Multi-Benefit, Landscape Scale Restoration in the Eel River Estuary, Humboldt County, CA

Presented To:

Florida Shore and Beach Preservation Association

Presented By:

Pete Duin, MSE, EIT
Environmental Engineer

February 8, 2024

Photo Courtesy: Brad Finney

Presentation Overview

1. Overview Restoration Efforts
2. Purpose / Need
3. Location Characteristics - Eel River Estuary
4. Design Approach
5. Project/Regulatory Constraints
6. Post Project Takeaways/ Conclusion

Mouth of the Eel River, Humboldt County, CA

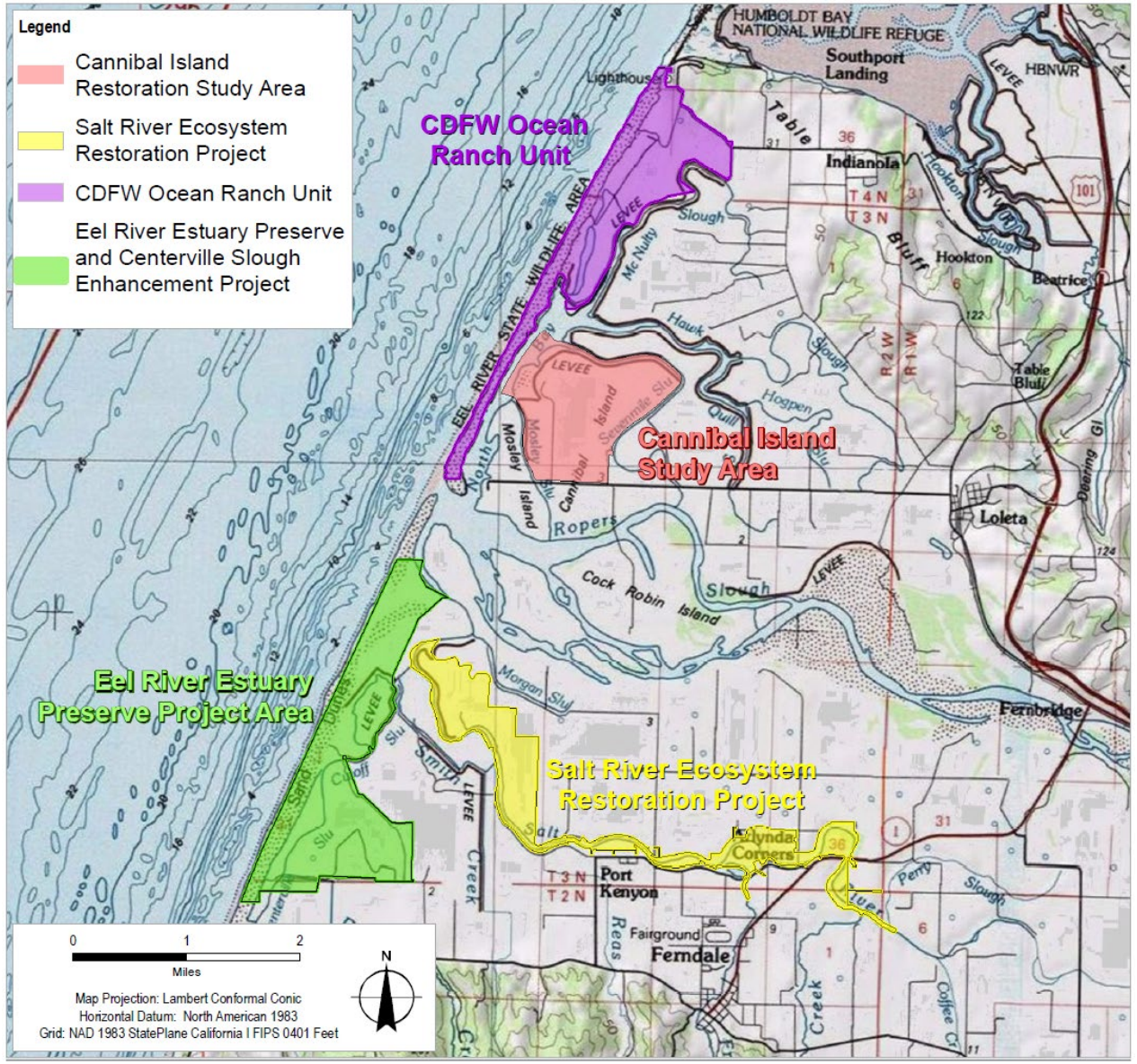
Eel River Estuary, Humboldt County, CA

Eel River Estuary near Loleta, California

- 3rd largest river system in California
- 4 restoration projects in the Eel River Estuary

Watershed Characteristics:

- Highest suspended sediment load in US
- Highest rate of sea level rise in CA (Intermediate: 1.1 ft by 2060 (OPC, 2024))
- Highest rates of cliff erosion and coastline retreat in CA



Purpose and Need

Purpose

- Restore/improve and expand natural estuarine function
- Enhancement of native species and habitat
- Increase resilience of habitat and agricultural land to sea level rise

