2D Modeling for the San Joaquin Basin-Wide Feasibility Study to Promote Multi-Benefit Projects

2016 CWEMF Annual Meeting

Modeling Extremes: Drought to Flood and In-Betweens

Devinder S. Dhillon, P.E.

California Department of Water Resources

April 2016

CVFPP 2017 ROADMAP

WBG040714003611SAC

Background

- Central Valley Flood Protection Plan (CVFPP)
  - Framework for system-wide flood management and flood risk reduction in the Sacramento and San Joaquin River Basins
- Basin-Wide Feasibility Study
  - Evaluate the feasibility of different alternatives for improving the flood management system in both the Sacramento and San Joaquin Basins
  - Promote ecosystem enhancements and multi-benefit projects

Challenge

Model floodplain inundation to assess floodplain benefits

2D

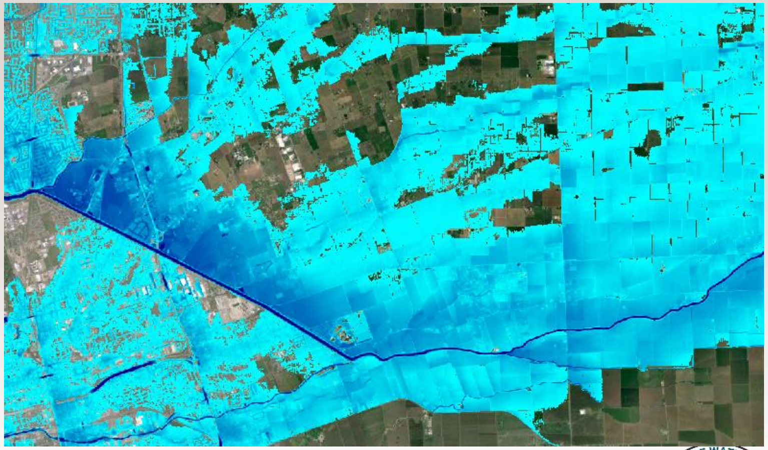
Need for 2D Modeling

Ecosystem

- Determine additional floodplain available for fish within ecosystem restoration areas

Inundation Maps

- Develop inundation maps for evaluation of other benefits



Tools

HEC-RAS 5.0 (2D modeling capabilities)

- Detailed 2D channel modeling*
- Detailed 2D channel and floodplain modeling*
- Combined 1D channels with 2D floodplain areas*

Information and Tools used from the DWR Central Valley Floodplain Evaluation and Delineation (CVFED) Program: HEC-RAS Models and LiDAR Data

*2D Modeling Users Manual. HEC-RAS, River Analysis System, Version 5.0. August 2015.

HEC-RAS 5.0 Guidelines

Using the correct weir coefficients for Lateral Structures connected to a 2D Flow Area

