Provo River Modeling Study

— ADH Model Application

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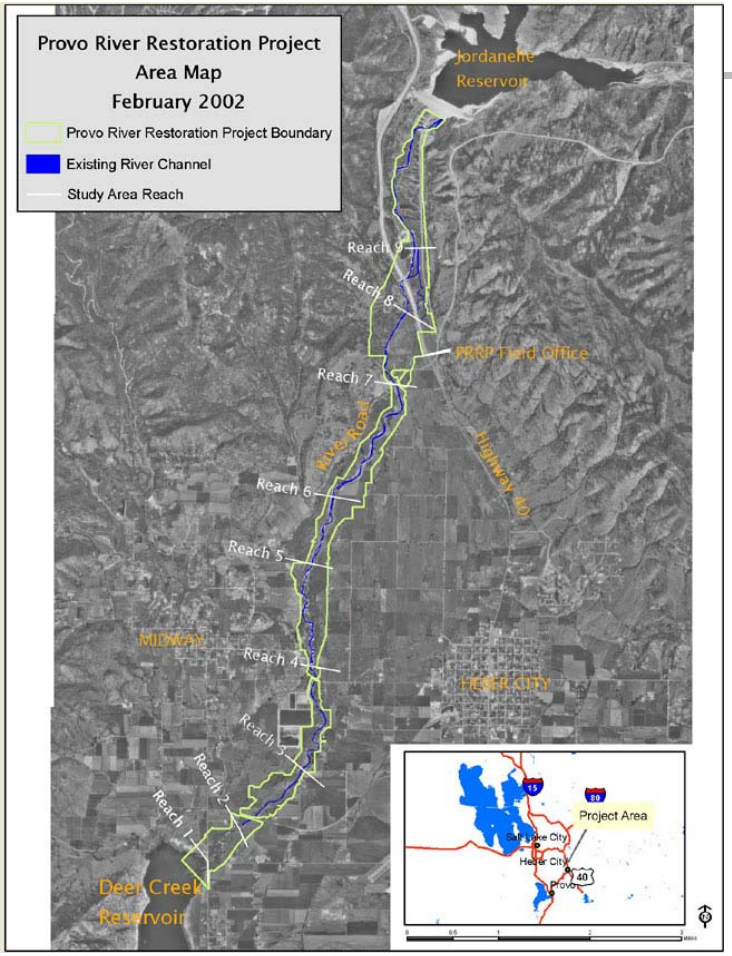
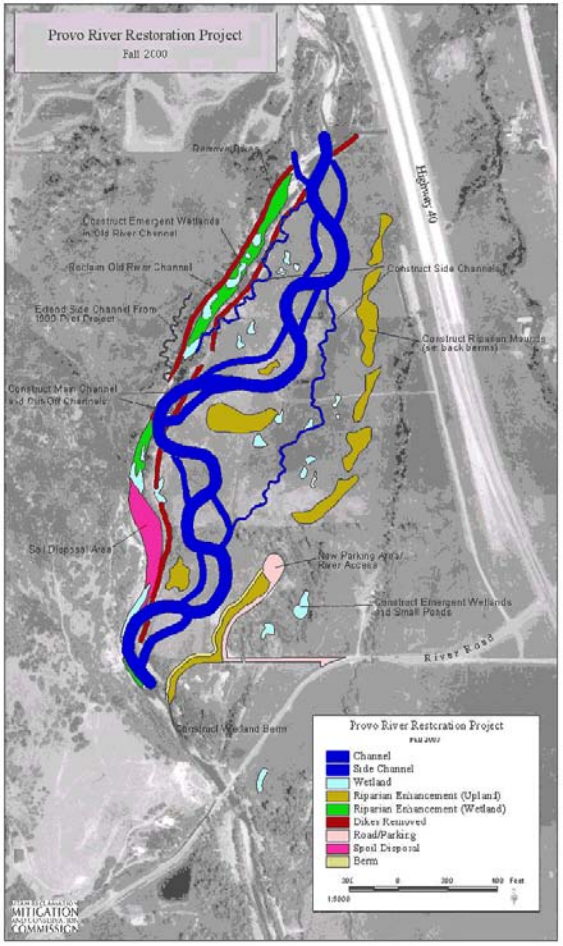
Background and Objectives

- Funded by Urban Flood Demonstration Program
- Collaboration between DRI and ERDC
- Aimed to improve methods of stream restoration design
- Application of ADH model and Numerical Fish Surrogate (NFS)

Study Site – Provo River

- Provo River begins in the Uinta Mountains in Utah and flows through three counties (Utah, Wasatch, and Summit) into Utah Lake.
- A major source of drinking water for local areas; also used for agriculture and recreational purposes.
- Parts of this river are blue-ribbon trout fisheries.
  - dominant type of fish is trout, especially brown trout.
  - other types of trout include: rainbow trout, and Bonneville cutthroat trout.


