Assessing Eco-System Benefits of Irrigation-System Efficiency: Lessons for Colorado from Montana

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Outline

- Water Budgets and Equilibrium
- The Flathead Indian Reservation
- Sites
  - Mission Valley
  - Jocko Basin
- Potential Infrastructure Changes
- Assessing Impacts
- Lessons for Colorado

Water-Budgets and Equilibrium

- Water budget: how much water moves through each component of your system
- Typical components:
  - River
  - Canal
  - Wetland
  - Groundwater
  - Evapotranspiration (Ag/Wetland/Riparian)
  - Recharge (Distributed/Mountain Front)
- Water budget equilibrium: components are always exchanging water, working towards **equilibrium**
- Applying the water budget approach: changing diversions from the Lazy River
  - Need to carefully evaluate the water budget changes
  - Spatial Distribution (*where do seepage, infiltration and return flows occur?*)
  - Timing (*does the extra flow help?*)

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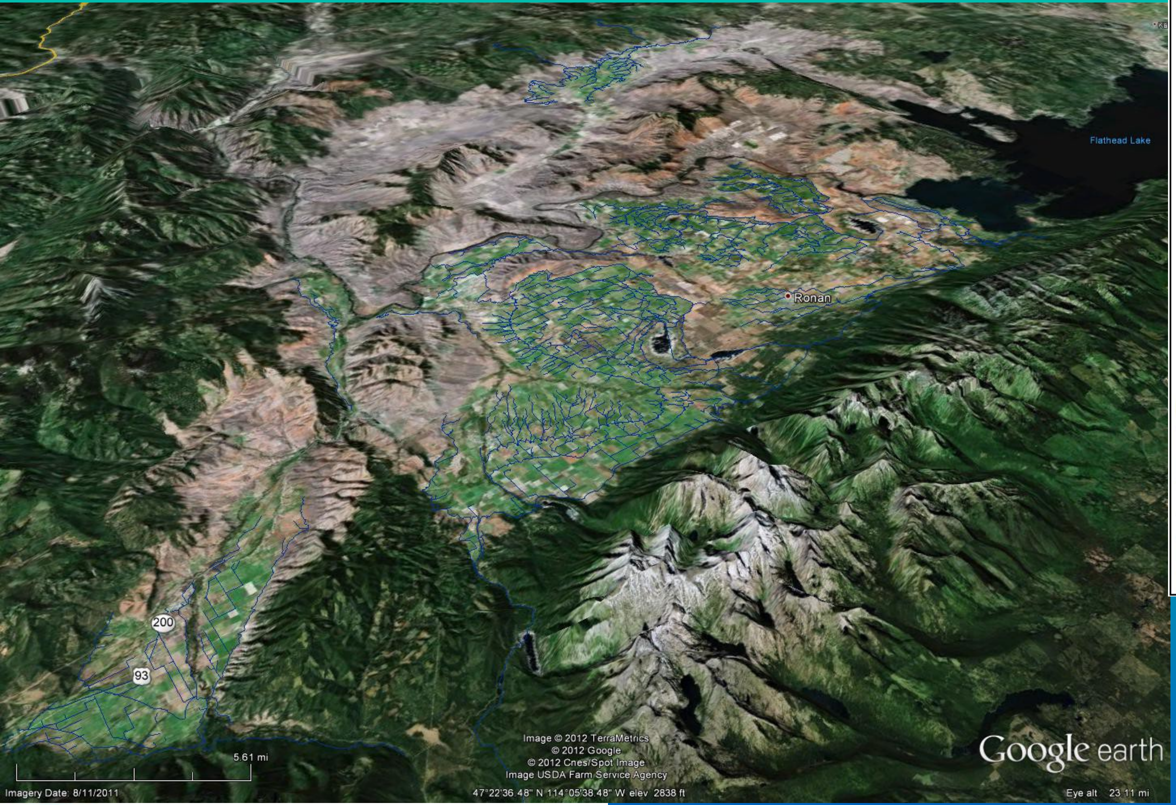
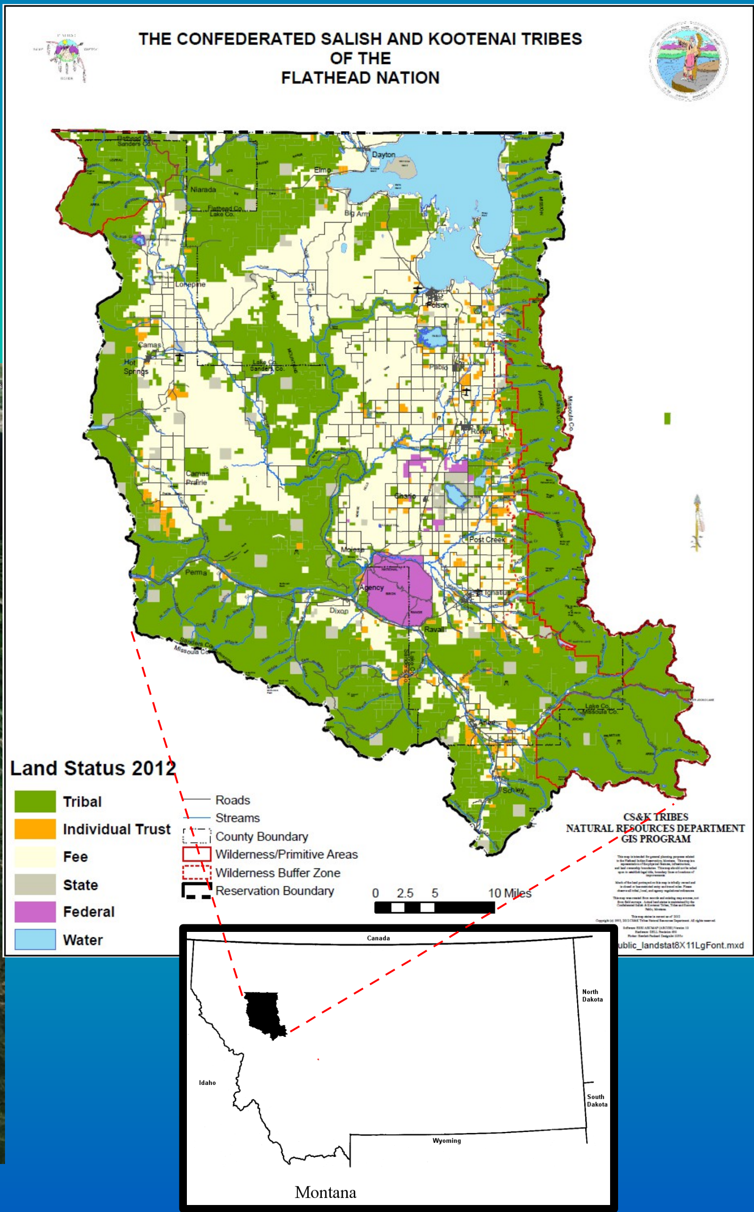
Flathead Indian Reservation