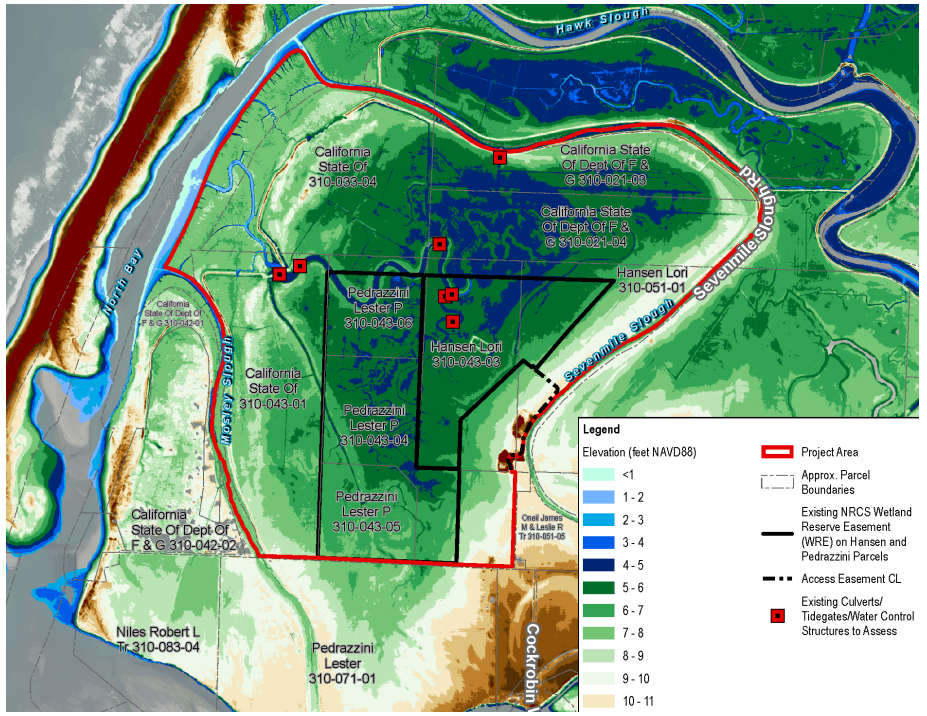
Need

- 90% of estuarine habitat lost in Eel River Estuary since European settlement
  - historic loss of endangered species and habitat
- Presence of special and listed plant and animal species
- Sea level rise and failing infrastructure threaten remaining agricultural lands

Typical Characteristics in the Eel River Estuary

Historic construction of dikes and ditches for agriculture and grazing

- Former tidelands diked and disconnected
- Partially and severely eroding dikes
- Failing culverts



Cannibal Island Elevation Model

Interior elevations between 3 and 7 feet

Reference area marsh exhibits elevations around 7 feet

Subsidence occurring due to lack of sedimentation, oxidation, compaction (grazing)

Centerville Slough High-Flow Event

Special Status Listed Species

Historically 24-30 fish species:
chinook, coho, steelhead, tidewater goby, longfin smelt, species of concern: coastal cutthroat, green sturgeon

Cannibal Island fish assemblage sampling (CDFW 2020) shows presence of 13 species.

Rare Plant Survey

Special Status Plant: Humboldt Bay Owls Clover in Salt Marsh on the Outside of Levees

Other Baseline Studies, Permit Applications - Cannibal Island

Studies:

1. Levee Condition Assessment
2. Water Level & Water Quality Monitoring
3. Fish Abundance Sampling
4. Cultural Resources Investigation Report & Addendum
5. Upland/Wetland Delineation Report
6. Baseline Conditions Aquatic, Terrestrial and Avian Species
7. Special Status Plants and Sensitive Natural Communities/ESHA Mapping

Regulatory Approvals:

1. CEQA/EIR - Statutory Exemption for Restoration Projects (SERP) or Environmental Impact Report
2. County of Humboldt - Conditional Use Permit and Grading Permit
3. CA Coastal Commission - CDP or Federal Consistency Determination (CD)
4. CDFW - LSAA & CESA Compliance
5. NCRWQCB - CWA Section 401 Certification through Statewide Restoration General Order (SRGO) Notice of Intent (NOI)
6. USACE - CWA Section 404 Permit, Nationwide Permit (NWP) 27
7. NOAA - ESA Programmatic Biological Opinion (PBO)
8. USFWS - ESA Statewide Restoration PBO
9. State Lands Commission - Lease

Design – Objectives, Procedure

Objectives:

1. Avoid off-site impacts
2. Maximize tidal range within project area
3. Improve existing channel network:
   - ✓ maximize marsh accretion
   - ✓ increase circulation
   - ✓ maintain equilibrium overtime
4. Balance cut/fill

Process:

- Identify tidal channels (historic imagery)
- Size tidal channels
- Grade tidal channels using Civil 3D
- Input 3D Surface into Modeling Software
- Refine and analyze alternatives

2 hydraulic models:

- DHI Mike 21
  - Offsite impacts during low river stages
- HEC-RAS 2-D
  - Inboard hydraulics and offsite impacts during flood events

Tidal Channel Sizing

Williams et al. (2002) empirical formulas

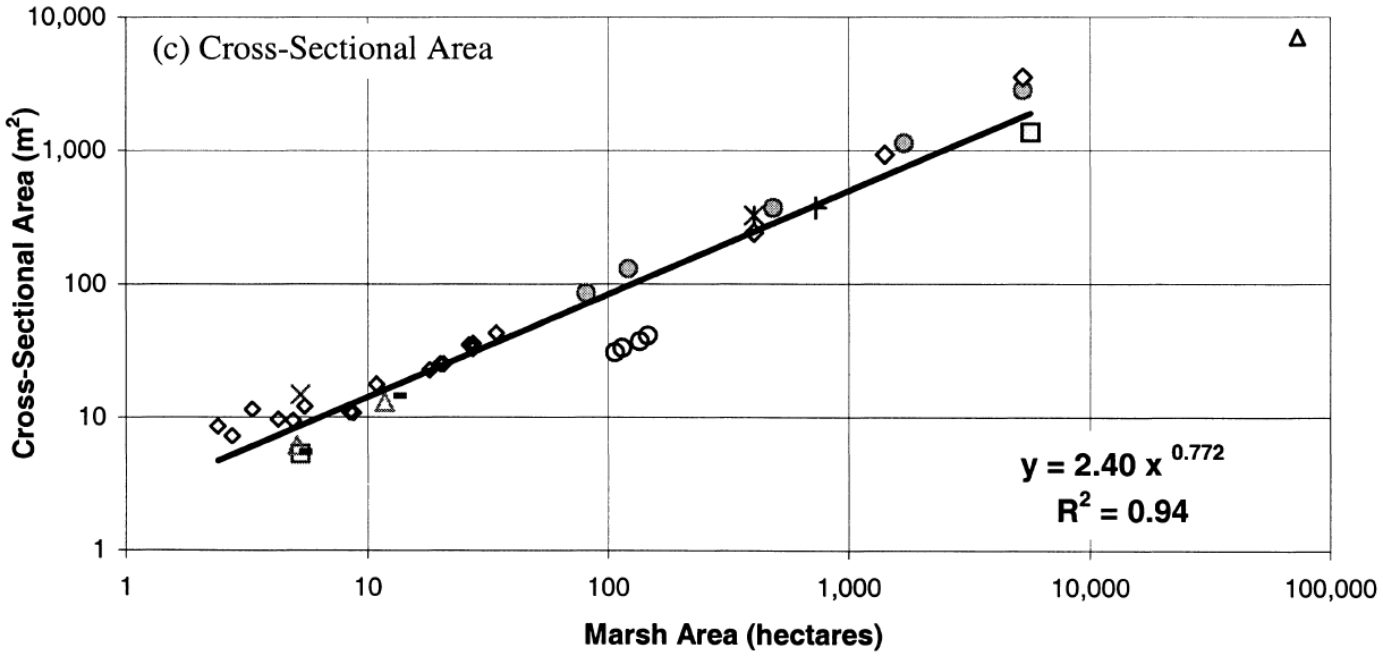
- Relate tidal slough channel geometry to contributing marsh area

