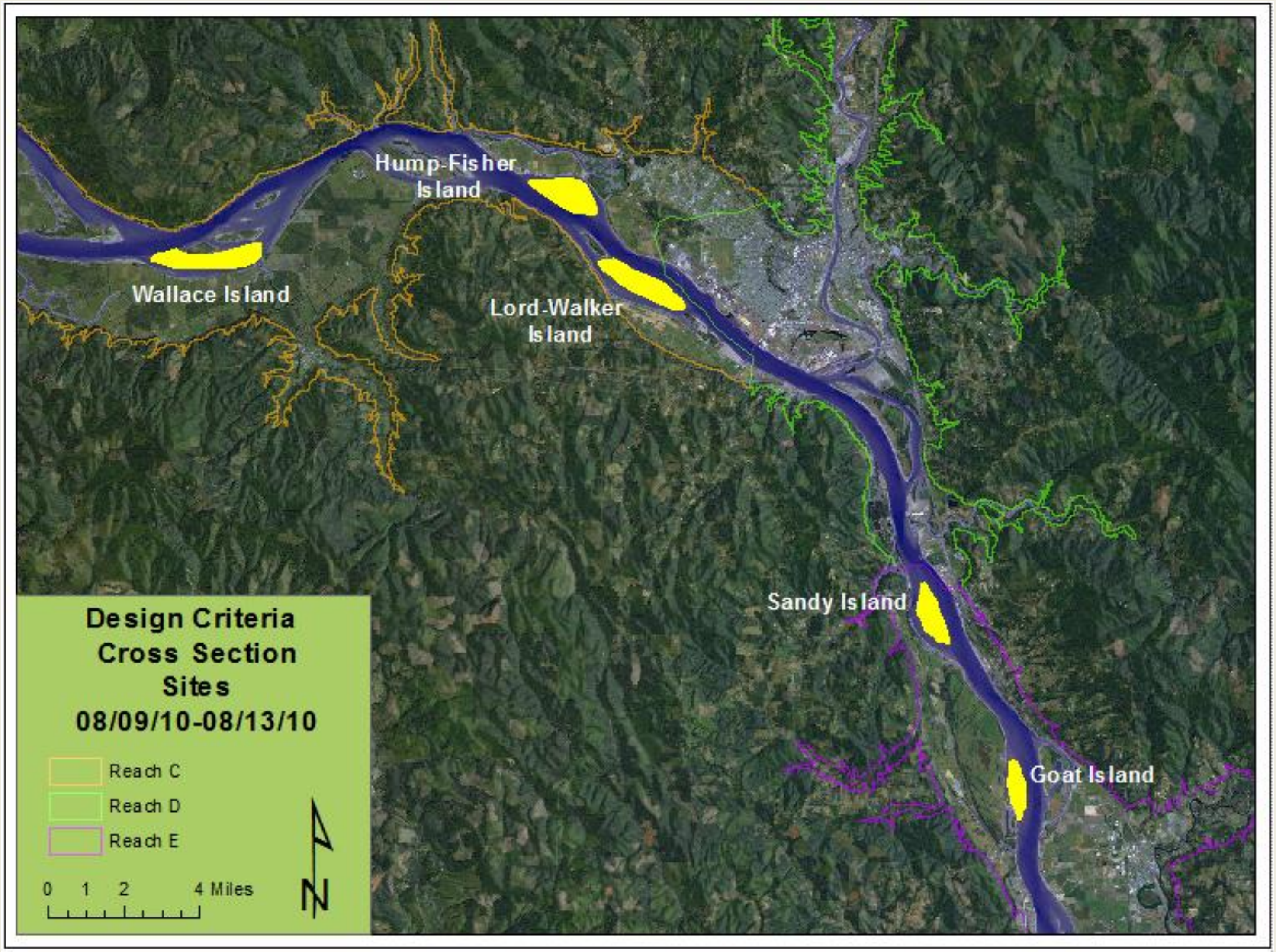

Stressors
Controlling Factors
Ecosystem-Complex Structures
Ecosystem-Complex Processes
Ecosystem-Complex Functions
Agriculture
Diking
Dredging
Extreme Climatic Events
Filling
Flow Regulation
Logging
Marinas
Seismic Activity
Shoreline Armoring
Urbanization
Volcanic Activity
Wastewater Discharges
Water Diversion
Currents
Elevation/Depth/Bathymetry
Hydrodynamics
Light
Nutrients
Salinity
Sediment Quality
Temperature
Turbidity
Plankton
Scrub-Shrub Forest
Emergent Marsh
Mud/Sand Flat
Submerged Aquatic Vegetation
Shallow Slope
Deep Channel
Primary Production
Food Web Support
Refuge
Reproduction
Element Cycling
Successional Development
Sediment Supply & Trapping
Water Storage
Water Quality Maintenance
Salmonid Production
Other Fish Production
Avifauna Production
Wildlife Production
Aesthetics & Recreation
Flood Attentuation
Biodiversity Maintenance
Click any of the boxes above to jump to an overview of that component