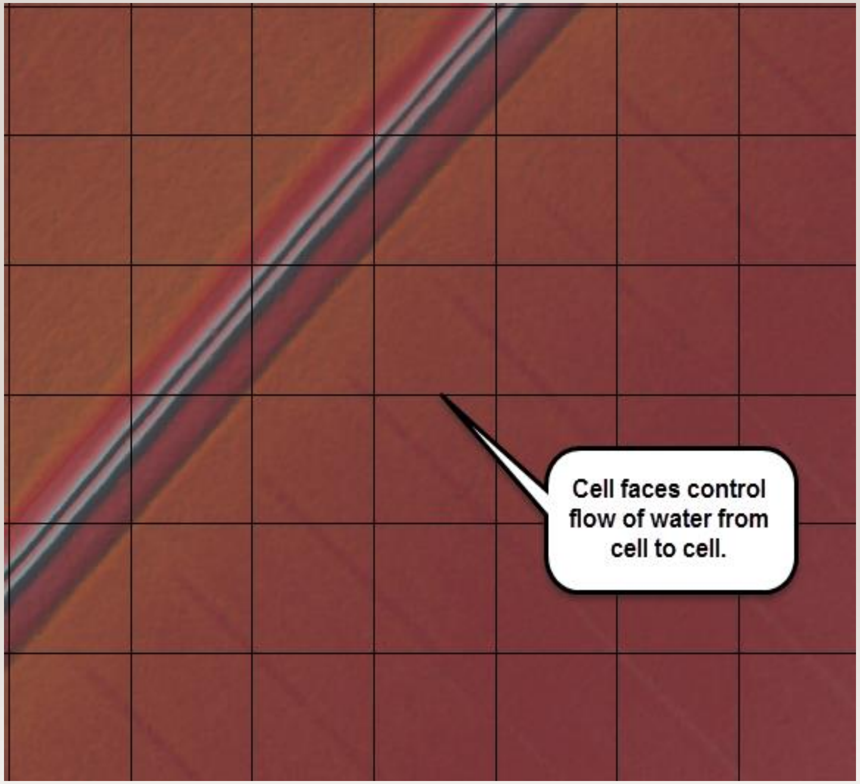
Table 1. Lateral Weir Coefficients

What is being modeled with the Lateral Structure	Description	Range of Weir Coefficients
Levee/Roadway – 3ft or higher above natural ground	Broad crested weir shape, flow over levee/road acts like weir flow	**1.5** to **2.6** (2.0 default) SI Units: 0.83 to 1.43
Levee/Roadway – 1 to 3 ft elevated above ground	Broad crested weir shape, flow over levee/road acts like weir flow, but becomes submerged easily.	**1.0** to **2.0** SI Units: 0.55 to 1.1
Natural high ground barrier – 1 to 3 ft high	Does not really act like a weir, but water must flow over high ground to get into 2D flow area.	**0.5** to **1.0** SI Units: 0.28 to 0.55
Non elevated overbank terrain. Lat Structure not elevated above ground	Overland flow escaping the main river.	**0.2** to **0.5** SI Units: 0.11 to 0.28

