



Skagit Delta Hydrodynamic Modeling Project

by

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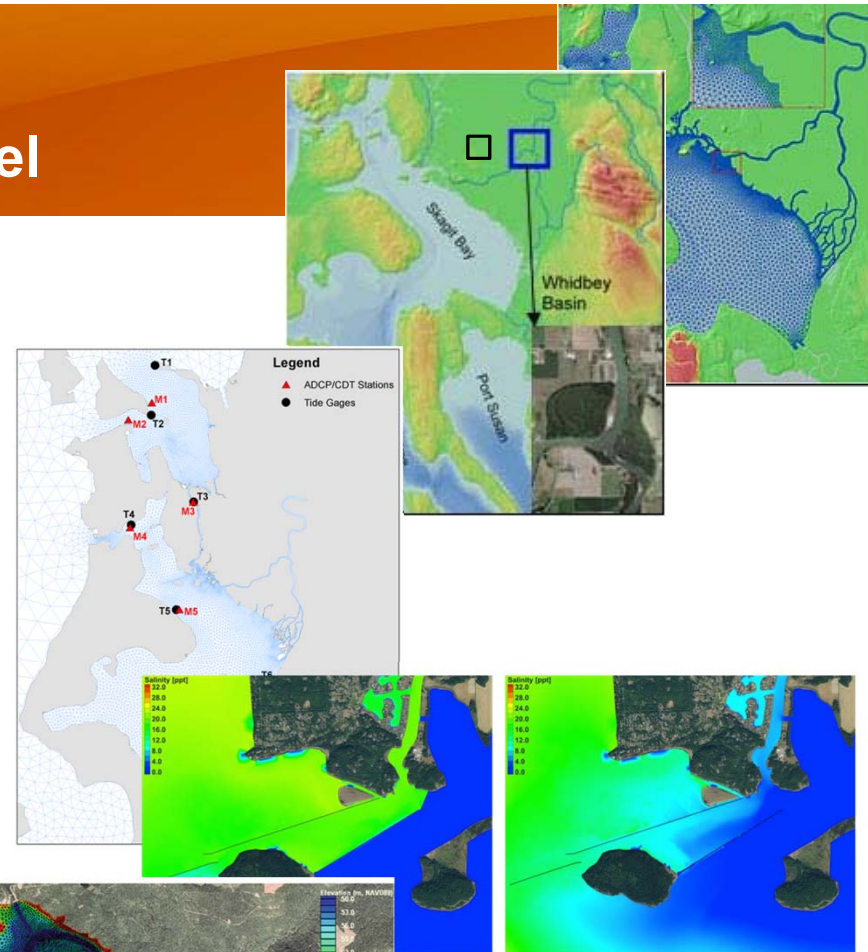
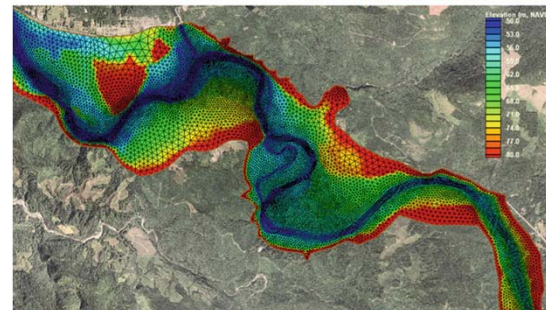
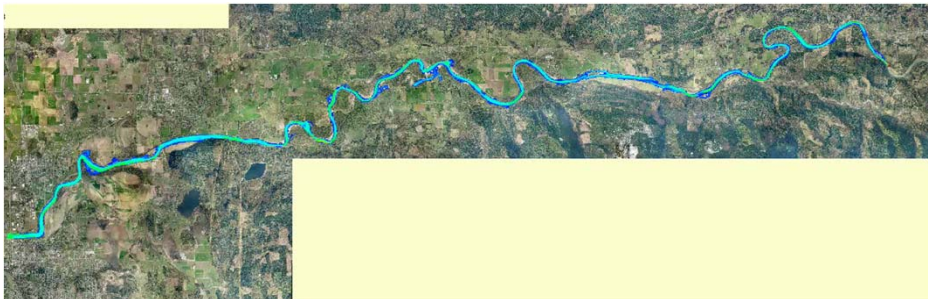
Presentation to
River Restoration Northwest Symposium
Stevenson, WA
February 7, 2018



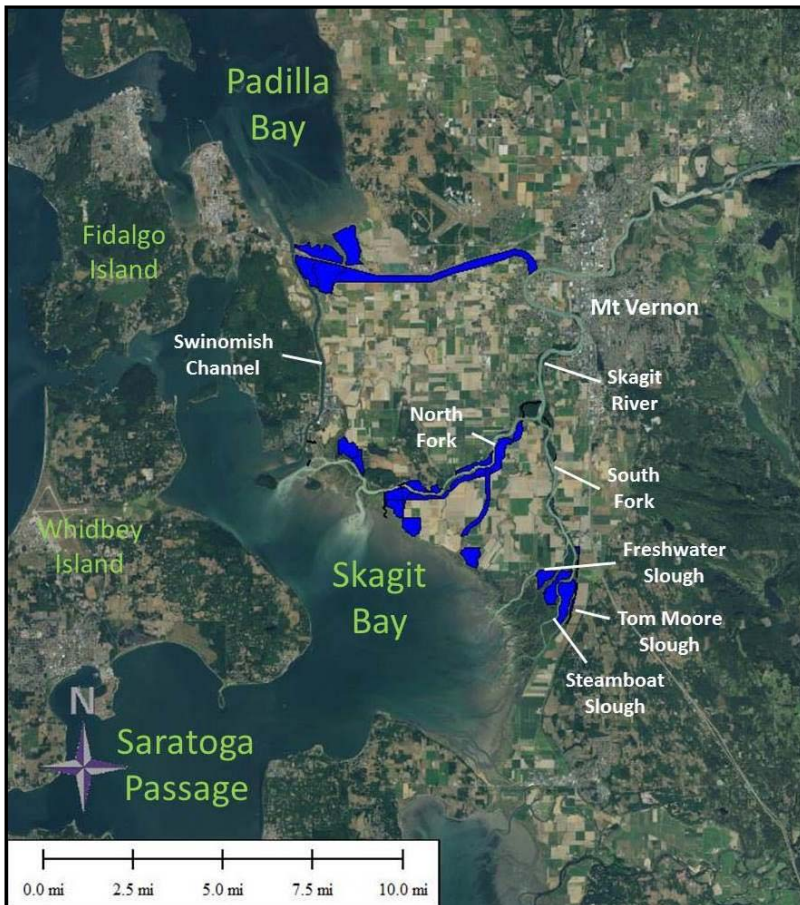
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Development of Skagit Hydrodynamic Model

- ▶ Rawlins Road Restoration Project – SWC (2005-2007)
- ▶ Cottonwood Island Restoration Feasibility – SWC (2006-2007)
- ▶ EPA Grant - Whidbey Basin Model – WWU & SRSC (2007-2011)
- ▶ McGlinn Causeway Project – SRSC (2009-2011)
- ▶ Crescent Harbor Restoration – SRSC (2008)
- ▶ Pocket Estuaries – Whidbey Basin (2008-2010)
- ▶ Flood Plain Restoration Project Assessment – SWC/SRSC (2010)