NMFS, 2011

Approach-Refine model and insert actions

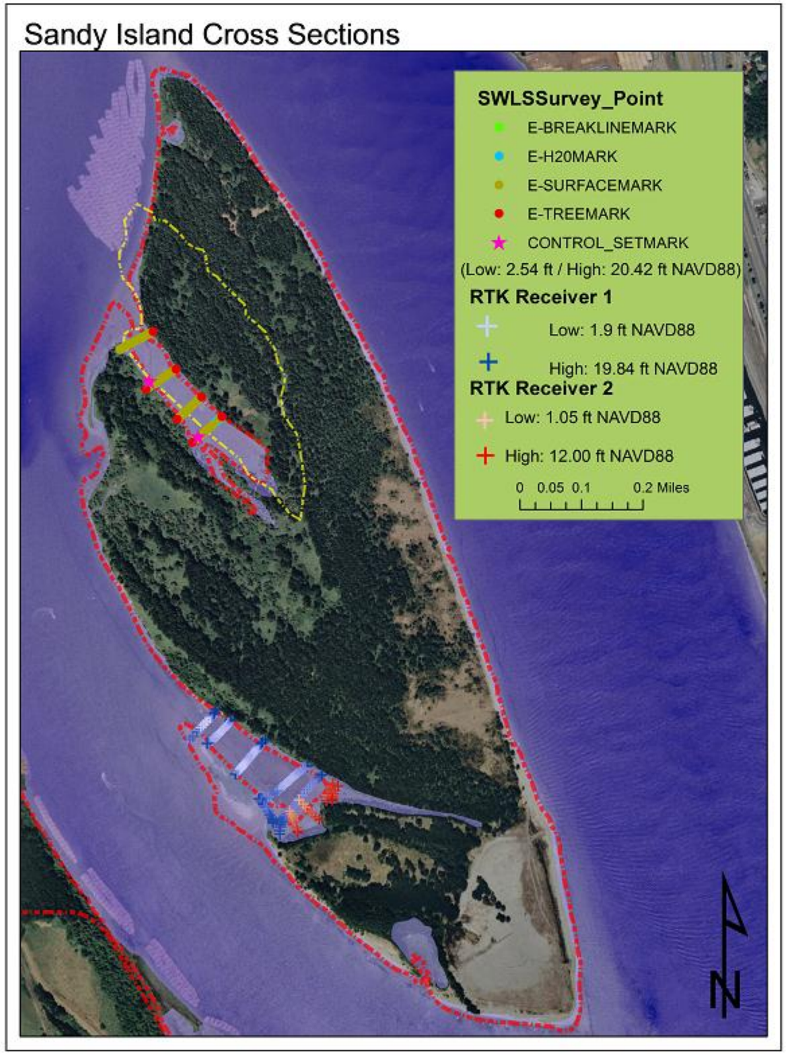


Field Data Collection-Mid Channel Islands, HG Reaches C-E

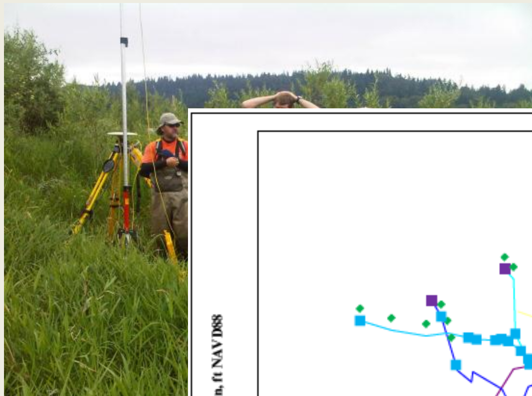


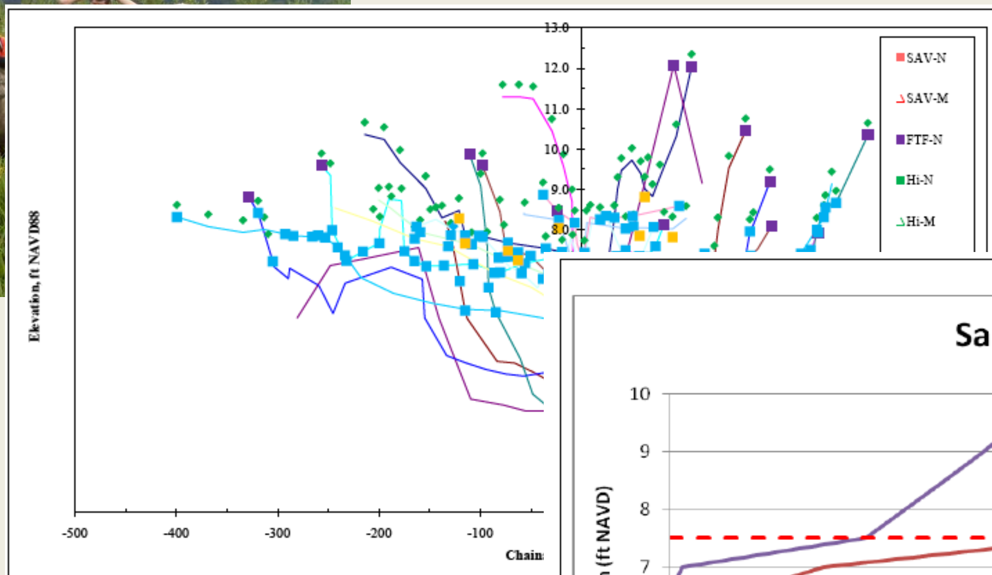
Field Data Collection-Mid Channel Islands