Delineate subareas

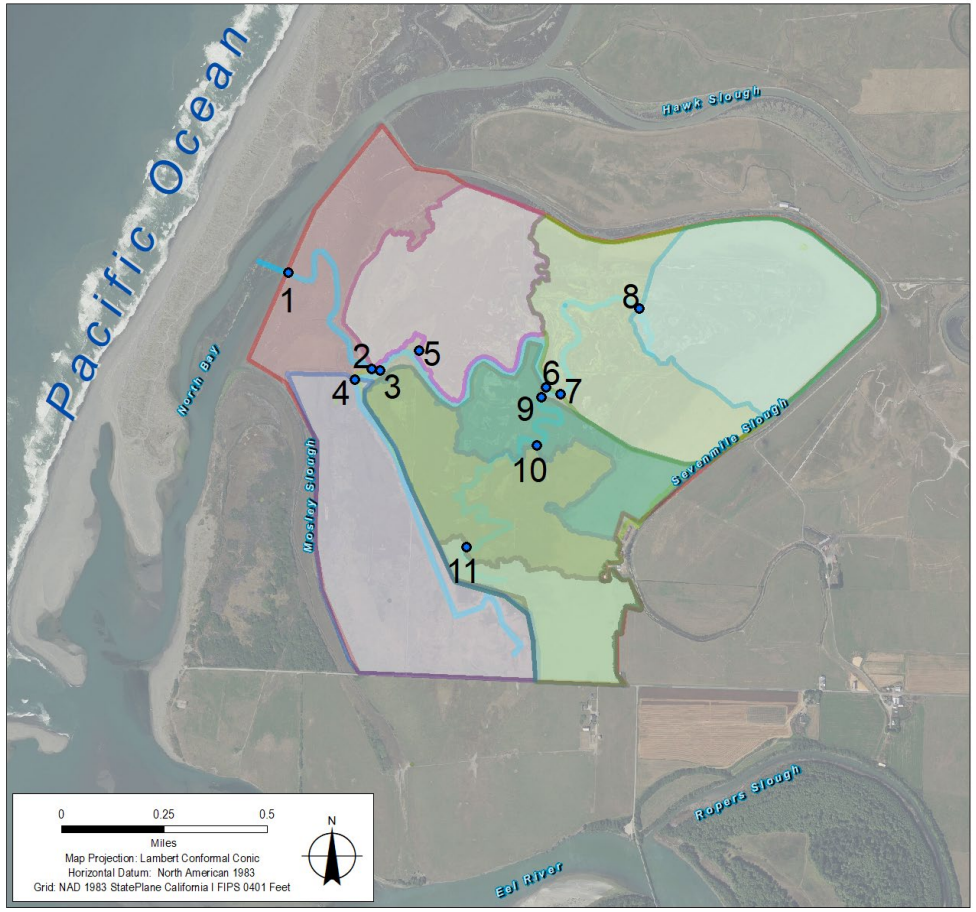
Contributing marsh area:

- Stage-storage analysis (MHHW 6.9 ft)
- Inundated area as contributing marsh area

Regression Equation (Williams et al. 2002)



Cannibal Island Marsh Area Delineation (GHD 2023)