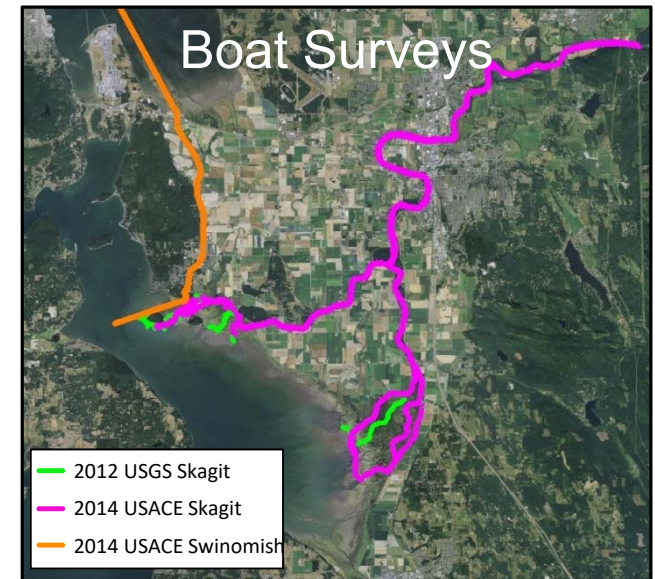
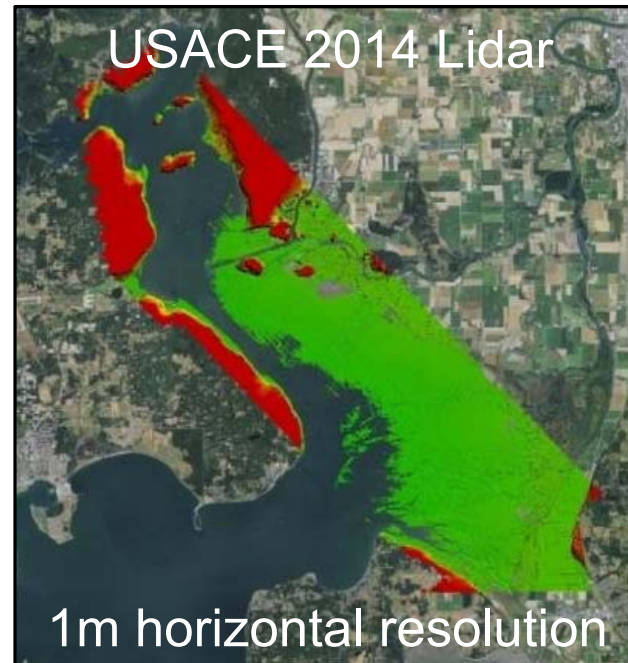
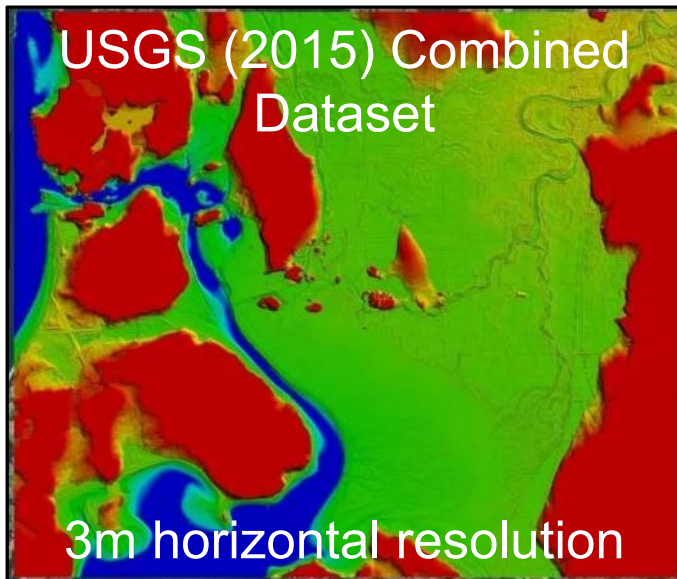
Objective: Assess Cumulative Impacts of Proposed Restoration Projects



- ▶ Modeling work began in 2015
- ▶ 23 proposed projects (blue polygons)
- ▶ Located in the Skagit River Delta and South Padilla Bay, Washington
- ▶ 10 simulations comparing restored conditions to a calibrated baseline