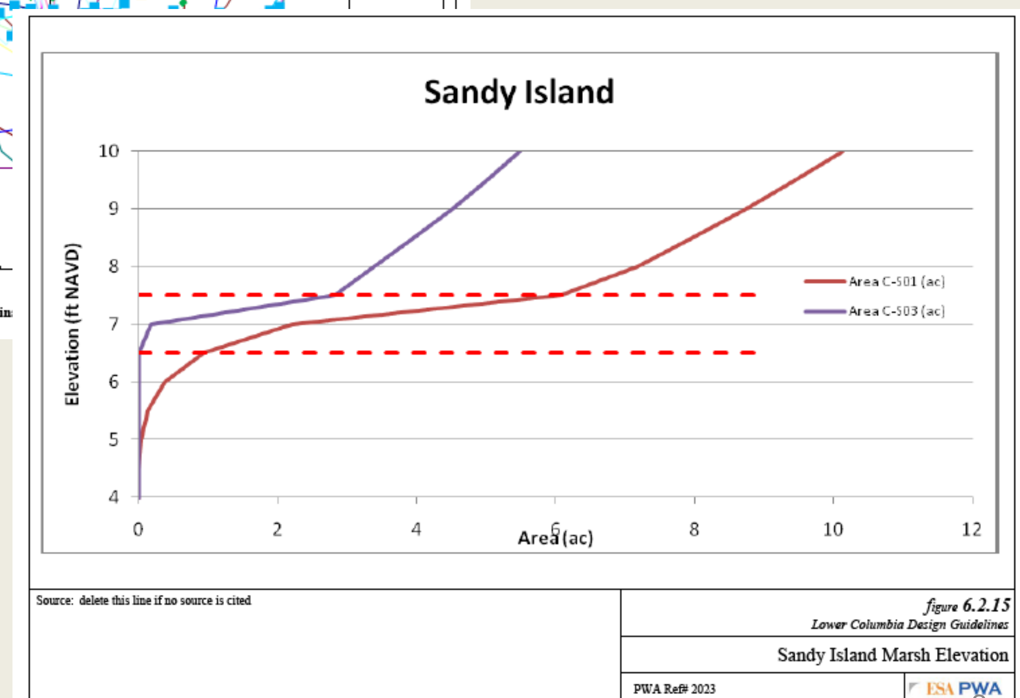
- Parameters desired:
  - Vegetation-Elevation Relationships
  - Hydraulic Geometry
  - Hypsometric Curves
  - Drainage Density



Field Data Collection-Mid Channel Islands







Design Guidelines Questions:

WHAT ELEVATION SHOULD THE FLOODPLAIN BE?