Provo River Restoration Project
Area Map
February 2002
Provo River Restoration Project Boundary
Existing River Channel
Study Area Reach
Jordanelle Reservoir
Reach 9
Reach 8
PRRP Field Office
Reach 7
River Road
Highway 40
Reach 6
Reach 5
MIDWAY
Reach 4
HEBER CITY
Reach 3
Reach 2
Reach 1
Deer Creek Reservoir
Project Area
Salt Lake City
Heber City
Provo
15
80
40


Provo River Restoration Project
Fall 2000
Highway 40
Construct Emergent Wetlands in Old River Channel
Reclaim Old River Channel
Construct Side Channels
Extend Side Channel From 1999 River Project
Construct Riparian Mounds (set back berms)
Construct Main Channel and Cut Off Channels
Soil Disposal Area
New Parking Area/ River Access
Construct Emergent Wetlands and Small Ponds
River Road
Construct Wetland Berm
Provo River Restoration Project
Channel
Side Channel
Wetland
Riparian Enhancement (Upland)
Riparian Enhancement (Wetland)
Dikes Removed
Road/Parking
Spoil Disposal
Berm
MITIGATION COMMISSION

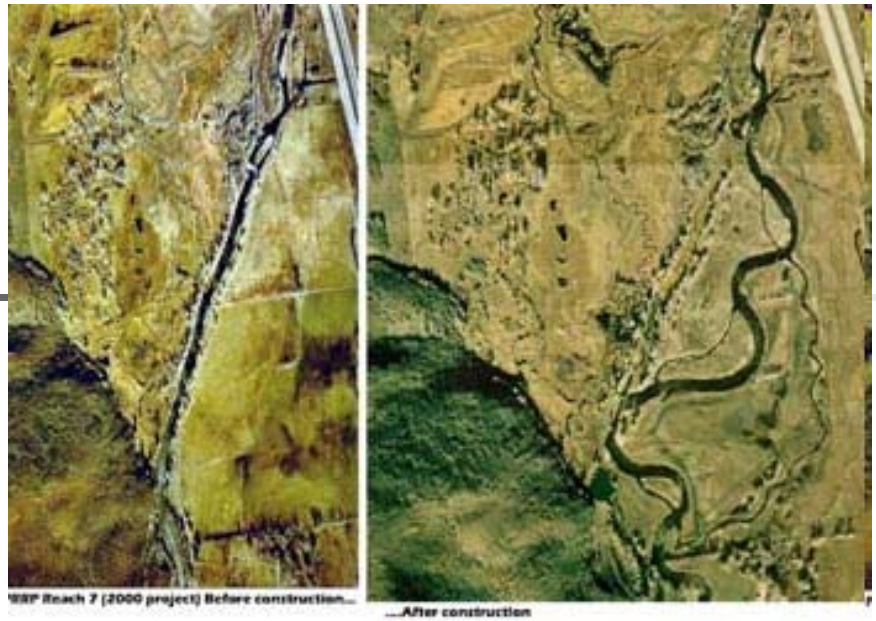
189
40
32
River Rd
Image State of Utah
© 2009 Tele Atlas
Google

Study Site – Provo River

- Average annual precipitation ranges from 13 inches to 21 inches.
- Mostly comes from snow during the winter months
  - flows tending to peak in the spring due to snowmelt
  - return to base levels by the middle of the summer.
- Middle Provo River legally requires a minimum instream flow of 125 cfs.
- Streamflows in the Middle Provo River controlled by releases from Jordanelle Dam, also impacted by agricultural diversions in the Herber Valley.
- Little sediment is supplied to Reach 7 from upstream because of Jordanelle dam; Sediment sources are mostly bank and bed erosion.