Updated Bathymetry Data

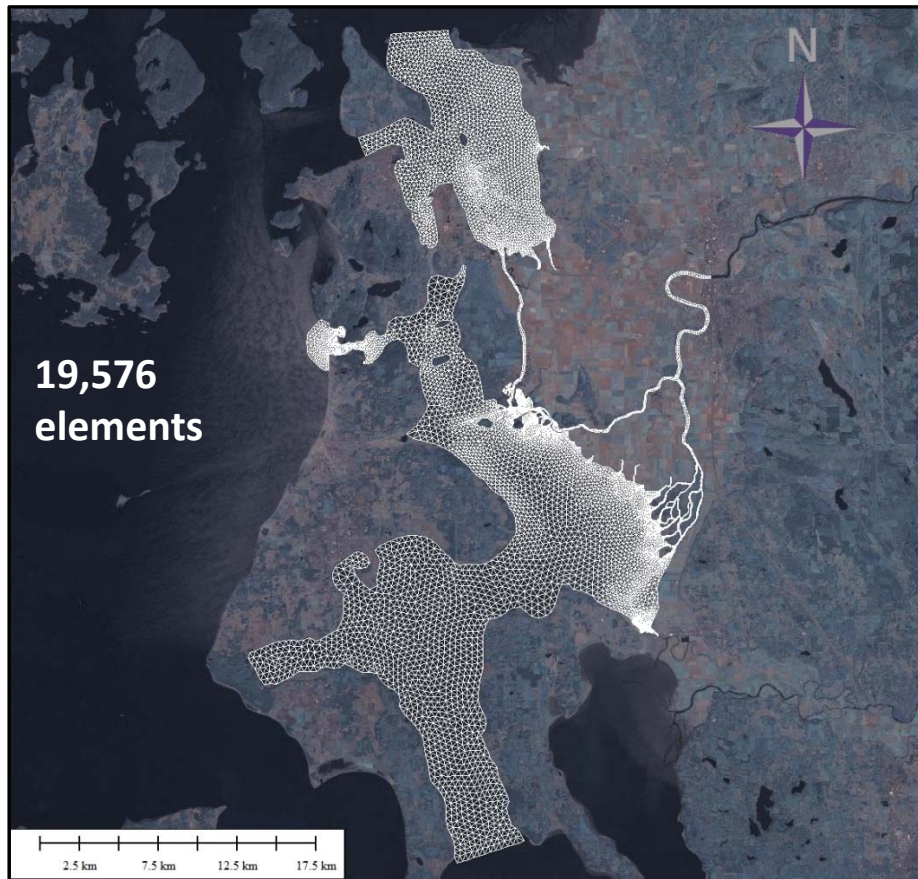
Combined Recent Available Datasets



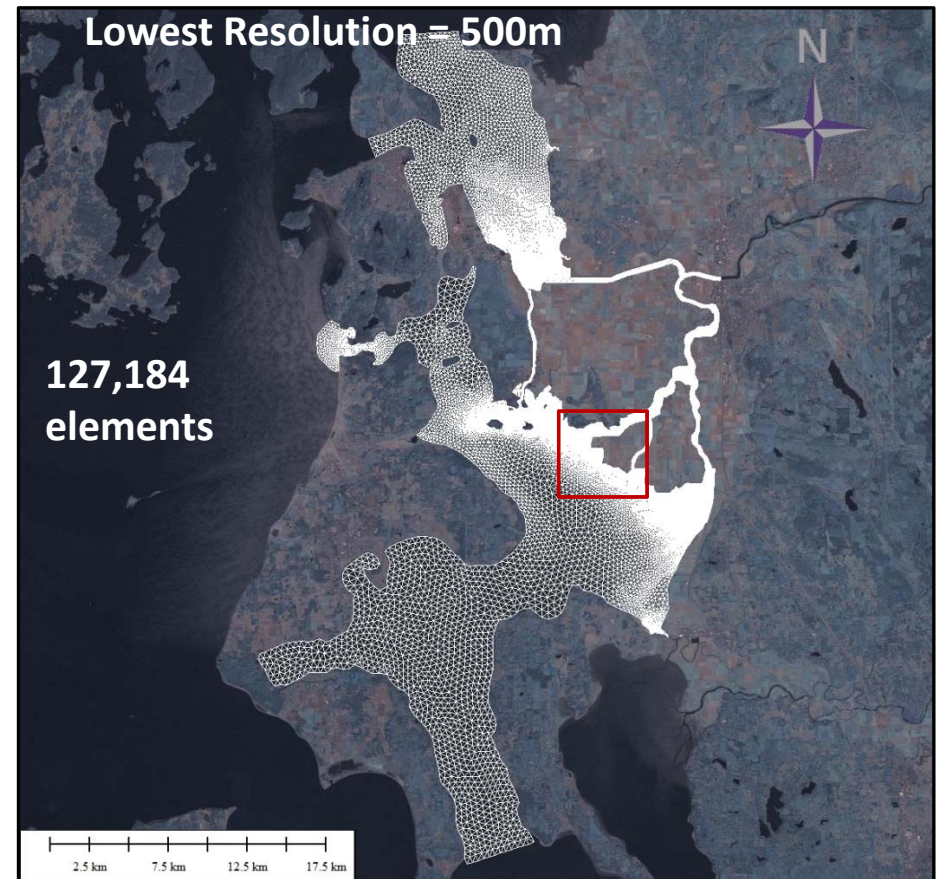
Also used 2006 data
from LIDAR Consortium