- 1,938 square miles in Northwestern Montana
- 144,000 acres of agriculture
- Surface water diversions supplies most of the irrigated acreage





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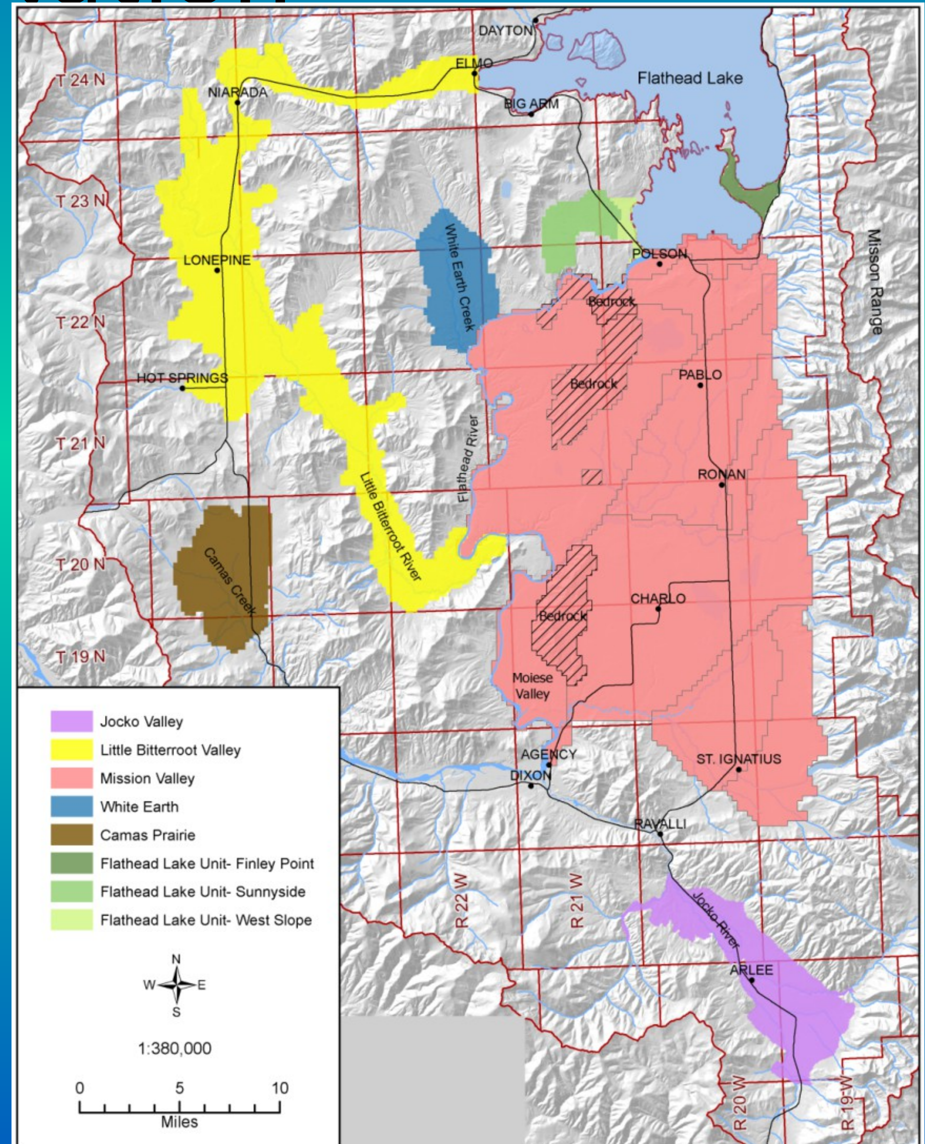
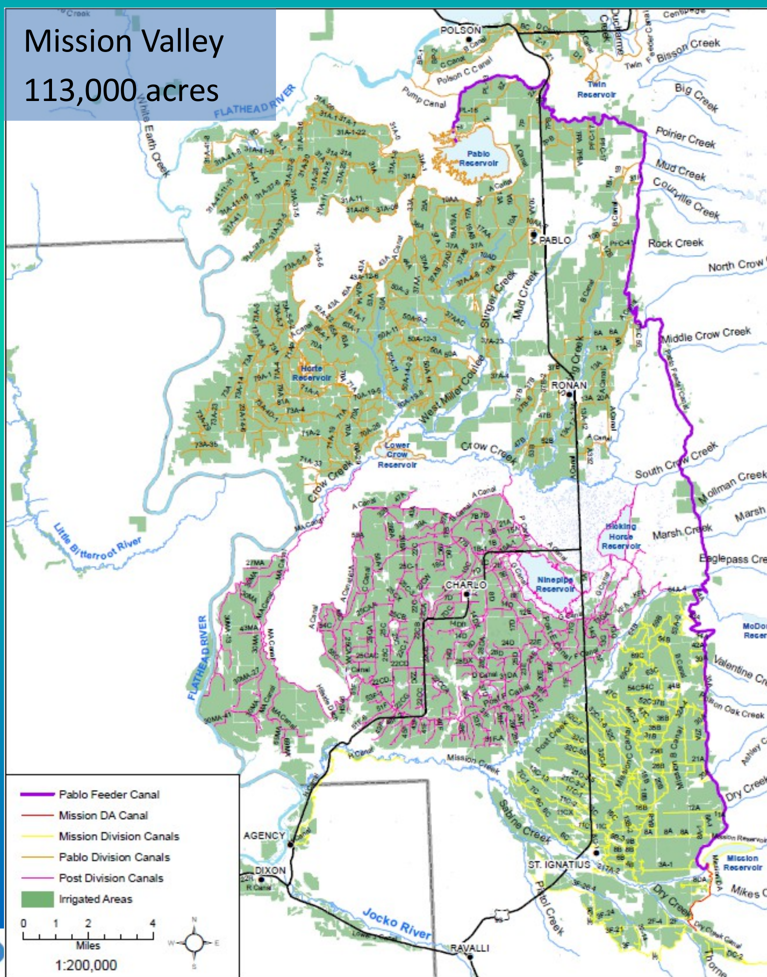
Alluvial Basins of the Flathead Indian Nation