Study Site – Provo River

- During 1940s - 1960s, portions of the Provo River were straddled with levees, channelization, straightening, and other human-induced modifications
  - the original Provo River Project or Provo River Channel Revision Project
  - to improve water conveyance
  - led to the destruction of wetlands and backwater areas in the watershed
- In 1999, the Provo River Restoration Project was commissioned to begin restoring the Middle Provo River.
  - to restore the middle Provo River's pattern and ecological function to a more natural condition.
  - to provide an 800 to 2,200 foot wide protected corridor along the restored river
  - major work completed by 2008
  - five-fold increase in trout population.



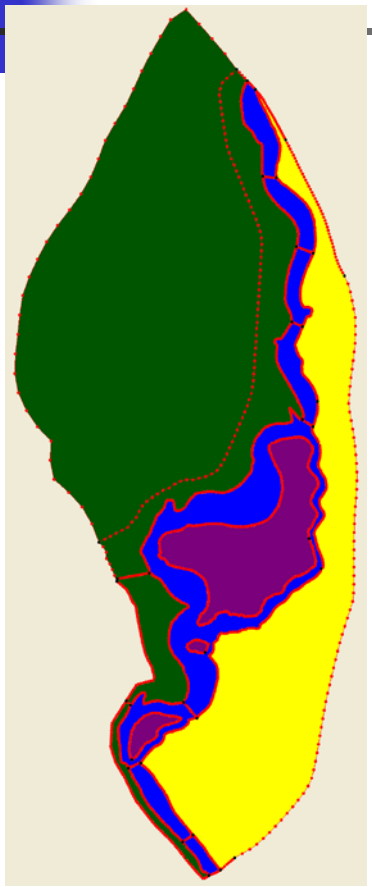
Aerials of 2000 project before construction (left), and after in 2001

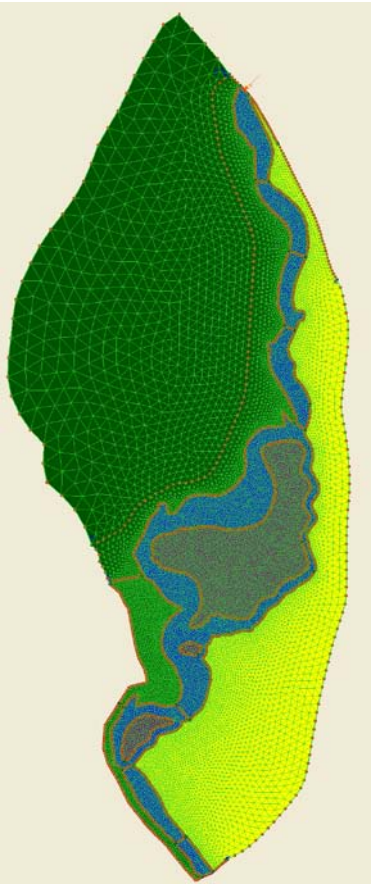
Before and after project – reach 7

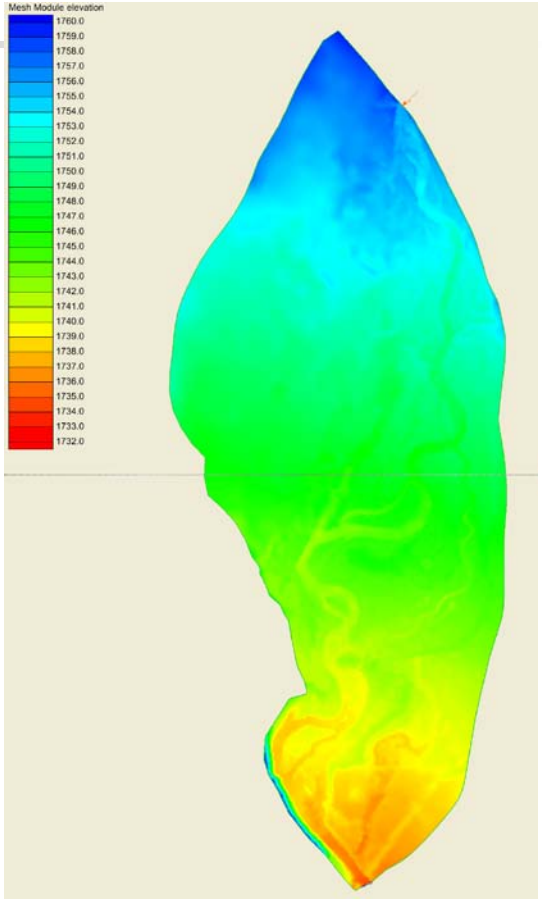
Modeling Procedure

- Select study reach
  - Reach 7
- Data acquisition
  - Topographic data
    - Utah State Government GIS portal
      between October 2006 and June 2007
  - Flow data
    - USGS gage 10155200 at River Road Bridge
- Mesh generation
  - SMS software