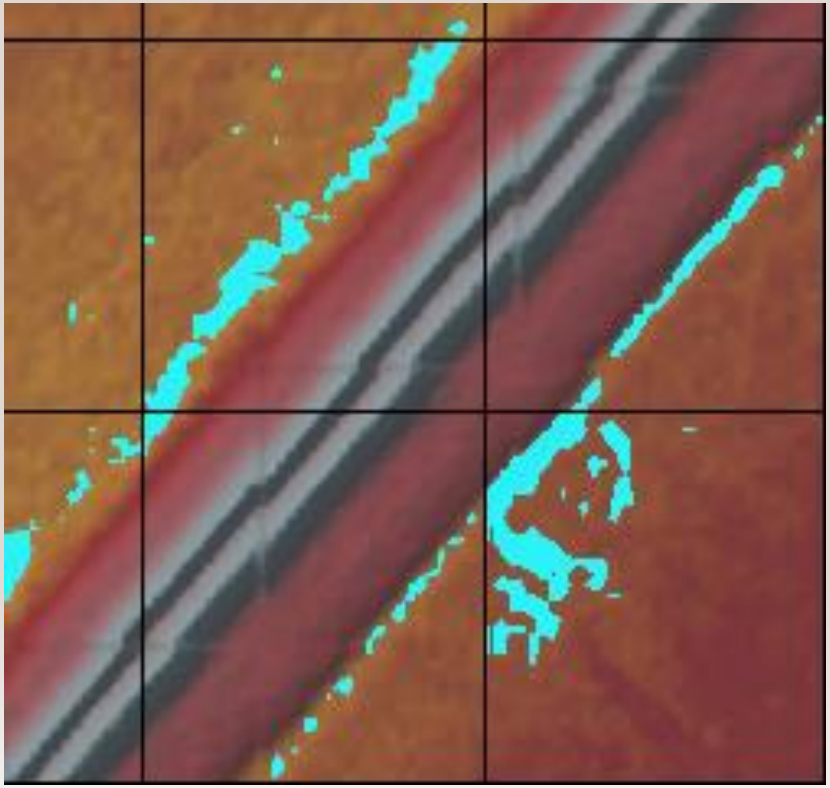
HEC-RAS 2D Modeling User's Manual

HEC-RAS 5.0 Guidelines

Cell faces control flow of water

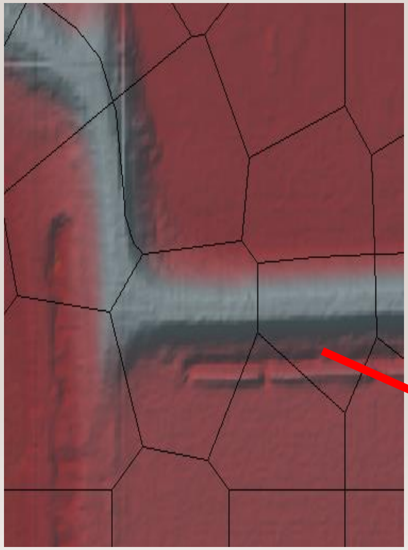


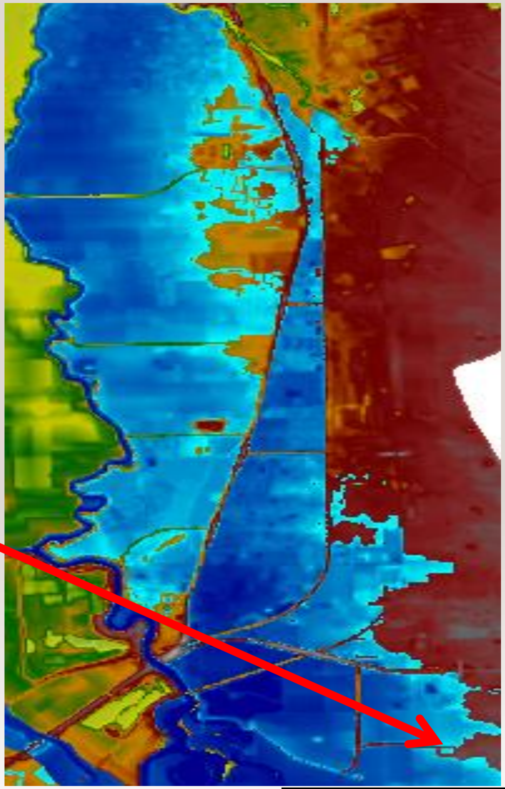
Water "jumping" across high ground

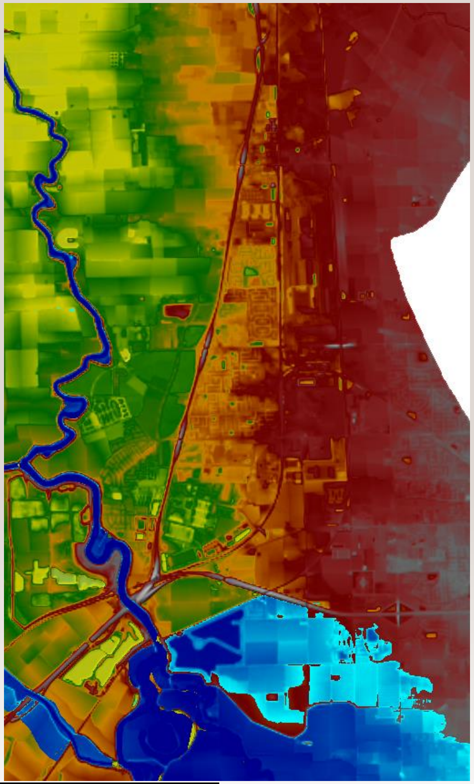


HEC-RAS 5.0 Guidelines