Model Domain and Grid

Unstructured Grid within Puget Sound



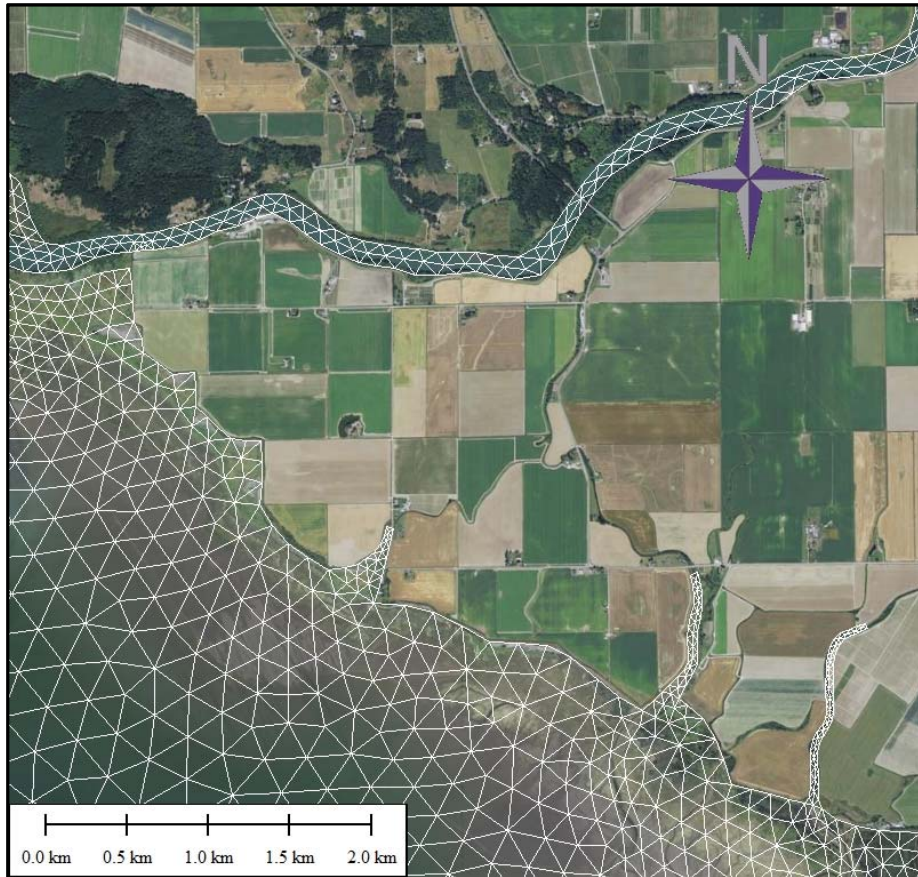
Existing Skagit Bay Model



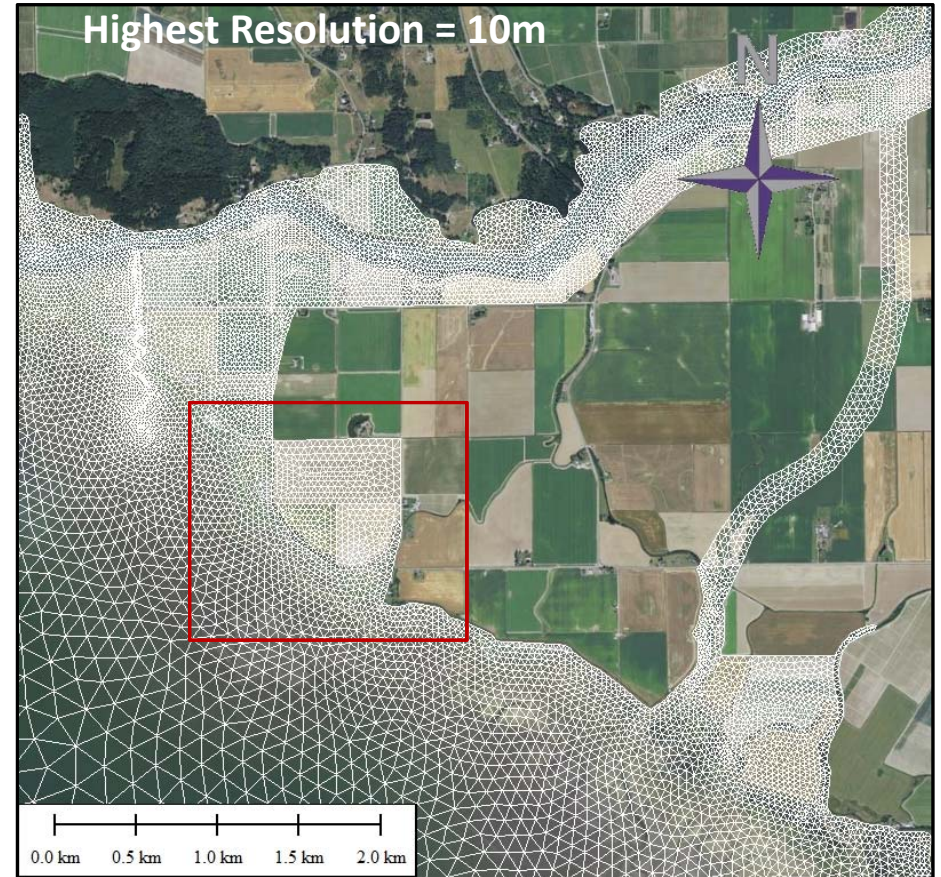
Updated Grid

Model Domain and Grid

North Fork

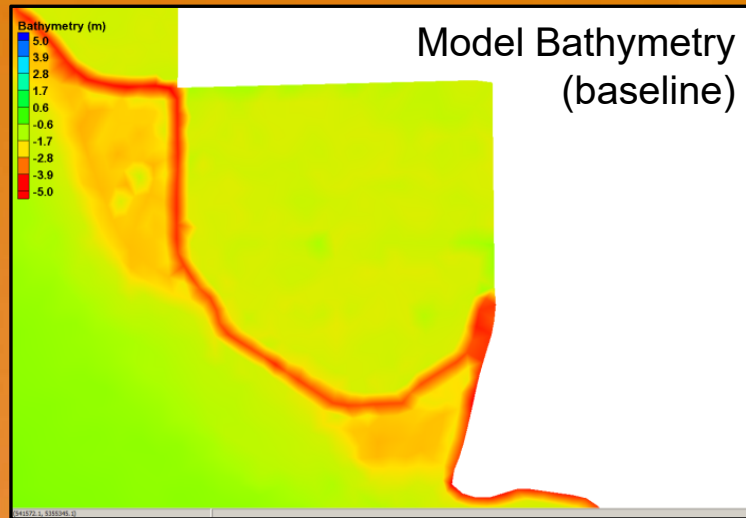
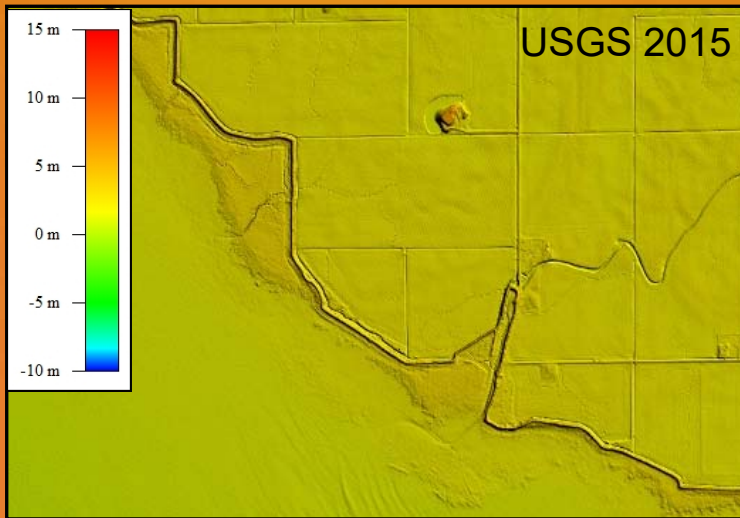