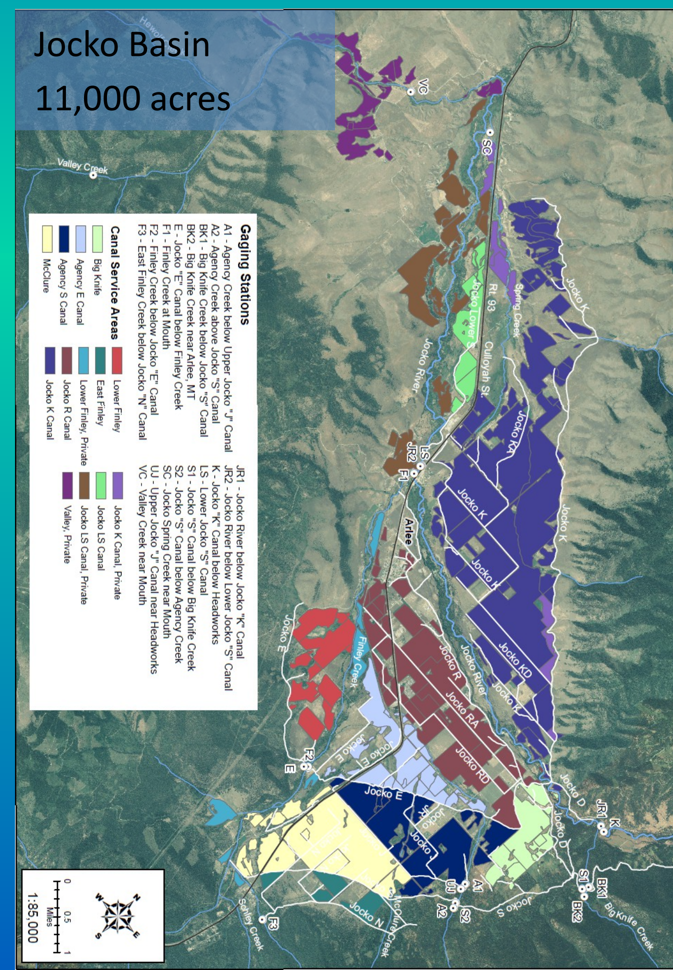
- Three major alluvial basins
  - Mission Valley (pink)
  - Jocko Basin (purple)
  - Little Bitterroot (yellow)
- Mountains/geology provide some good boundaries
- Each basin has
  - Major rivers
  - Transboundary inflows/outflows
  - Storage