Water “jumping” across high ground

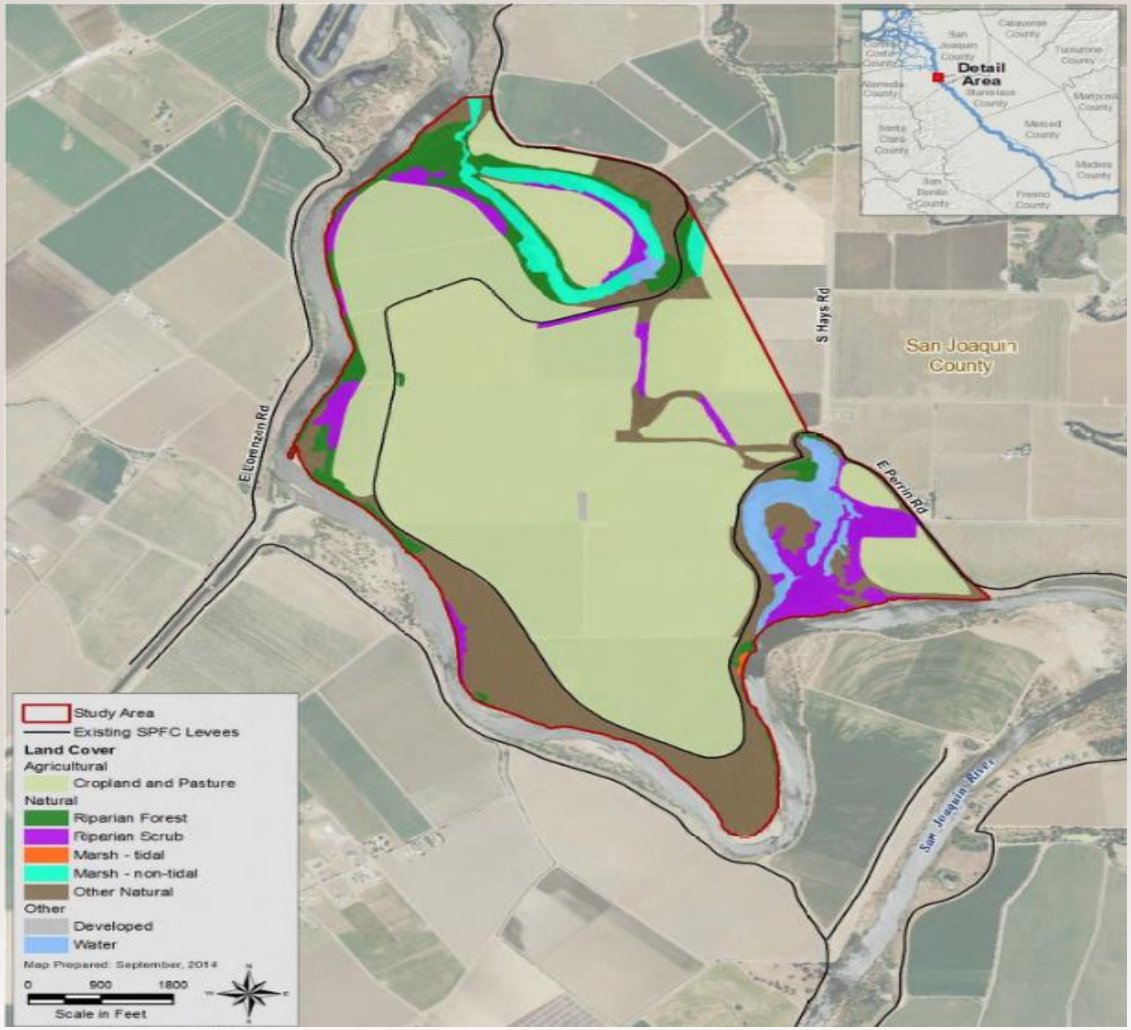






This is a hypothetical event. Intended purpose is to only show difference of flooding in the floodplain.

Ecosystem: River Mile 60-65



Ecosystem: River Mile 60-65 2D Model

Spatially Varied Manning’s n

Land Cover to Manning's n (2D Flow Areas Only)