Existing Skagit Bay Model



Updated Grid

Site 7 – Hall Slough

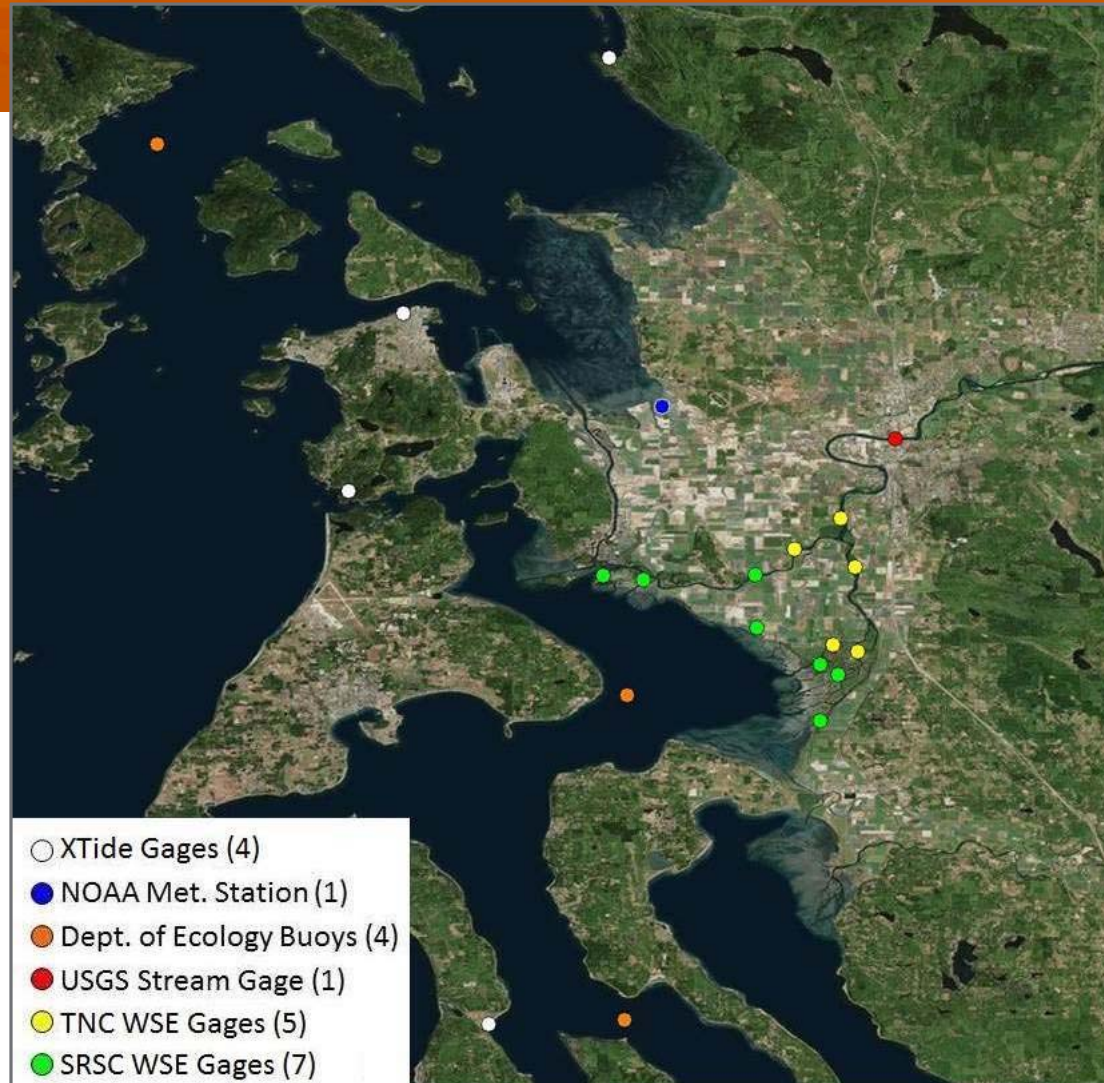


Available Monitoring Data



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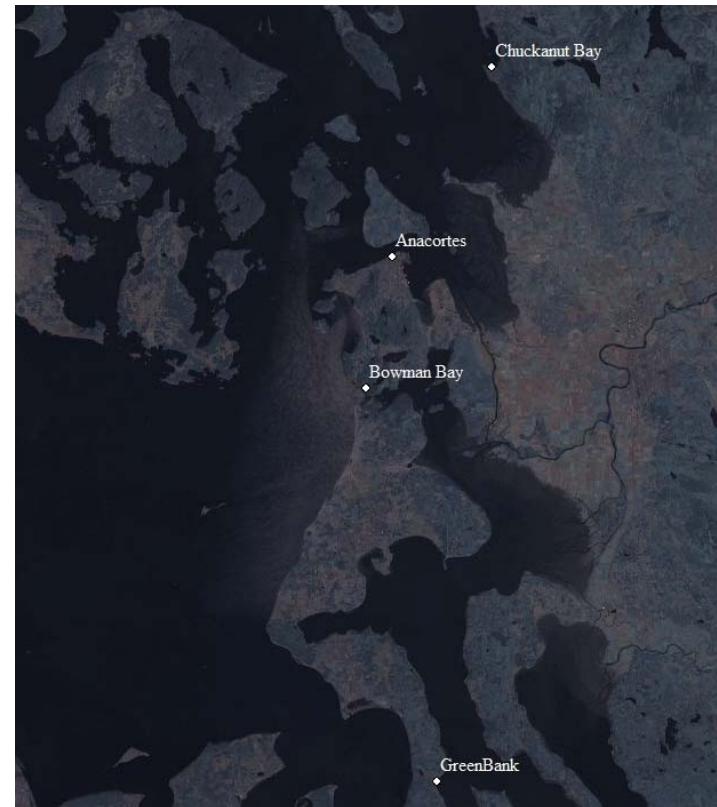
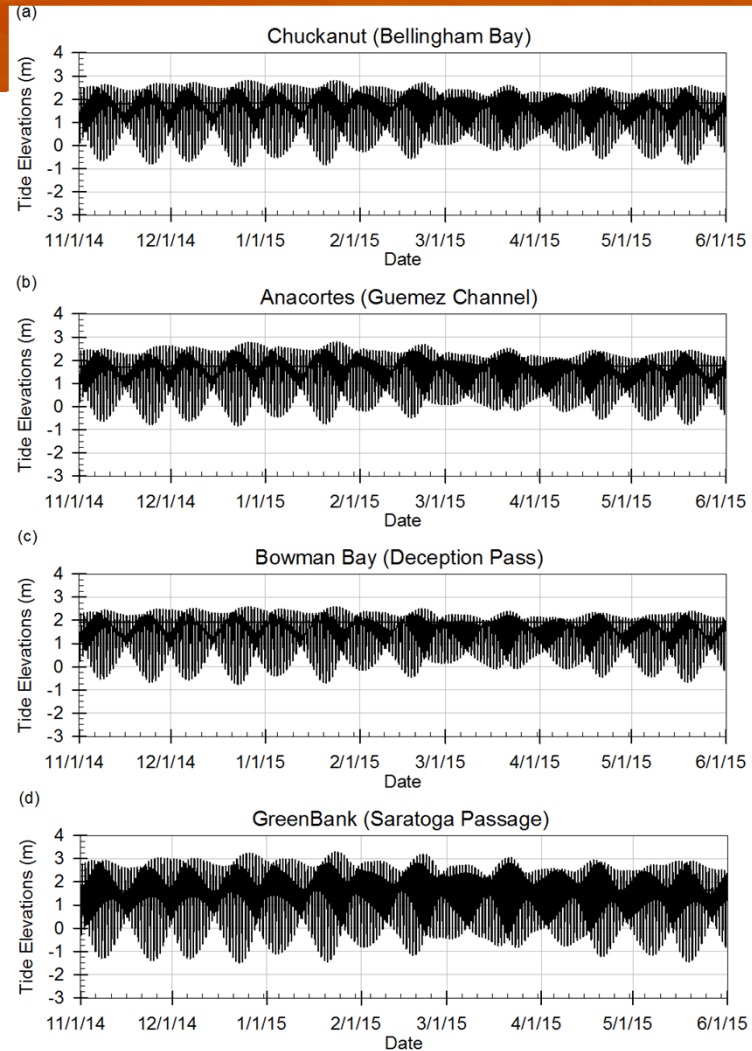


Boundary Conditions – Tides



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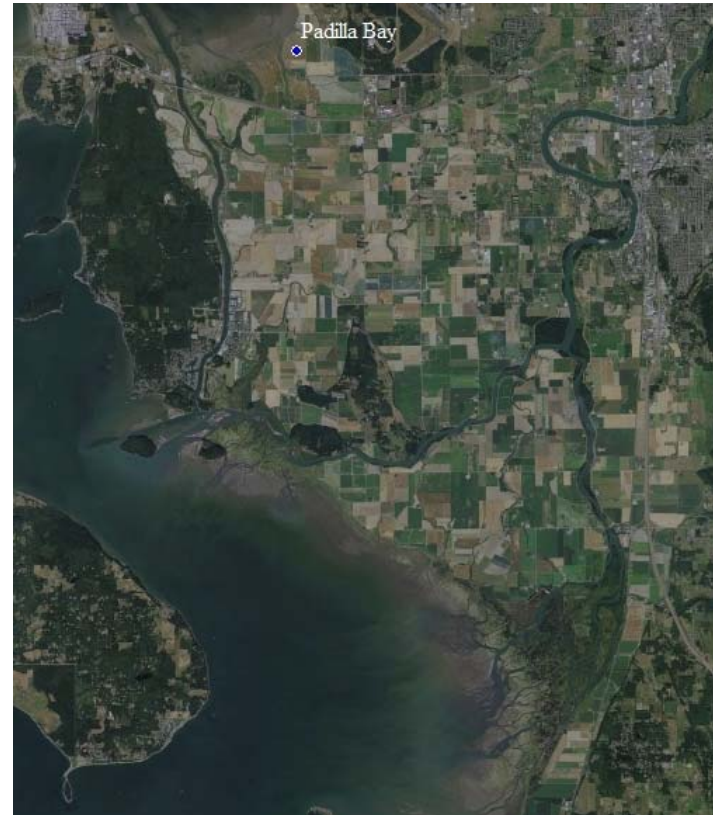
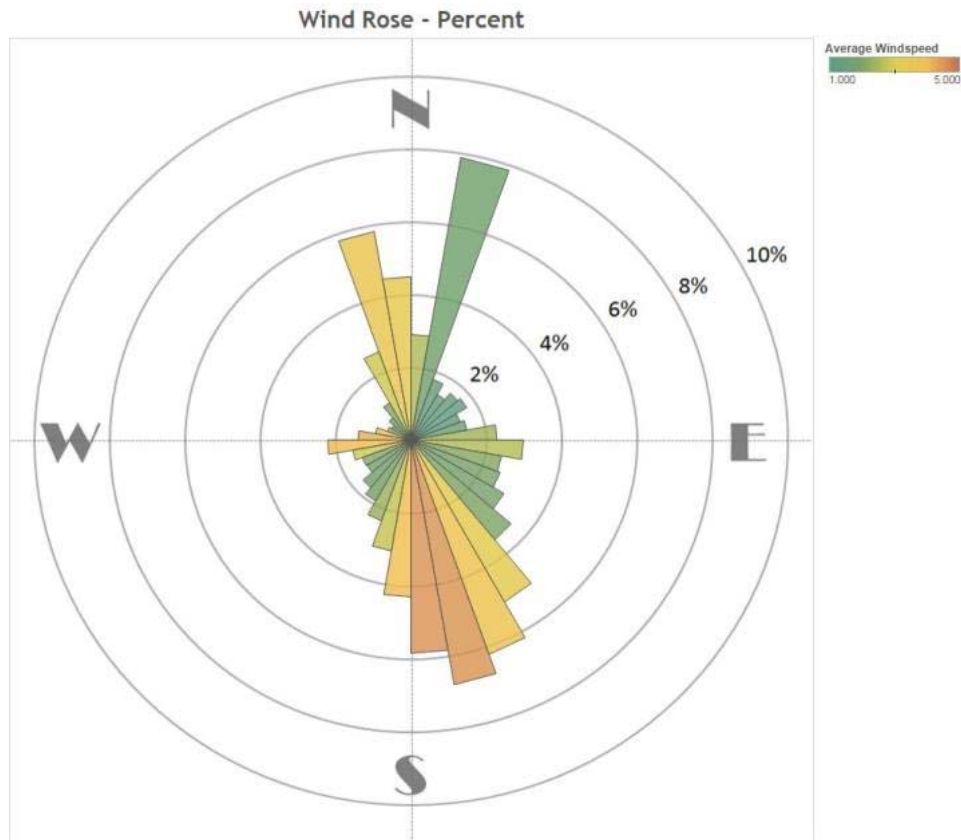
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Elevations: NADV88 Datum
Source: XTide