Mesh Generation



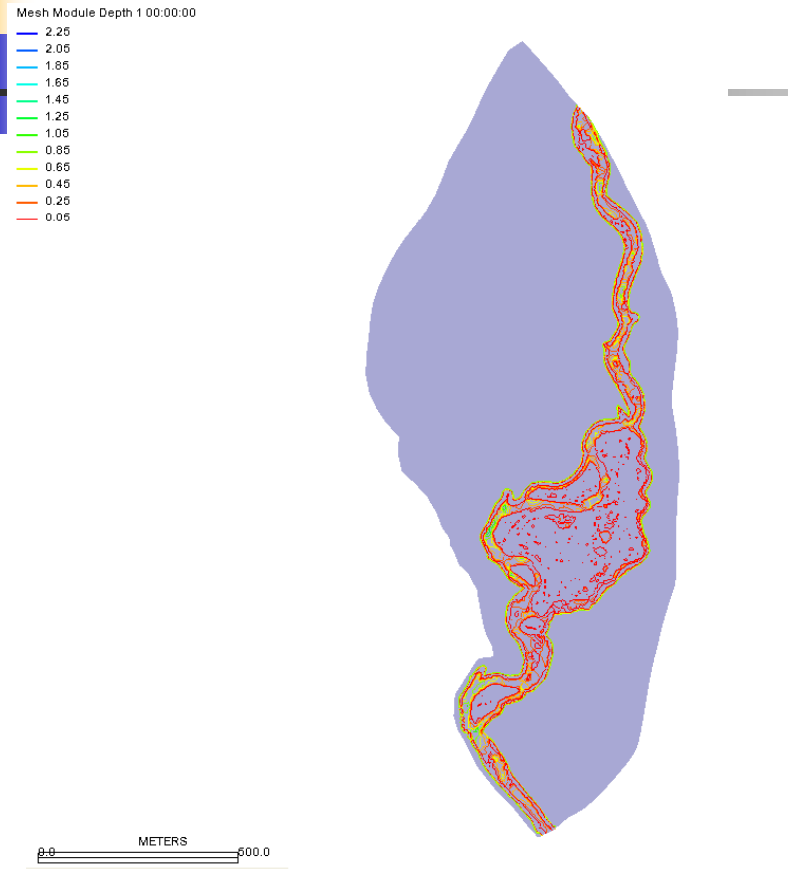


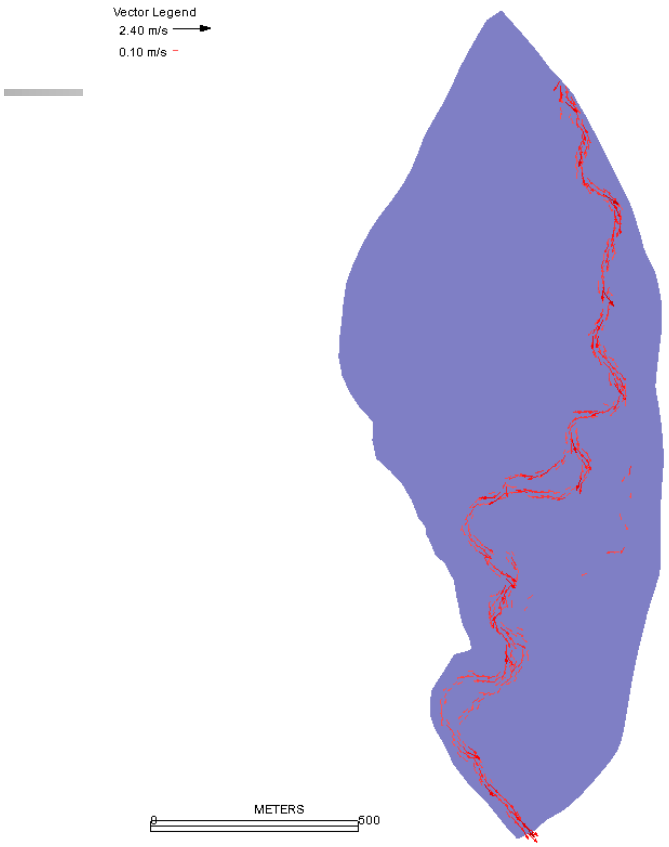


Model Runs

- 2D Steady flow conditions
  - 100 cfs to 1000 cfs; 50 cfs increment
  - Dynamic runs
  - Manually check if steady state is reached
  - Hotstart file based on previous steady state
- Down stream boundary condition
  - Using HEC-RAS to calculate a short reach
- Manning's n
  - Based on previous USGS study