Gage / Island	Skamokawa Tide Gage	Wallace Island	Hump-Fisher Island	Lord-Walker Island	Longview Tide Gage	Sandy Island	Goat Island	St. Helens Tide Gage
River Mile	33.3	49.0	60.0	62.5	66.4	75.0	81.0	85.6
Maximum Flood[1] Level (ft NAVD)	13.2	14.5	15.4	15.6	15.9	17.0	17.8	18.4
Mean Flood Level[1] (ft NAVD)	11.7	12.9	13.7	13.9	14.2	15.1	15.6	16.1
Annual Flood Level[1] (ft NAVD)	10.6	11.6	12.2	12.4	12.6	13.1	13.4	13.7
MHHW (ft NAVD)	8.9	9.2	9.4	9.5	9.6	9.5	9.5	9.4
MTL (ft NAVD)	5.2	6.1	6.8	7.0	7.2	7.4	7.5	7.6
MLLW (ft NAVD)	1.3	3.1	4.3	4.6	5.0	5.5	5.9	6.1

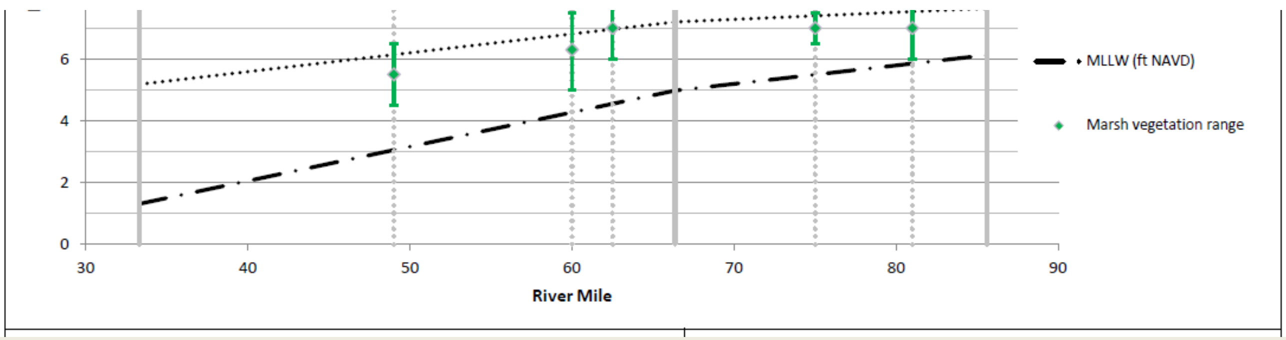
Surface Profiles

PWA Ref# 2023 | ESA PWA

Design Guidelines Questions:

WHAT ELEVATION SHOULD THE EMERGENT MARSH BE?

Island	Minimum Marshplain Elevation (ft NAVD)	Average Marshplain Elevation (ft NAVD)	Maximum Marshplain Elevation (ft NAVD)
Wallace	4.5	5.5	6.5
Hump-Fisher	5.0	6.3	7.5
Lord-Walker	6.0	7.0	8.0
Sandy	6.5	7.0	7.5
Goat	6.0	7.0	8.0



Design Guidelines Questions:

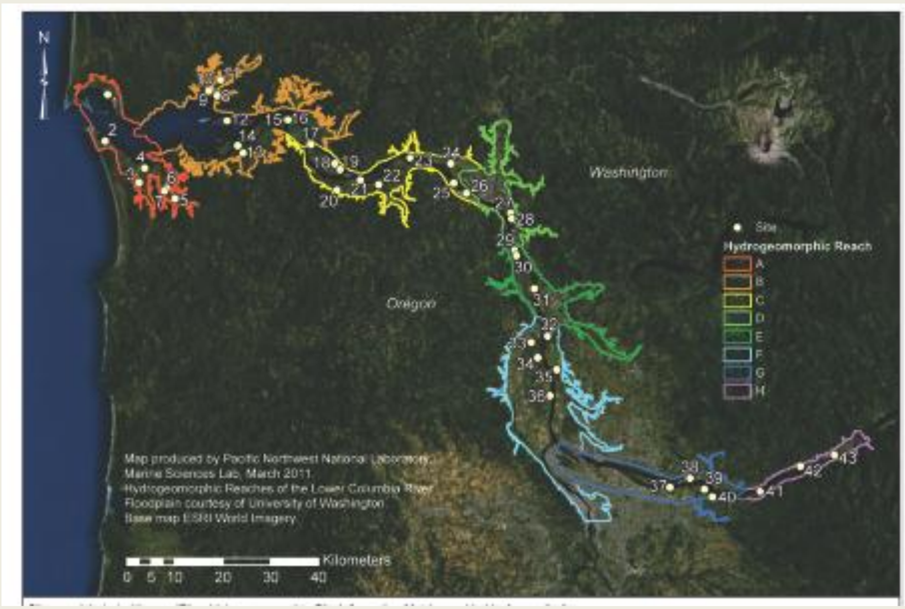
HOW LARGE AND WHAT SHAPE SHOULD THE WETLAND BE?
(Assumption Target Depth =1.5 feet below MLLW for juvenile salmonids)