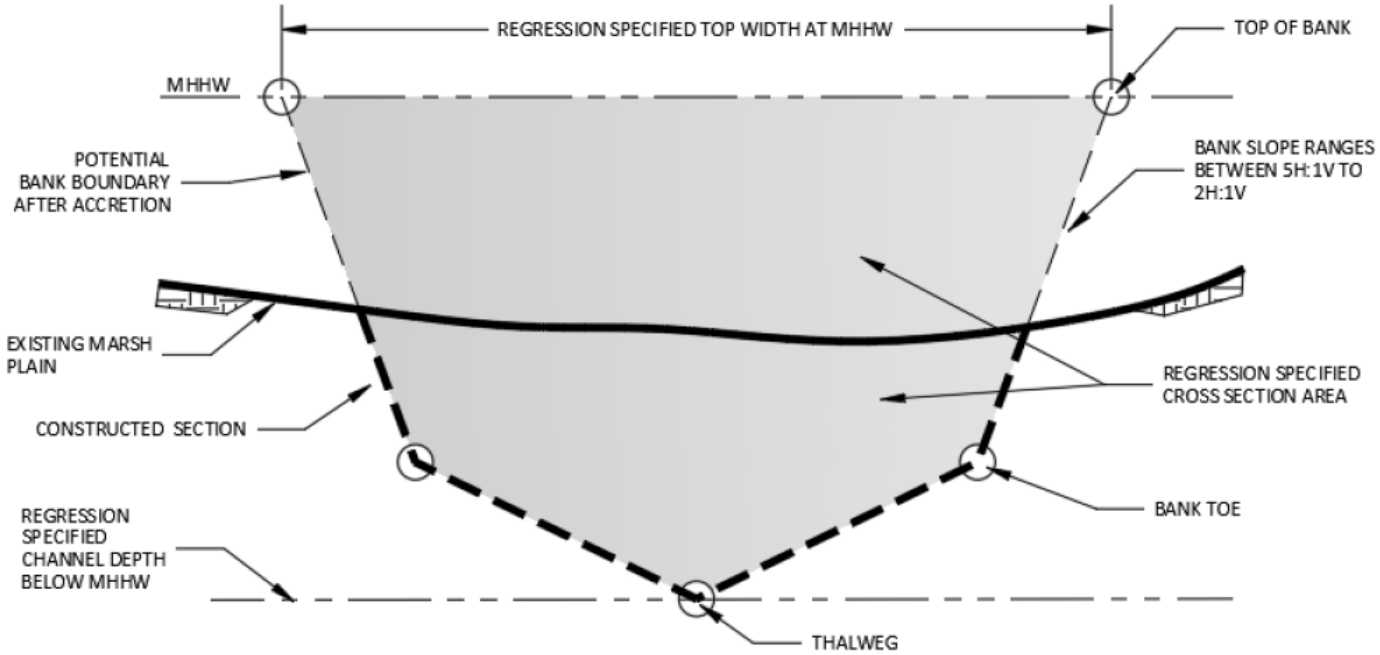


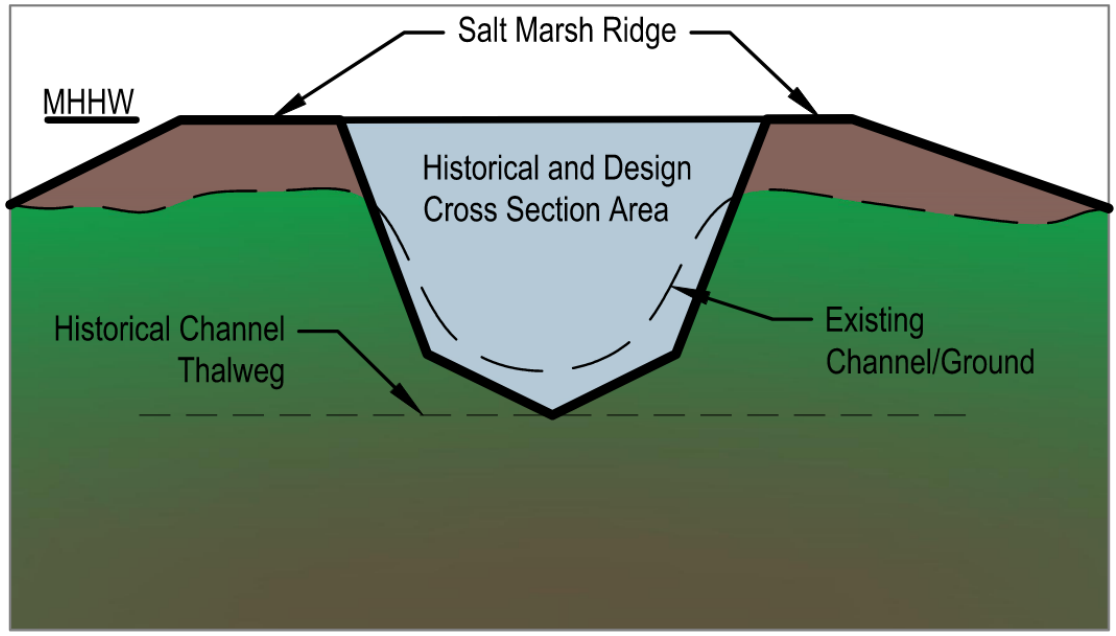
Tidal Channel Sizing

- Regression equations estimate channel top widths and thalweg depth below mean higher high water
- Five-point parabolic cross section developed to match estimated areas
- Used as a starting point - develop design alternatives for hydraulic assessment and refinement