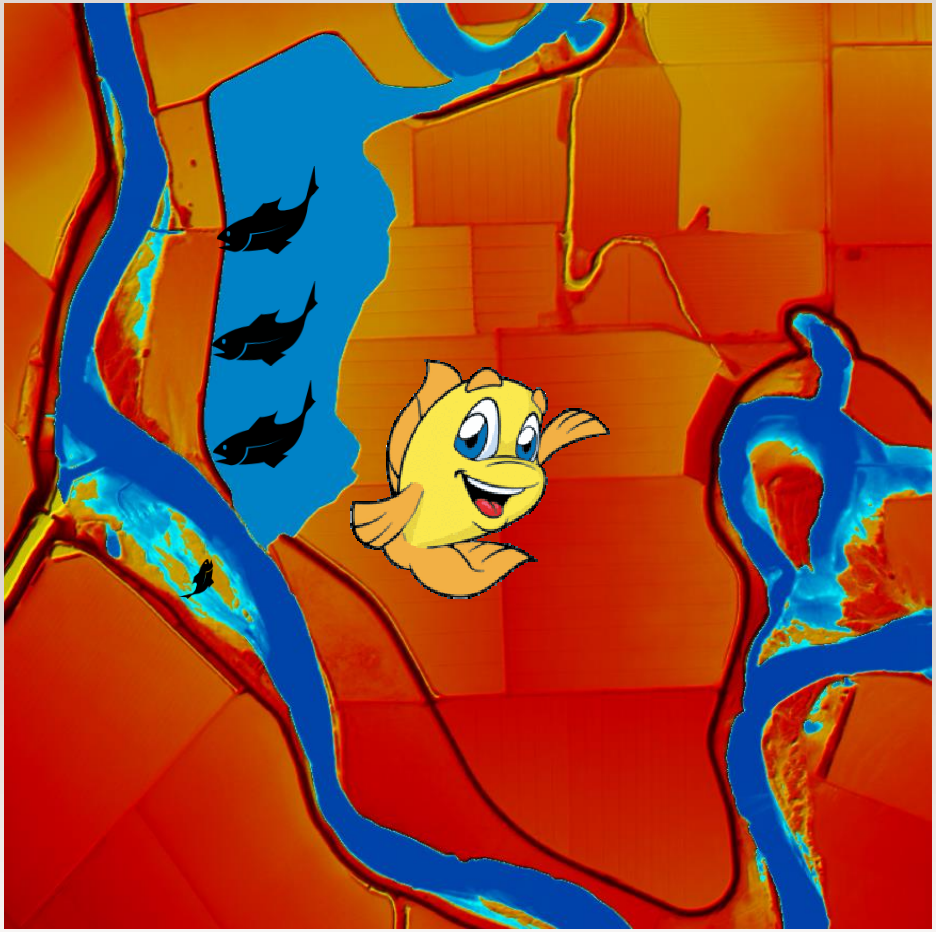
Set Manning'sn n for Base column and override where desired in each region

Selected Area Edit Options

Add Constant ... | Multiply Factor ... | Set Values ... | Replace ...

	Land Cover Name	Base
1		0
2	NoData	0.04
3	Annual Grassland / Oak Savannah	0.035
4	Developed	0.1
5	Floodplain Agriculture	0.035
6	Fresh Emergent Wetland	0.04
7	Riparian Forest	0.1
8	Riparian Scrub	0.07
9	Seasonal Wetland	0.045
10	Water	0.03
11	Cropland and Pasture	0.035
12	Marsh - non-tidal	0.045
13	Marsh - tidal	0.045
14	Other Natural	0.04
15	Annual Grassland	0.035