Surface Water and Agriculture

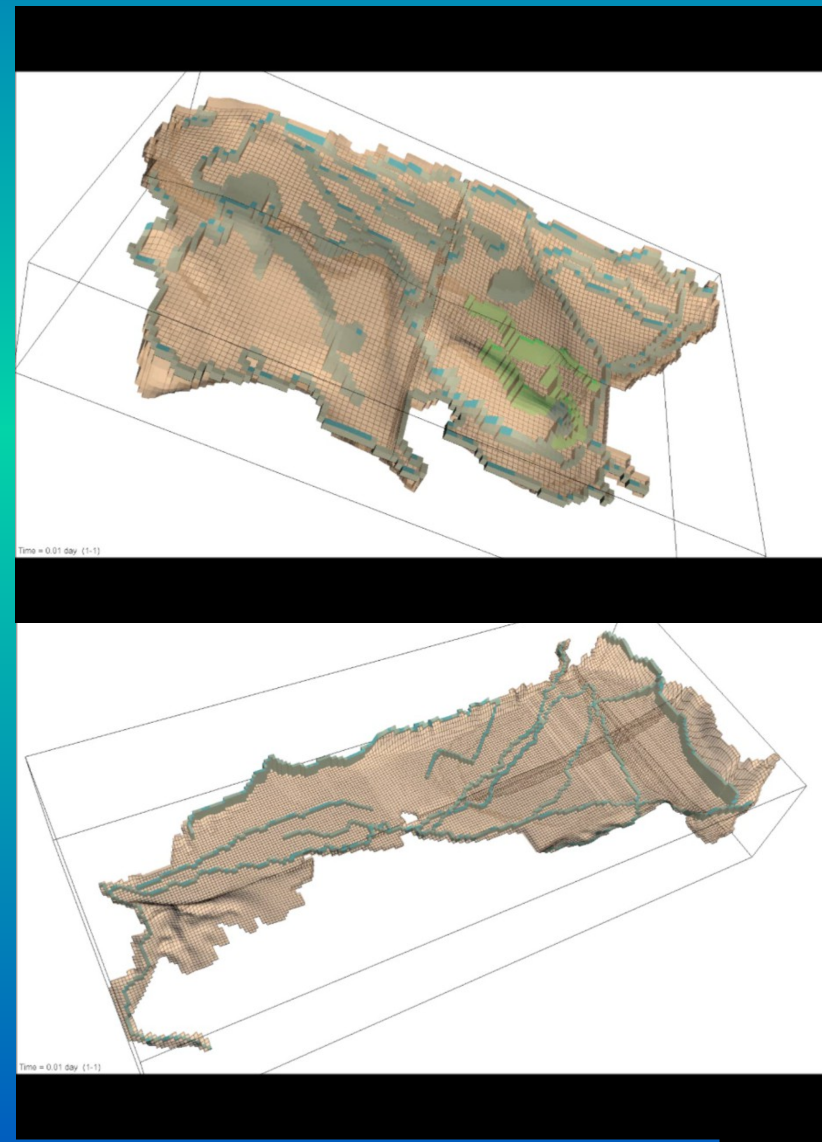
- HYDROSS surface water model (Dowl HKM, 2011)
- Stream flow provides most agricultural water
- Increase system efficiency to improve streamflows?
- Shutting down a diversion leaves more water in the stream, but how does that change each water budget component??