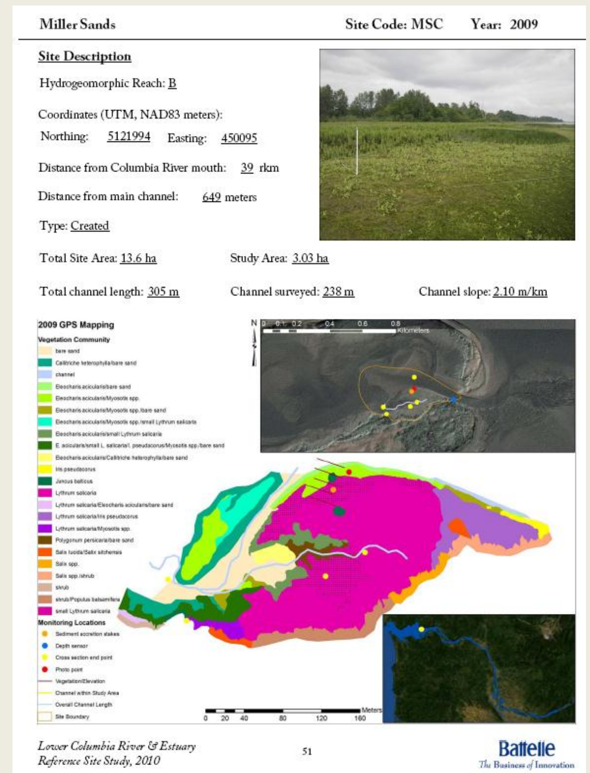
$$A_d=3.2922^{-1}\ D_c^{\ 1/0.215}$$

Gage/Island	River Mile	Target Channel Depth below MHHW (ft)	Minimum Drainage Area to sustain Target Channel Depth (ac)
Skamokawa	33.3	9.2	119.7
Longview	66.4	6.2	19.3
St Helens	85.6	4.9	6.6
Wallace	49.0	7.8	54.9
Hump-Fisher	60.0	6.8	29.1
Lord-Walker	62.5	6.6	24.8
Sandy	75.0	5.6	12.3
Goat	81.0	5.2	8.7

Build in research findings to add rigor:

(i.e. PNNL Reference Site Study)





Miller Sands **Site Code: MSC** **Year: 2009**

Site Description

Hydrogeomorphic Reach: B

Coordinates (UTM, NAD83 meters):
Northing: 5121994 Easting: 450095

Distance from Columbia River mouth: 39 rkm

Distance from main channel: 649 meters

Type: Created

Total Site Area: 13.6 ha Study Area: 3.03 ha

Total channel length: 305 m Channel surveyed: 238 m Channel slope: 2.10 m/km

Lower Columbia River & Estuary Reference Site Study, 2010 51 Battelle *The Business of Innovation*

Additional Guidance

- Consider Wind-Wave processes
- Need to create shelter effects
- Accretion rates
- Sea level rise/shifting hydrographs
- Changes in sediment budget

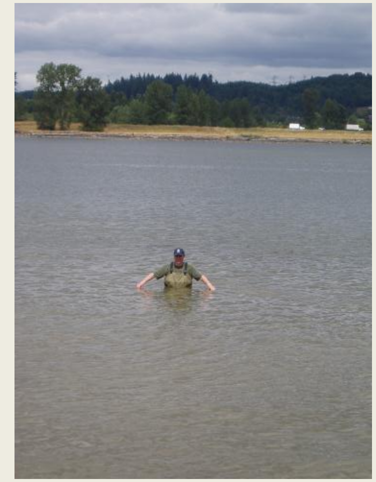
Management Implications

- Experimental in nature necessitates adaptive management approach
- Apply planning approach suggested in report :
  - ✓Selection of planning horizons
  - ✓Establish planning goals and objectives AND operation objectives
  - ✓ID opportunities and constraints including NO ACTION
  - ✓Develop monitoring and long term management plan in concert with project partners
- Interface with existing RME and RSM programs in Columbia River Estuary

Big Thanks!

- Sharon Schultz, Cindy Studebaker (USACE)
- Craig Haskell, Steve Waste (USGS)
- Phil Williams (as himself)
- Jeremy Lowe (project mgr)
- Blaine Ebberts(USACE)
- And Blaine
- And more Blaine…

Questions and/or cocktail of choice?



Allan Whiting
allan@pctrask.com
503.517.0705

Jeremy Lowe
JLowe@esassoc.com
415.262.2304

Blaine Ebberts
Blaine.D.Ebberts@usace.army.mil
503.808.4763