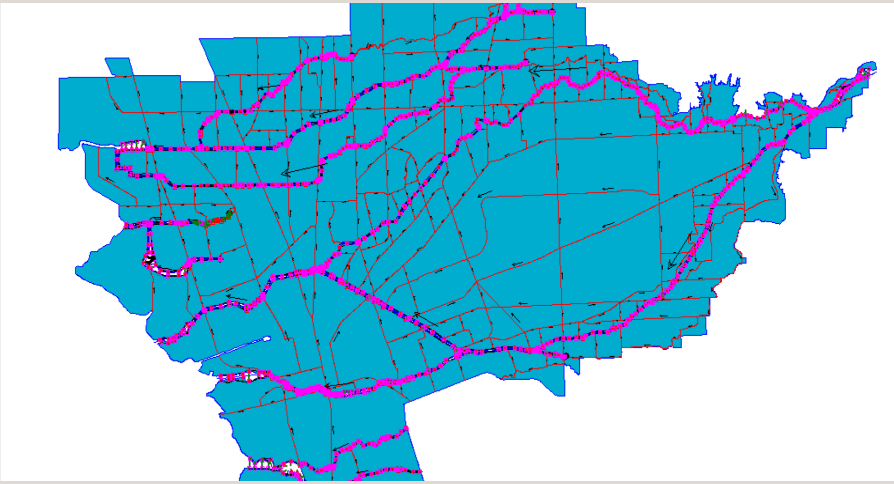
Ecosystem: River Mile 60-65 Inundation



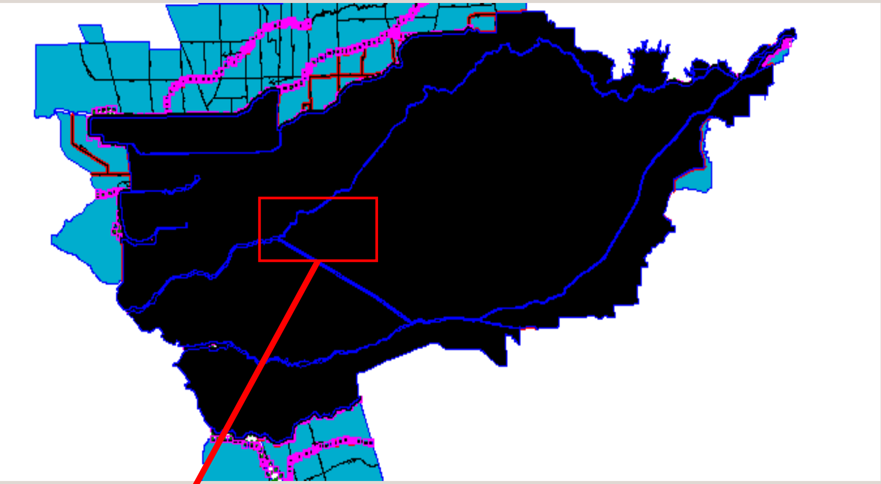
Inundation Map: Stockton

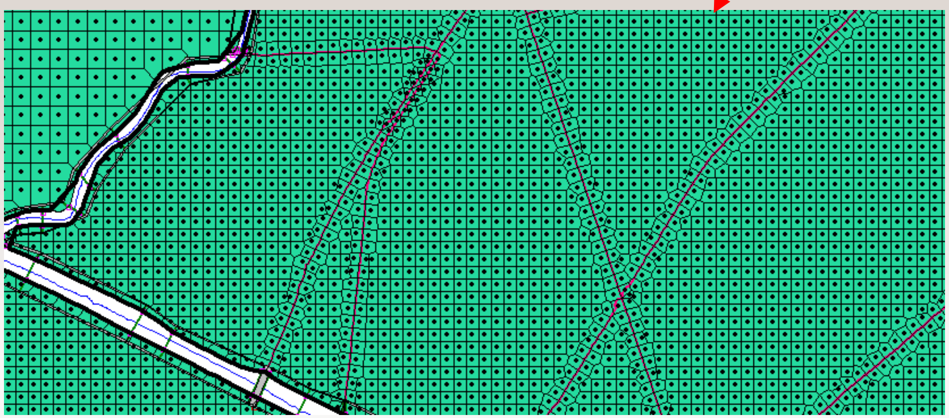
Inundation Map: Stockton 2D Model

Original Stockton Model



Stockton 2D Model



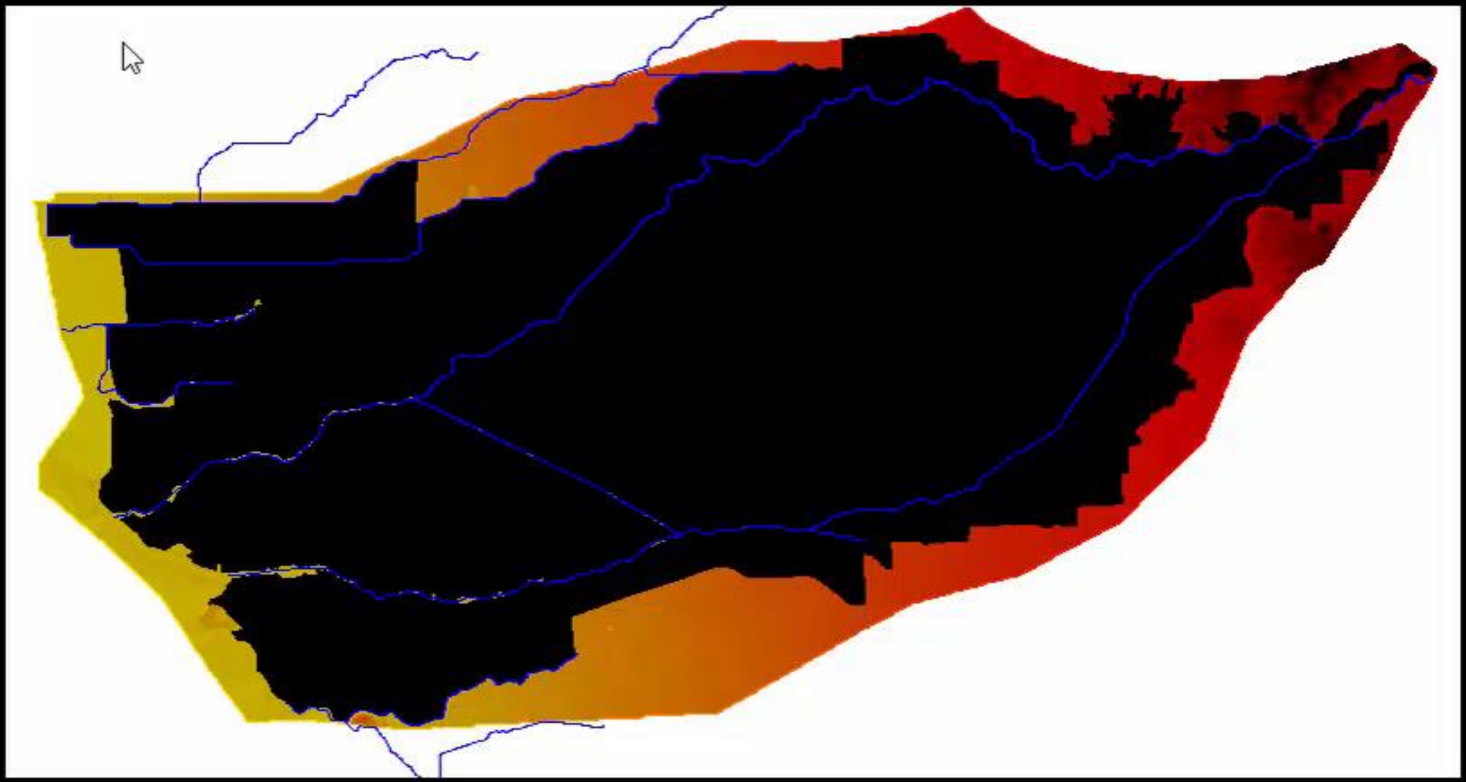


Next Steps: Stockton 2D Model

- Move to Official Release of HEC-RAS 5.0
- Spatially Varied Manning's n
- 2D Saint Venant Equations (currently using 2D Diffusive Wave Equations)
- Calibration

Stockton 2D Model Animation