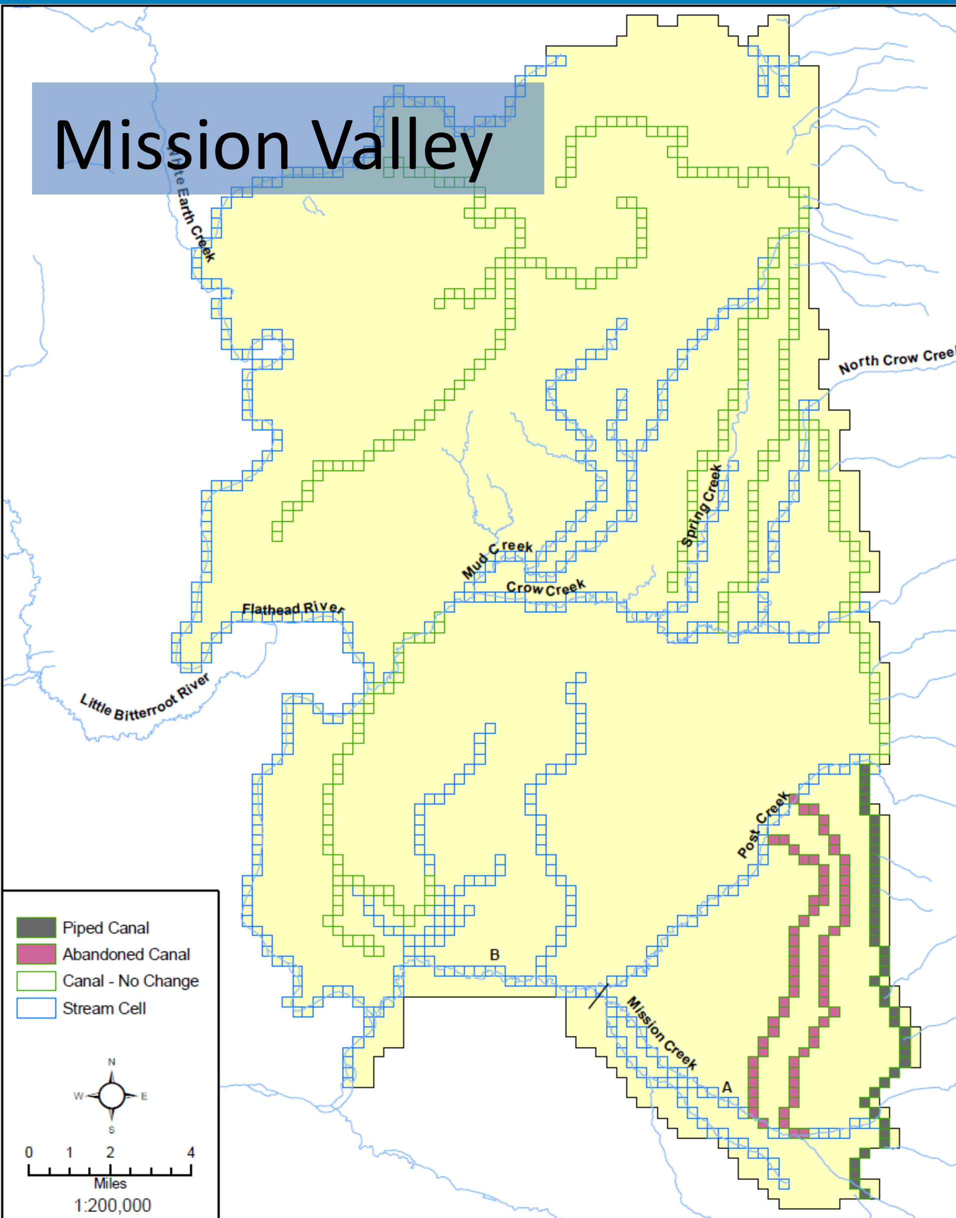


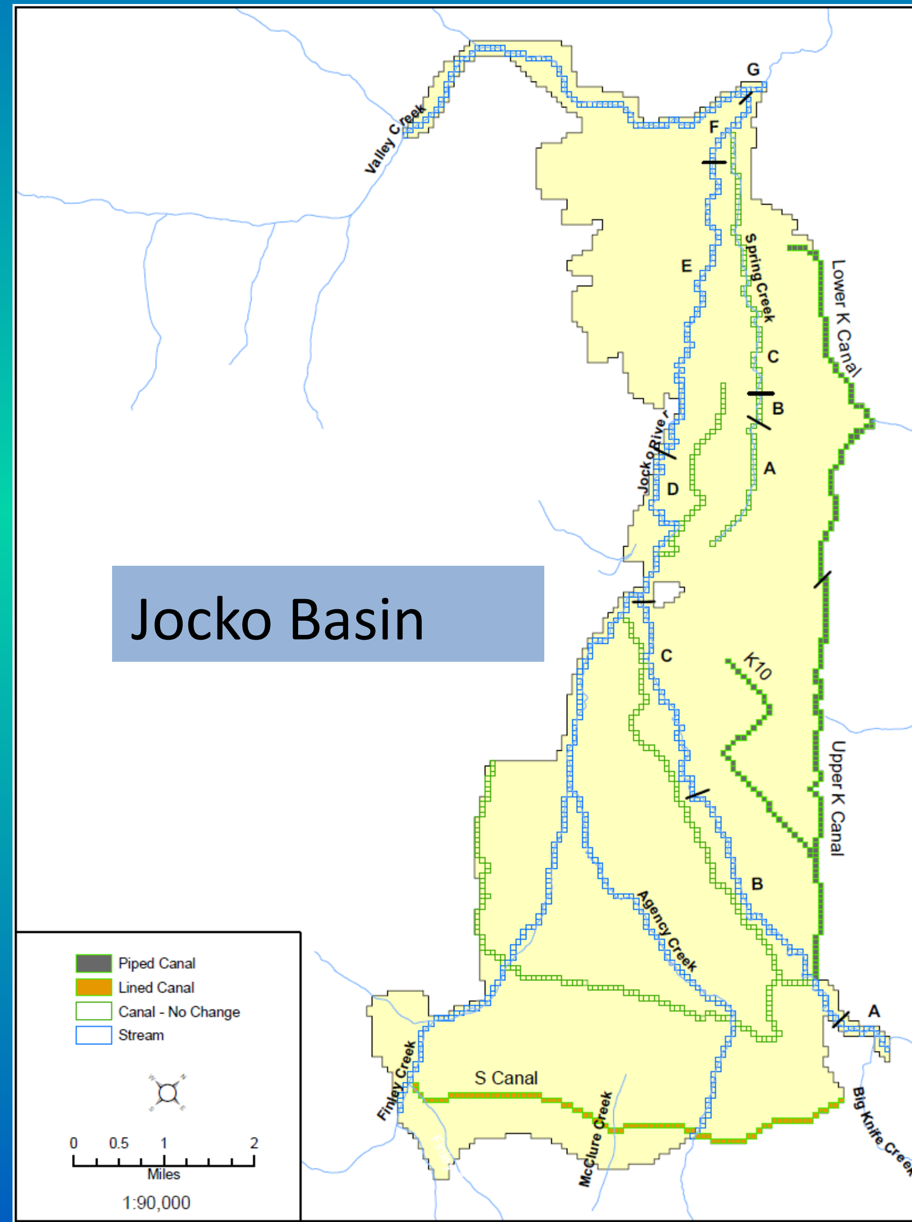
Water Budgets, Level II

- Basin-Scale Groundwater Models
- Put in enough to get the “important” parts
  - Rivers
  - Irrigated Acreage
  - Diversions/canals
  - Seasons
- What do we get out of a model?
  - A tool to track water budgets
  - Changes in time
  - Changes in space
  - Predictions