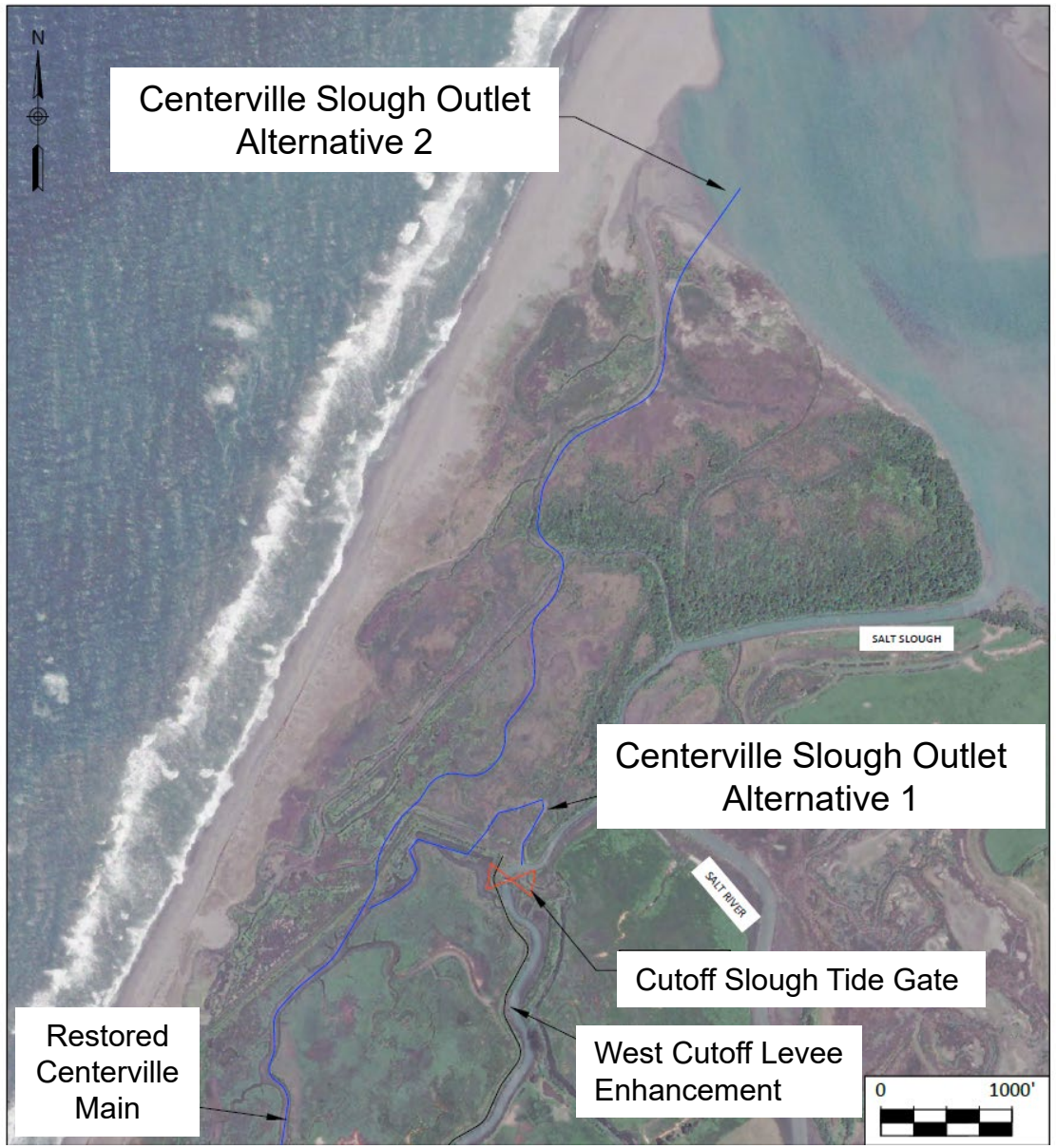
One Possible Alternative –

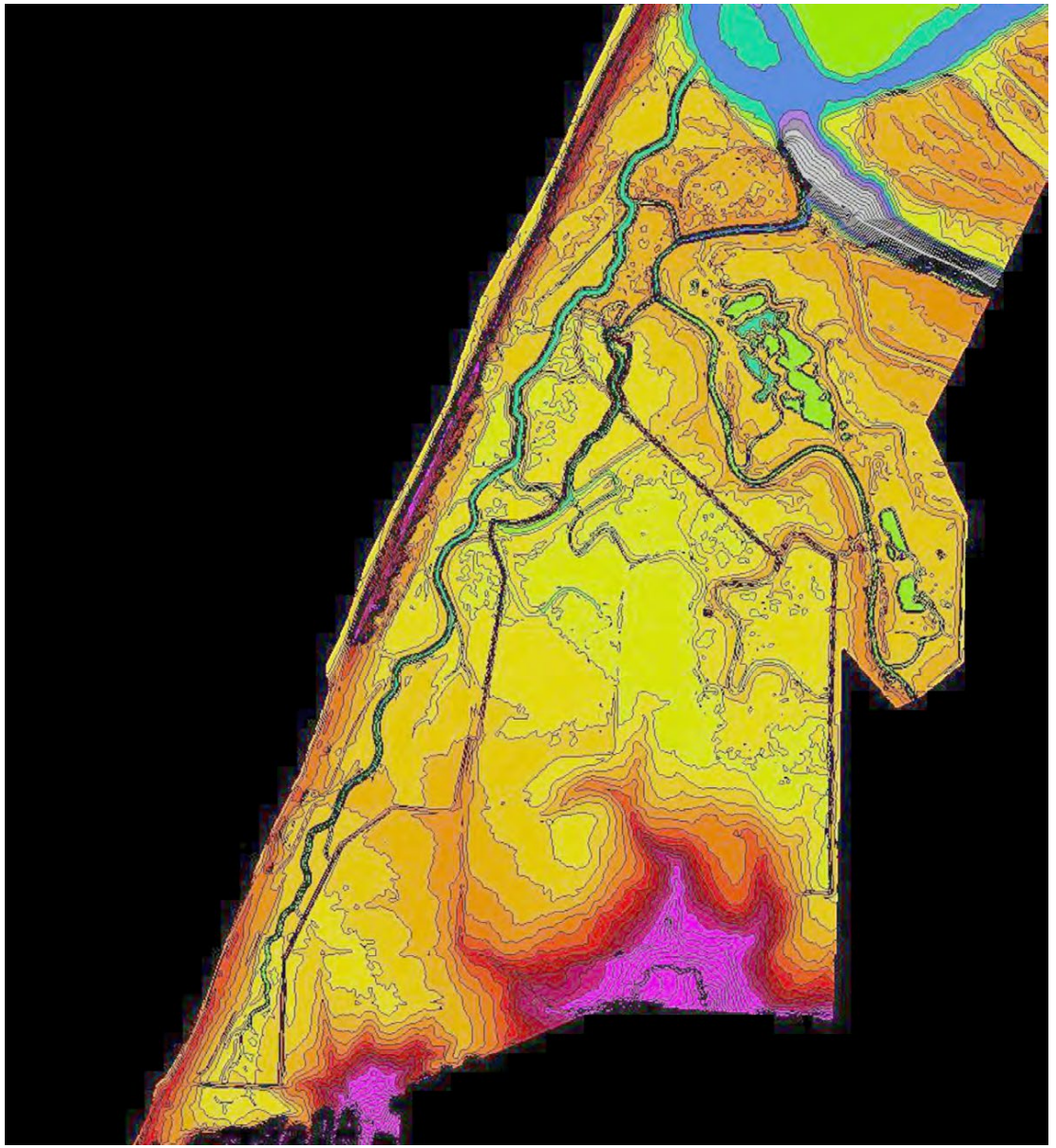
Alter to add berms to mimic historical channel geometry, creating ponds for sediment deposition and reduced tidal prism





