

## Sedimentation and River Hydraulics Modeling

*Understanding river hydraulics and sediment processes for better river restoration, infrastructure design, and water management planning*

### Bottom Line

These research projects improve Reclamation's ability to simulate river behavior to better design hydraulic structures and river restoration projects.

### Better, Faster, Cheaper

Modeling flow interactions and bank erosion provides more effective planning and design.

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### Collaborators

- U.S. Department of Transportation's Federal Highway Administration
- U.S. Department of Agriculture's Agricultural Research Service
- Taiwan Water Resources Agency

### Problem

River channels and habitats change, depending on erosion and deposition of sediments. Sediment builds up behind dams and other structures. Tracking how rivers transport water and sediment is crucial to understanding the ever-changing landscape of our waters. Thus, modeling water and sediment as dynamic systems is critical to water management planning, rehabilitating and protecting streams and river habitat, understanding reservoir sedimentation, and determining impacts of infrastructure changes, (e.g., dam removal; diversion dams modification).

### Solution

The Sedimentation and River Hydraulics–Two-Dimensional Model (SRH-2D) developed by Reclamation is a model for river systems for two-dimensional (2D) analysis of hydraulic, sedimentation, temperature, and vegetation changes in river systems. It has been widely used and tested under a variety of river engineering tasks, from analyzing flow around fish screens to bank erosion of fish habitat on floodplains. SRH-2D solves 2D dynamic wave equations (i.e., the depth-averaged St. Venant Equations). Modeling applications include flows with in-stream structures,

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*Channel restoration project on the Trinity River near Upper Junction City, California. A constructed side channel for the purpose of increasing salmon rearing habitat is in the foreground and an eroding bank is behind it.*

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through bends, with perched rivers, with side channel and agricultural returns, and with braided channel systems. SRH-2D is well suited for modeling local flow velocities, eddy patterns, flow recirculation, lateral velocity variation, and flow over banks and levees.

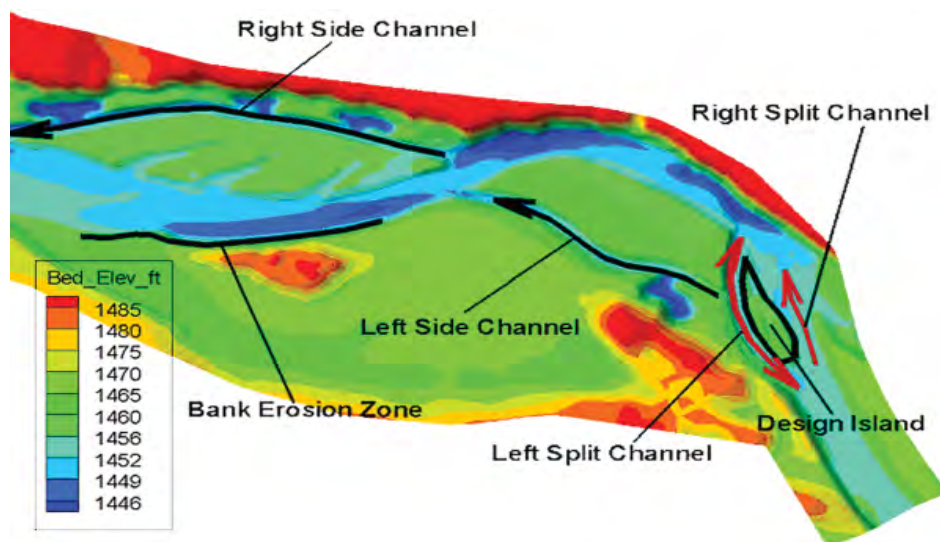
Reclamation's Science and Technology Program has several research projects designed to improve SRH-2D. SRH-2D has also received financial support from the Water Resources Agency in Taiwan to further develop its sediment transport ability and the U.S. Department of Transportation, Federal Highway Administration's ability to simulate hydraulics near bridges.

#### *Predicting the Interactions Between Flow, Sediment, and Riparian Vegetation (ID 1368)*

The survival of riparian vegetation within managed river systems is a growing challenge due to the increasing priority of maintaining or restoring ecosystem function while balancing the need for water supply and flood protection. Establishment, growth, and decay of riparian vegetation is largely determined by local hydraulics; conversely, characteristics of in-channel and floodplain vegetation affect hydraulics at the reach scale. Despite a wealth of prior research concerning the mechanics and biology of flow-vegetation interactions, the need for practical engineering tools for making quantitative predictions remains. SRH-2D provides this practical tool for decisionmaking. Vegetation simulation was integrated into a new SRH-2DV package that incorporates (1) a module that simulates spatially distributed establishment, growth, and mortality of riparian vegetation and (2) a module that simulates the effect of vegetation on river and floodplain hydraulics. These model abilities were tested on the San Joaquin River as part of the San Joaquin River Restoration Project.

#### *Prediction of Bank Erosion to Improve River Restoration Strategies and Reservoir Sediment Management (ID 6606)*

A predictive model of bank erosion in river channels and reservoirs was developed to improve designing river restoration strategies, planning river infrastructure, and managing reservoir sediment. This model builds on SRH-2D and adds the U.S. Department of Agriculture, Agricultural Research Service bank erosion module. This model was applied to the Trinity River near Upper Junction City, California, to estimate channel evolution and bank erosion impacts of river habitat improvement projects. It is also currently being used to estimate erosion from Lake Mills resulting from the removal of Glines Canyon Dam, Washington.



***“SRH-2D has the best combination of flexibility and accuracy among two-dimensional models.”***

Yong Lai  
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#### **More Information**

##### **SRH-2D:**

[www.usbr.gov/pmts/sediment/  
model/srh2d/index.html](http://www.usbr.gov/pmts/sediment/model/srh2d/index.html)

##### **Bank Erosion in SRH-2D:**

[www.usbr.gov/research/projects/  
detail.cfm?id=6606](http://www.usbr.gov/research/projects/detail.cfm?id=6606)

##### **Interactions between Flow, Sediment, and Riparian Vegetation:**

[www.usbr.gov/research/projects/  
detail.cfm?id=1368](http://www.usbr.gov/research/projects/detail.cfm?id=1368)

***SRH-2D Model of Bank Retreat Simulation at the Upper Junction site of the Trinity River, California, in support of the Restoration Project.***