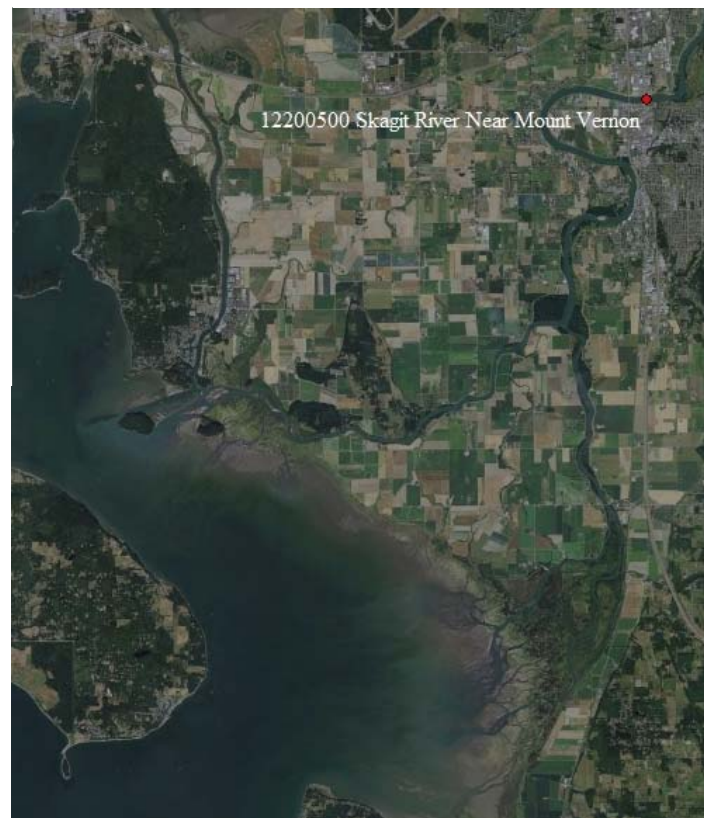
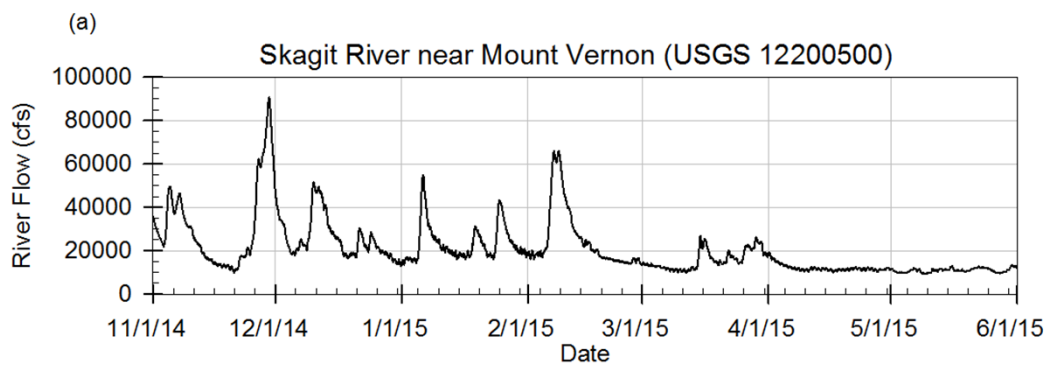
Meteorological Input

Wind (11/14 – 6/15)



Source: NOAA

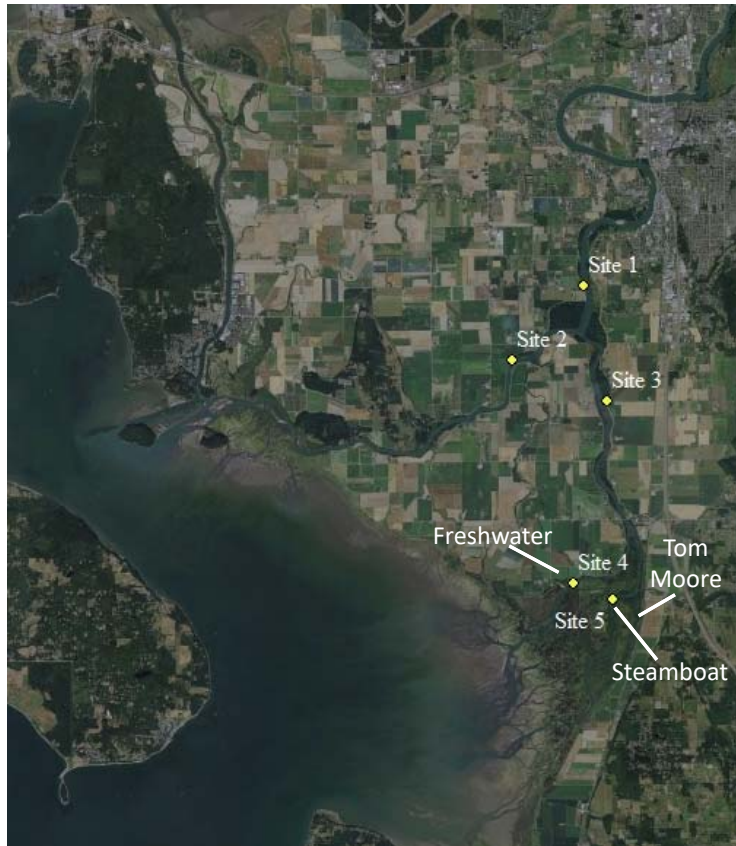
Boundary Conditions – River Flow



Elevations: NADV88 Datum
Source: USGS



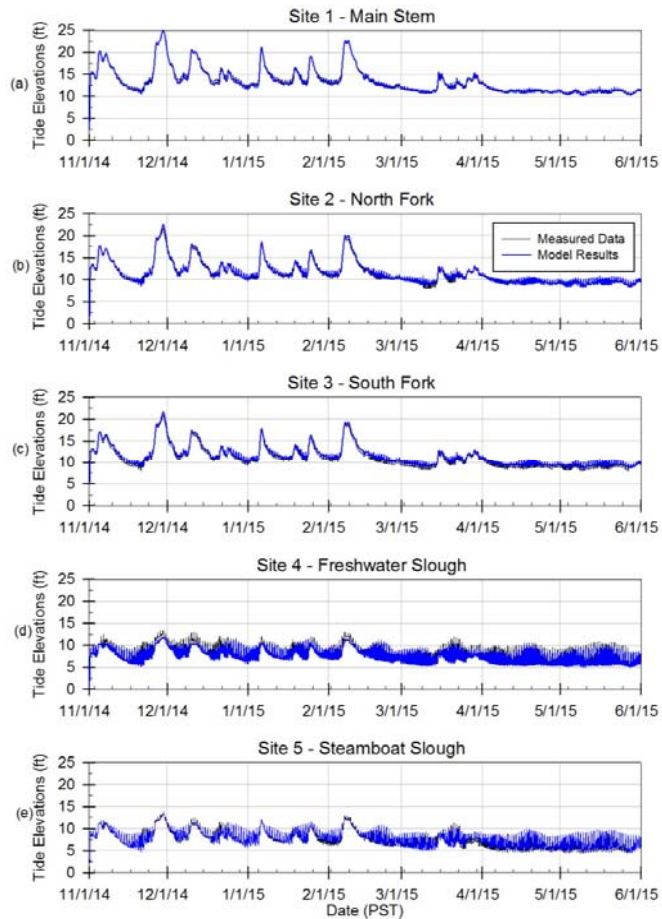
Skagit Water Surface Elevation Gauges



- ▶ WDFW Deployed from Nov 5, 2014 – May 27, 2015
 - Two 2-year floods
 - Fish out-migration period