Centerville Slough – Proposed Ground Surface

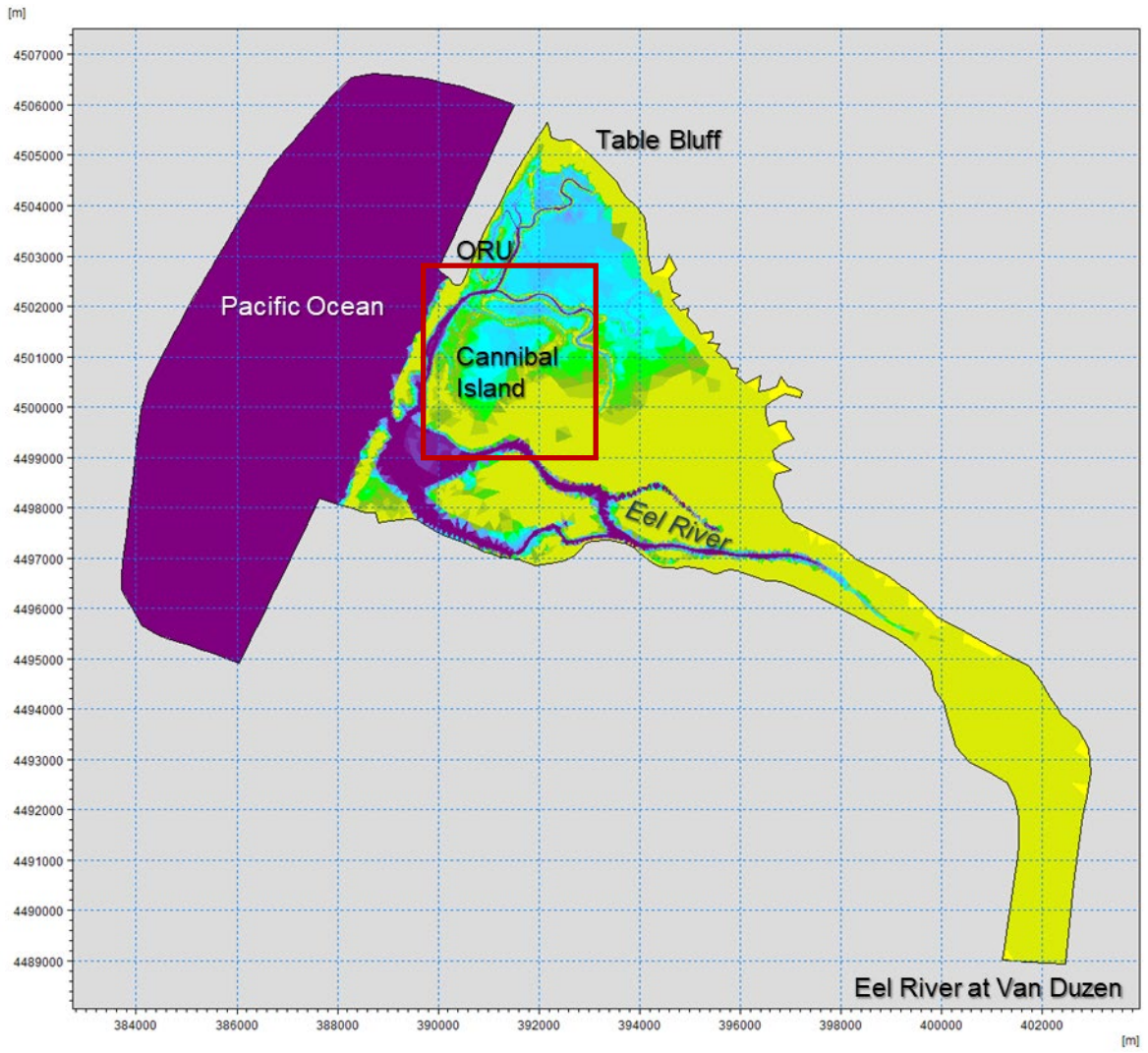


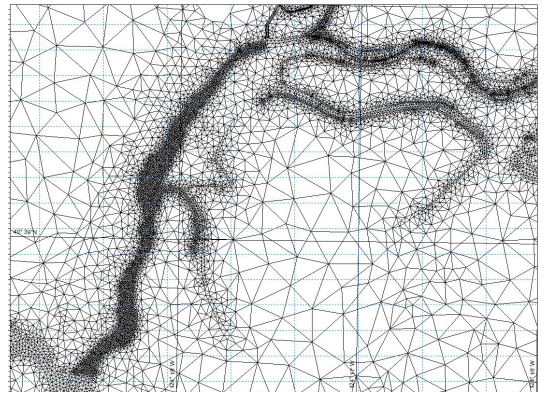


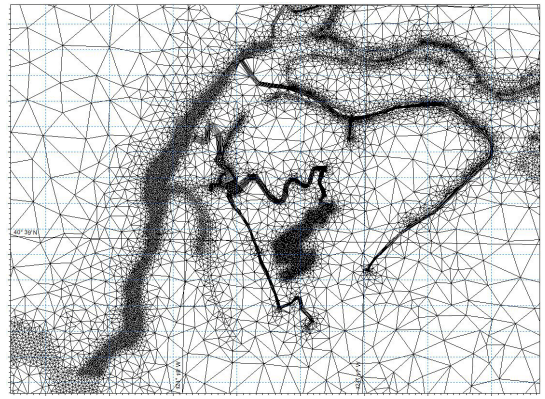
DHI MIKE 21 Model Development – Offsite Impacts

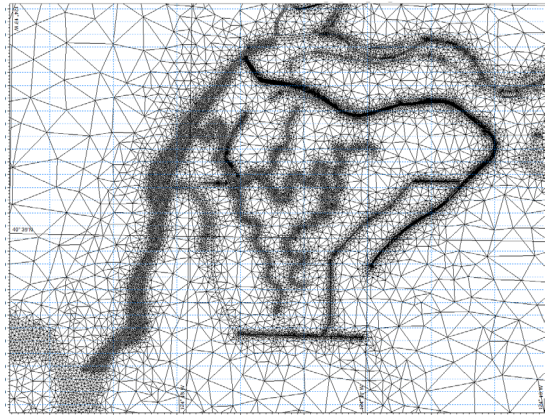
A hydrodynamic model, developed by Moffatt & Nichol (2015) and AECOM for the Ocean Ranch Unit Restoration Project

- Utilized to assess tidal hydrodynamics
- Account for the Ocean Ranch Project hydraulics