This is an extreme hypothetical event. Intended purpose is to only show flooding in the floodplain.



Other 2D Modeling Efforts

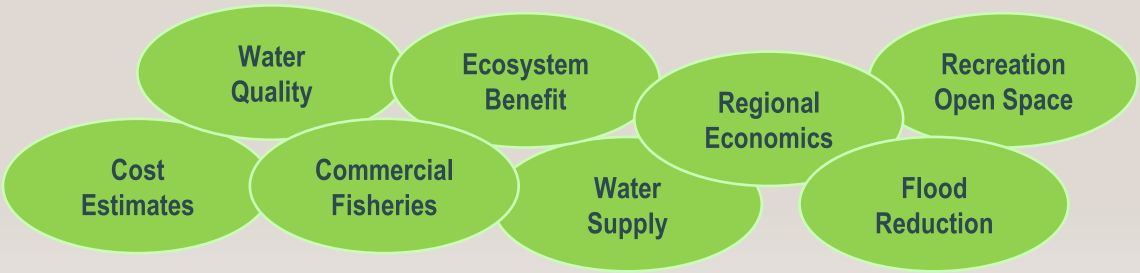
2D Modeling Efforts

- Reclamation District (RD) 17
- Butte Basin
- Yolo Bypass
- Sutter Bypass

Bottom Line

2D modeling helped model floodplain inundation and has helped evaluate floodplain benefits to promote multi-benefit projects

Multi-Benefit



Acknowledgements

- Bill Fleenor, UC Davis
- Gary Brunner, HEC, USACE
- BWFS Study Team

Questions and Comments

Floodpla
in
Food