- ▶ Determine flow distribution:
 - North Fork and South Fork
 - Freshwater Slough, Steamboat Slough, (and Tom Moore Slough)

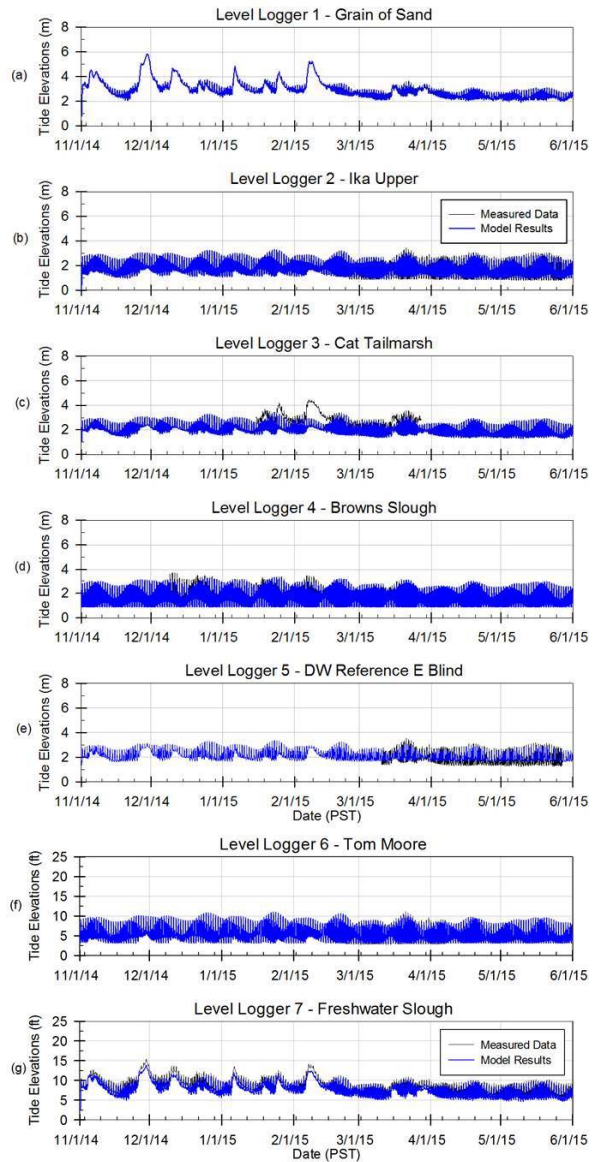
WDFW – Water Level Loggers



- ▶ Model sites calibrated within 1.4%, 1.0%, 2.8%, 9.6% and 2.3% relative error, respectively

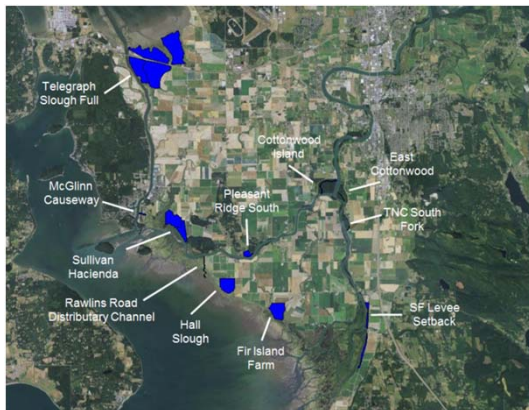


Tribes – Water Level Loggers



Grouped Project Runs

Simulation 1: Small Projects



Simulation 6: Moderate Influence #1



Simulation 7: Moderate Influence #2



Simulations 8 & 10: Selected Projects

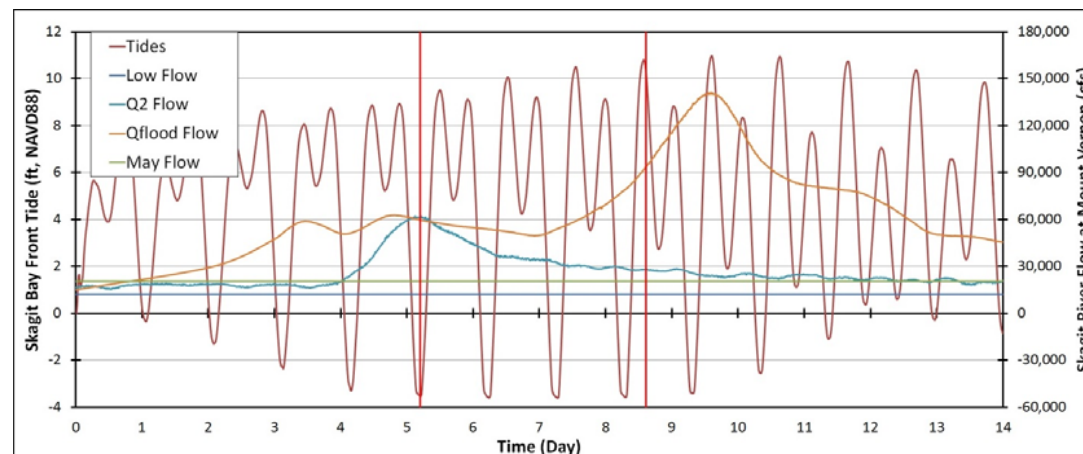


- ▶ Blue polygons are planned projects
- ▶ Simulations 1-7 isolate project effects
- ▶ Simulation 8 shows cumulative effect
- ▶ Simulations 9-10 show effects of climate change