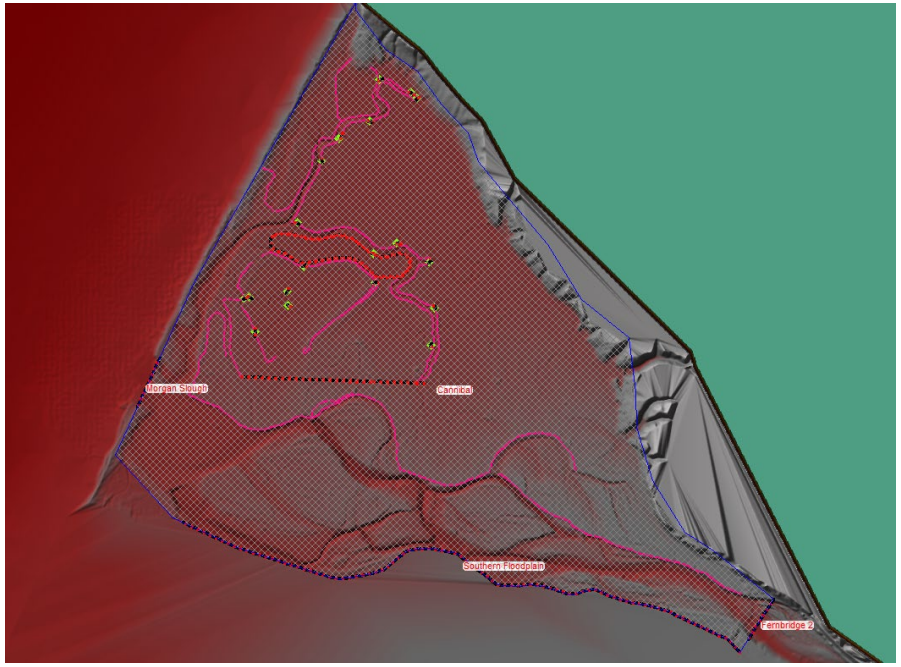




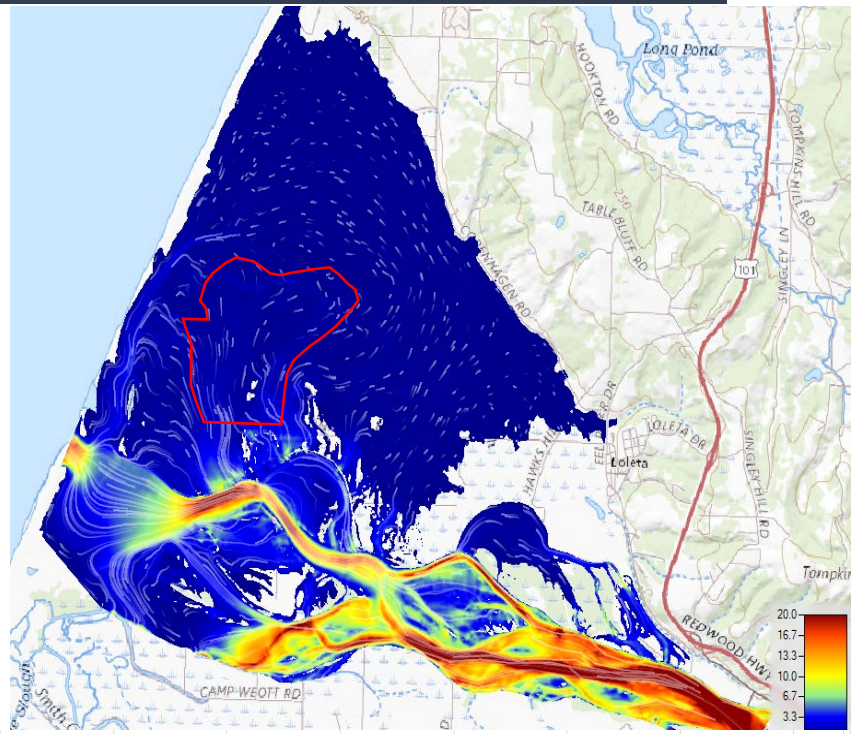




HEC-RAS 2-D Model Flooding Assessment

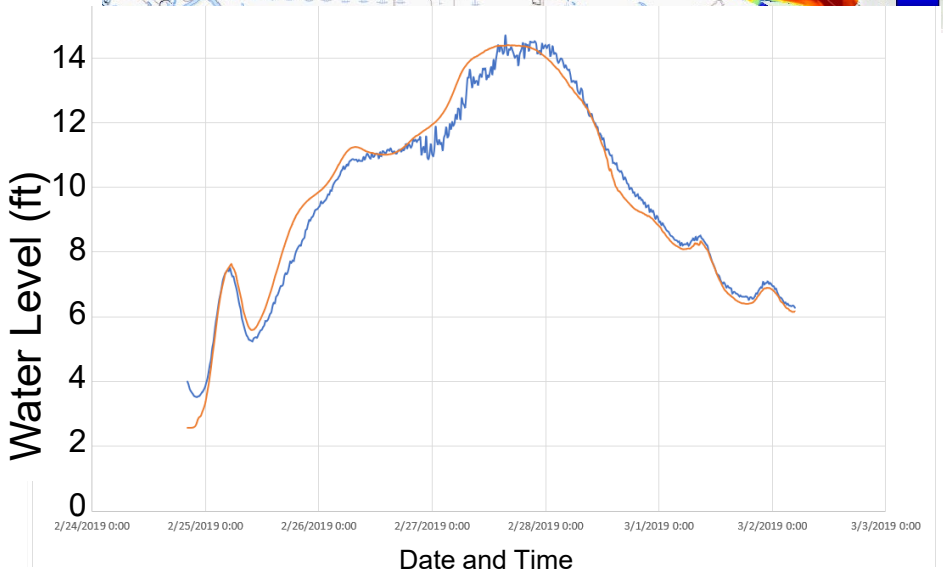


HEC-RAS 2-D Model Domain



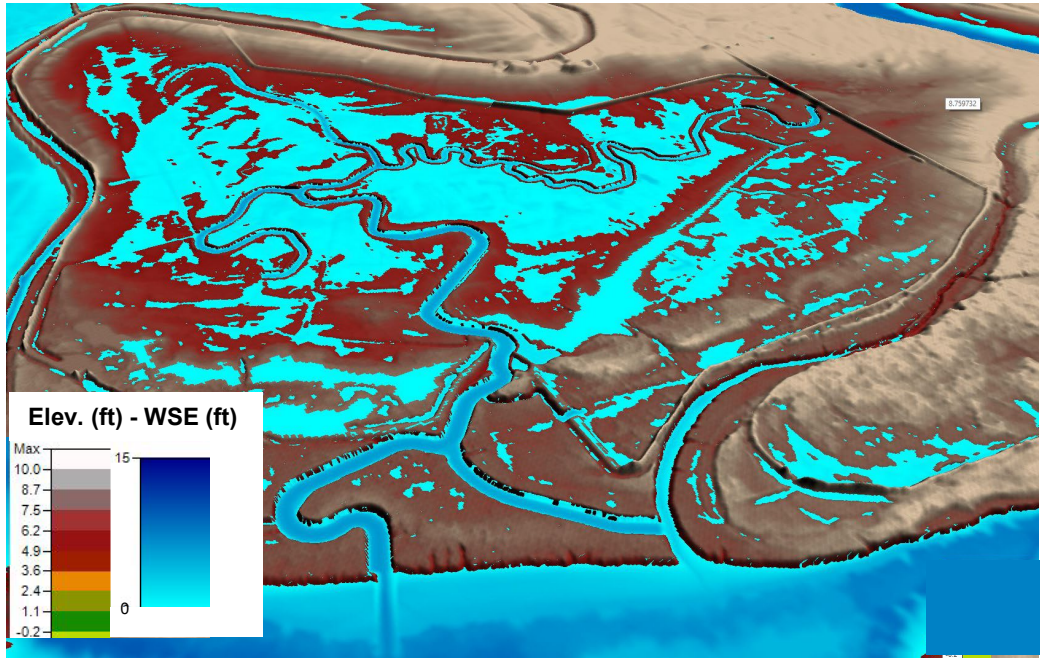
Extreme flood event representing 5th largest on record

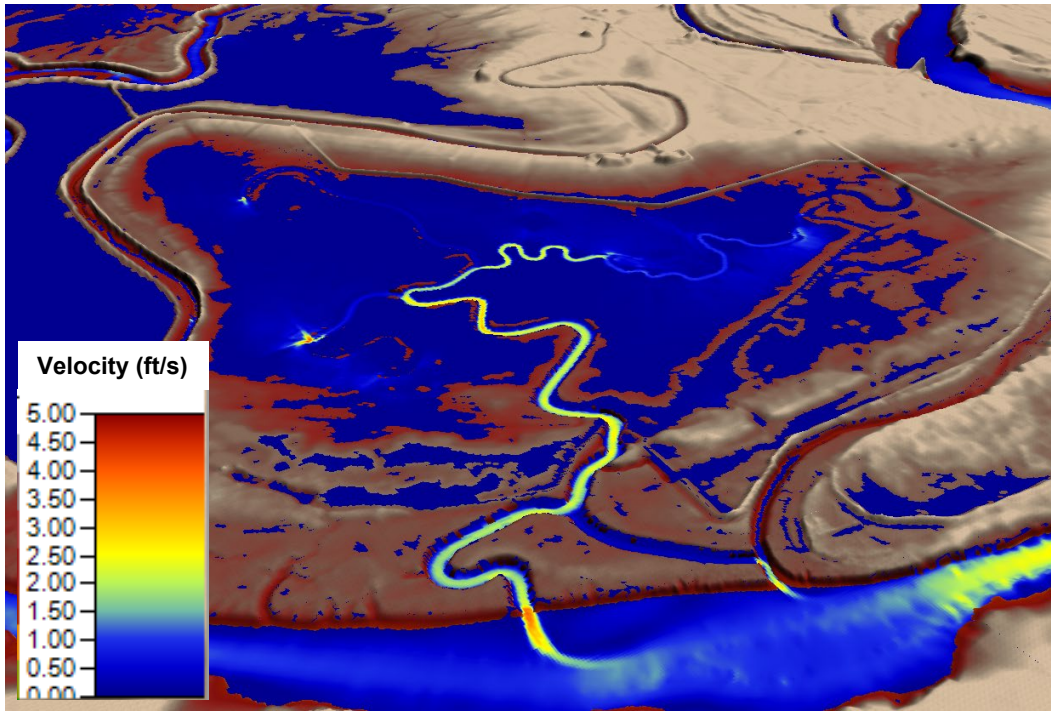
- Modeled water levels agree within 0.5 foot or less of observed



Cannibal Island - Alternative 4a Assessment

- Using HEC-RAS 2-D to balance velocity, promote tidal exchange and circulation, encourage sediment recruitment and monitor/adjust shear stress





Key Takeaways

Post construction monitoring informs/advances design approach

- Salt River post project monitoring (stable channel, equilibrium)
- Used to further refine and advance future modeling approaches
    - (Offsite impacts assessment expanding to incorporate prior hydrodynamic changes)

Building Landowner Trust (Multi-Year relations, budget and timeline alignment)

- Continually engaging/outreach
- Review and refine modeling/design approach to continually demonstrate effectiveness

Regulatory Agency Collaboration

- Model / information exchange across projects

Questions?

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AECOM. 2019. Ocean Ranch Hydraulic Study Report.

Ducks Unlimited (DU) and California Department of Fish & Wildlife (CDFW). 2015. Feasibility Study for the Restoration of the CDFW Ocean Ranch Unit of the Eel River Wildlife Area.

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USFWS. 2020. Feasibility Assessment for Russ Creek and Centerville Slough Restoration.

Williams and others 2002. Williams, Philip B., Michelle K. Orr, Nicolas J. Garrity, Hydraulic Geometry: A geomorphic Design Tool for Tidal Marsh Channel Evolution in Wetland Restoration Projects, Restoration Ecology, Vol. 10, No. 3, September 2002, pp 577-590.