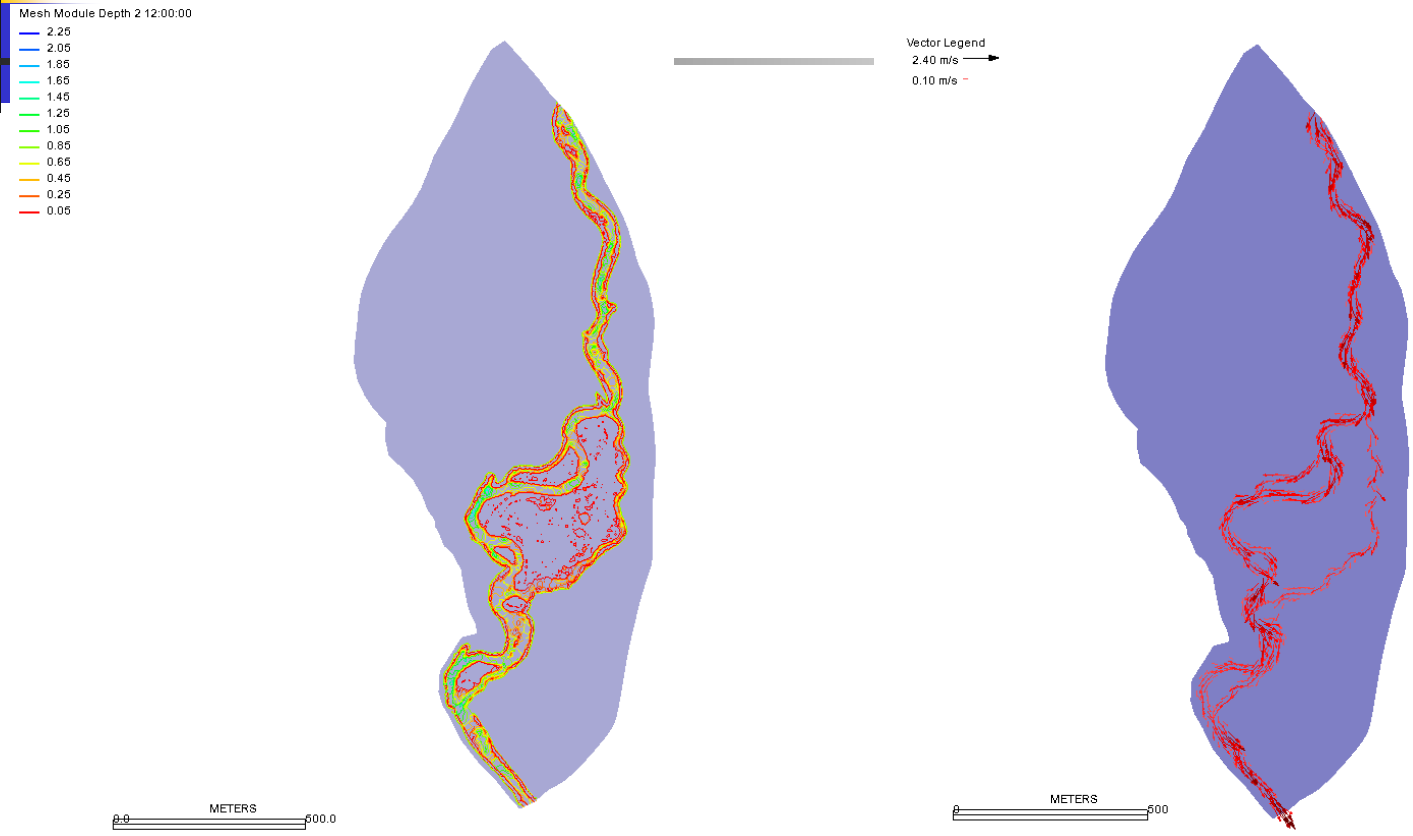
ADH Modeling Results





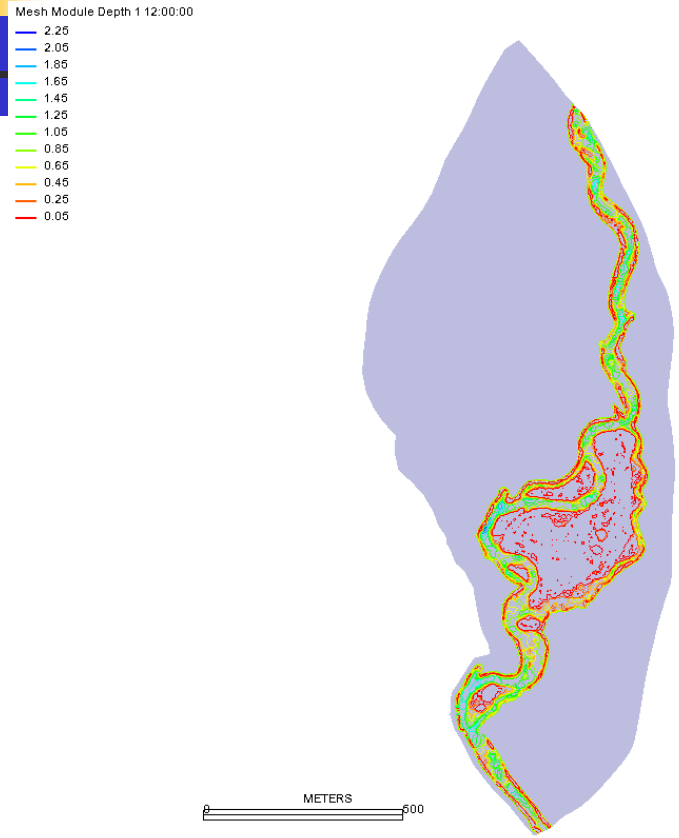
100 CFS steady flow condition

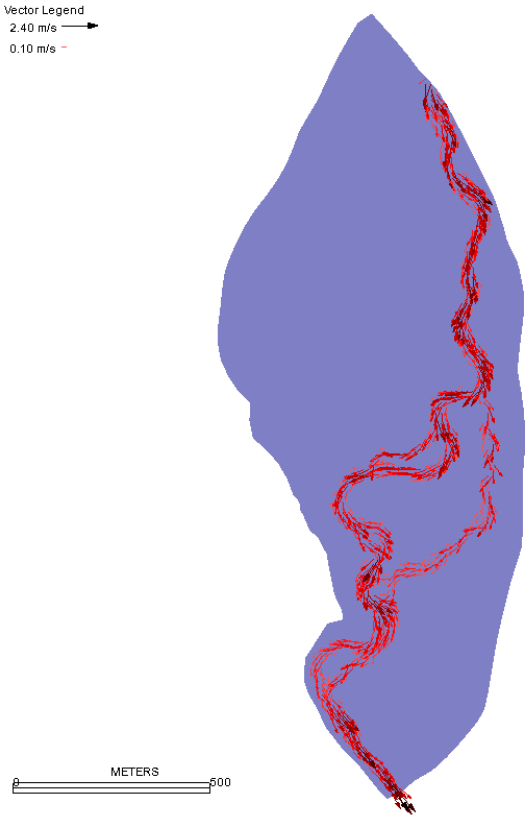
ADH Modeling Results



500 CFS steady flow condition

ADH Modeling Results





1000 CFS steady flow condition

Issues during ADH Application

- Local topography
  - Steep slope
  - Rapid slope change
  - Local flow regime
  - Quality of topographic data
- Steady state vs. Dynamic runs
  - Very fine time steps during steady state runs
  - Successful using dynamic run to achieve steady state
- Wetting/drying
  - Different wetting/drying setting affect results

Conclusion

- ADH is a versatile model for stream flow analysis
- ADH effectively simulated hydrodynamics in the Provo River restoration area
- The model may be further polished to better address complex topography and flow pattern