Model Runs per Scenario

Current Conditions

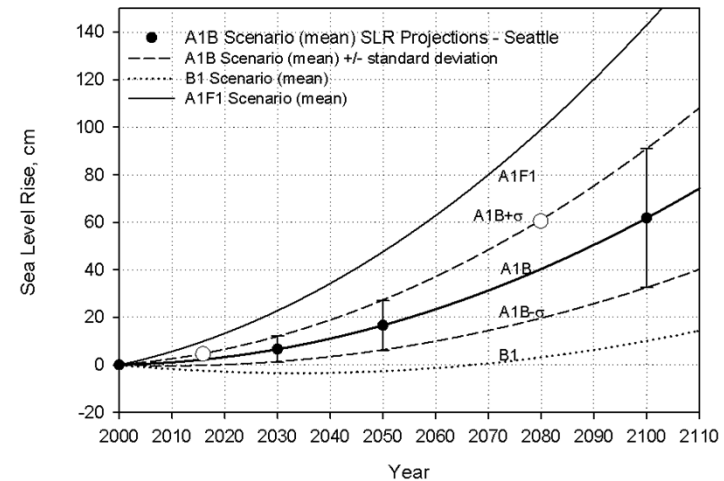
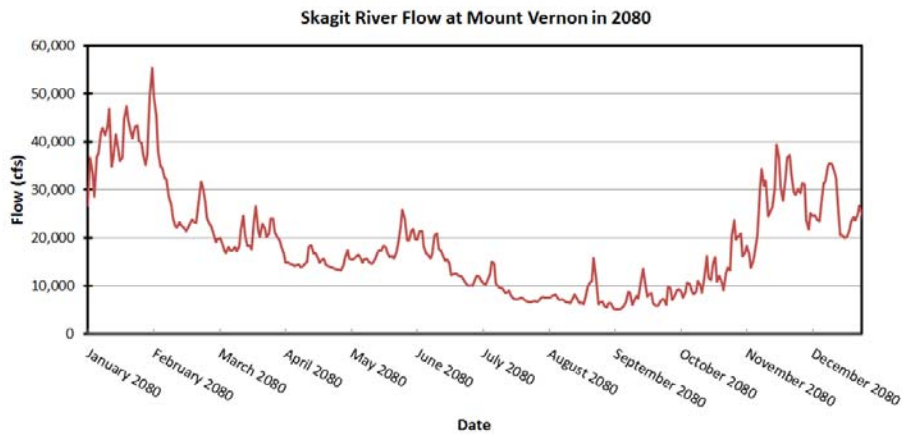
- ▶ Full model simulation from **Nov 1, 2014 – May 22, 2015** using historic hydrographs and tide charts
- ▶ Two-week design runs to isolate effects of riverine, tidal, flood, etc.
 - **Tidal**: Low flow (12,000 cfs) and high Spring tide (10.8 ft NAVD88)
 - **Riverine**: Q2 flow (62,000 cfs) and low Spring tide (-3.3 ft NAVD88)
 - **Flood**: Qflood (93,200 cfs) and high Spring tide (10.4 ft NAVD88)
 - Conditions in 1995 flood just before overtopping
 - Mean May flow (20,400 cfs) and high Spring tide (10.8ft NAVD88)



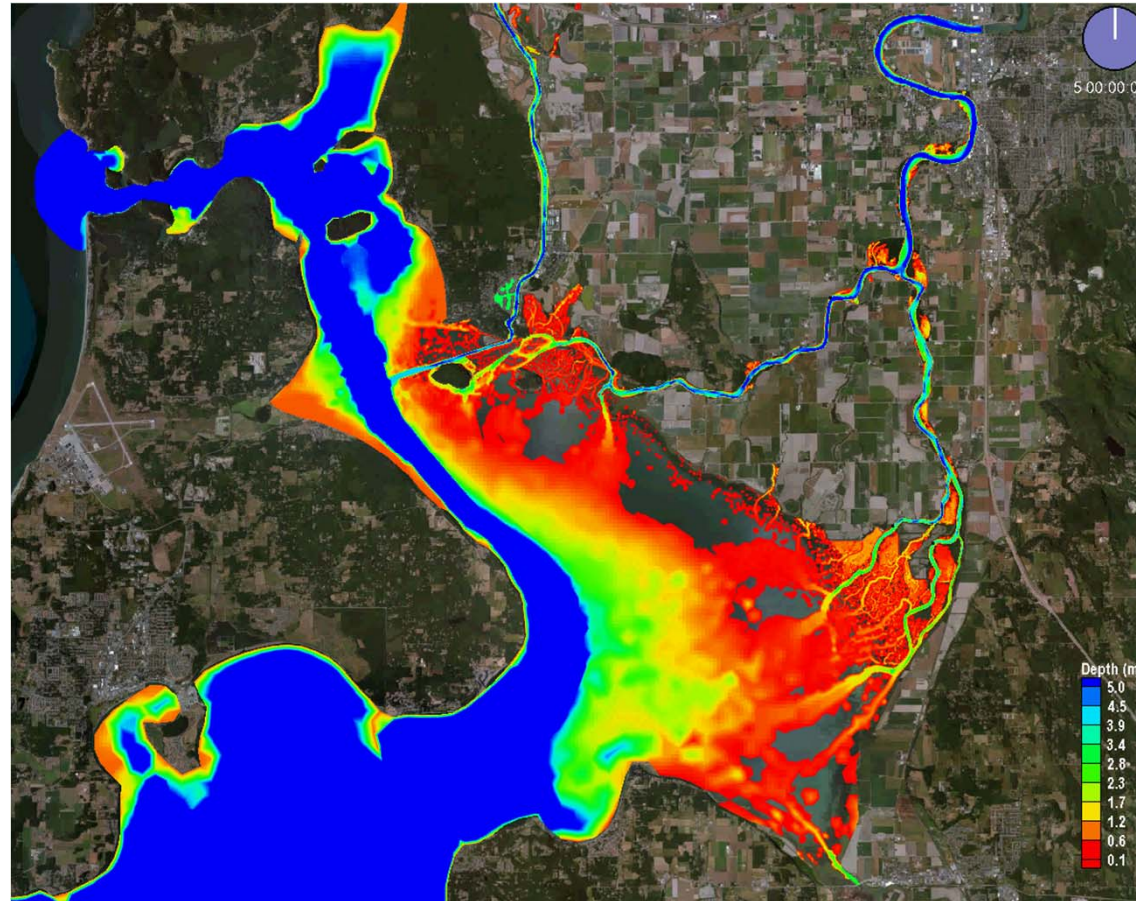
Model Runs per Scenario

Future Conditions

- ▶ Full model simulation from **Nov 1 – May 22** using future hydrograph and tide charts (A1B-IPCC emission scenario)
- ▶ Two-week design runs to isolate effects of riverine, tidal, flood, etc.
 - Tidal: Future low flow (12,000 cfs) and high Spring tide (12.67 ft NAVD88)
 - Riverine: Future Q2 flow (103,237 cfs) and low Spring tide (-1.43 ft NAVD88)



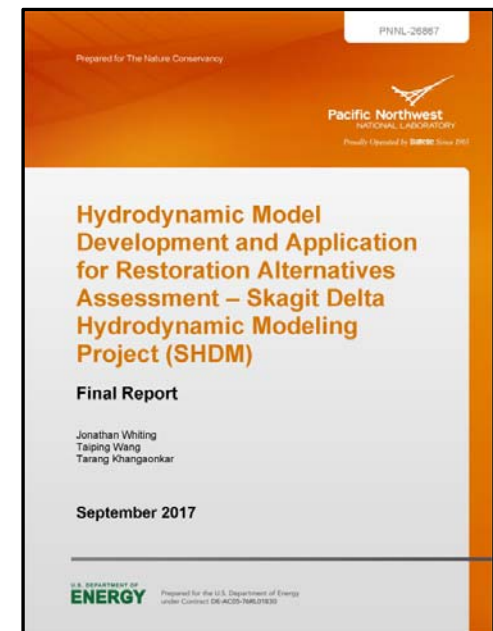
Animation: Water Depth (0 to 5 m levels)





Key Takeaways

- ▶ Findings in the next presentation
- ▶ Created a high-resolution regional model for the Skagit River Delta
 - Improved computing makes more detailed models feasible
 - Boundary conditions for site-specific modeling
- ▶ Cumulative effects on the viability of each project
 - River flow shifting between forks
 - Altering tidal prism
- ▶ Think long term: Project effectiveness in 60 years?
 - Projected sea level rise and hydrographs





Thank you!

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