Agricultural Infrastructure/Changes

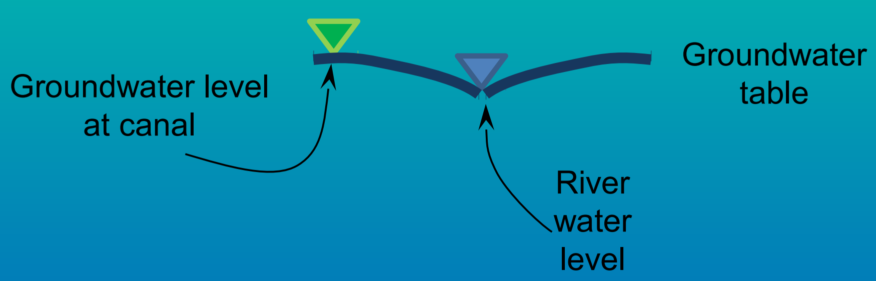




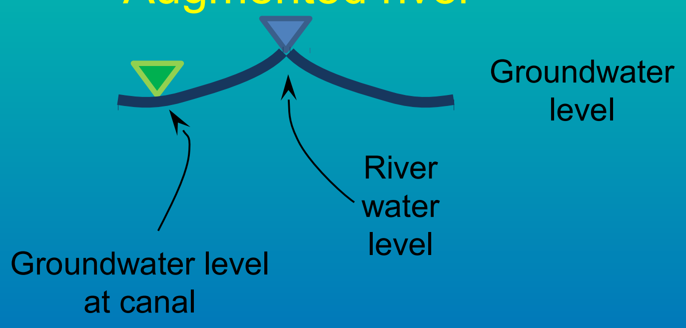
New Equilibriums

- What happens to water levels and seepage when the diversion is stopped
  - No diversion → river stage increases
  - No diversion→no canal seepage→local GW drops
- River may
  - Switch from gaining to losing, or
  - Gain less, or
  - Lose more

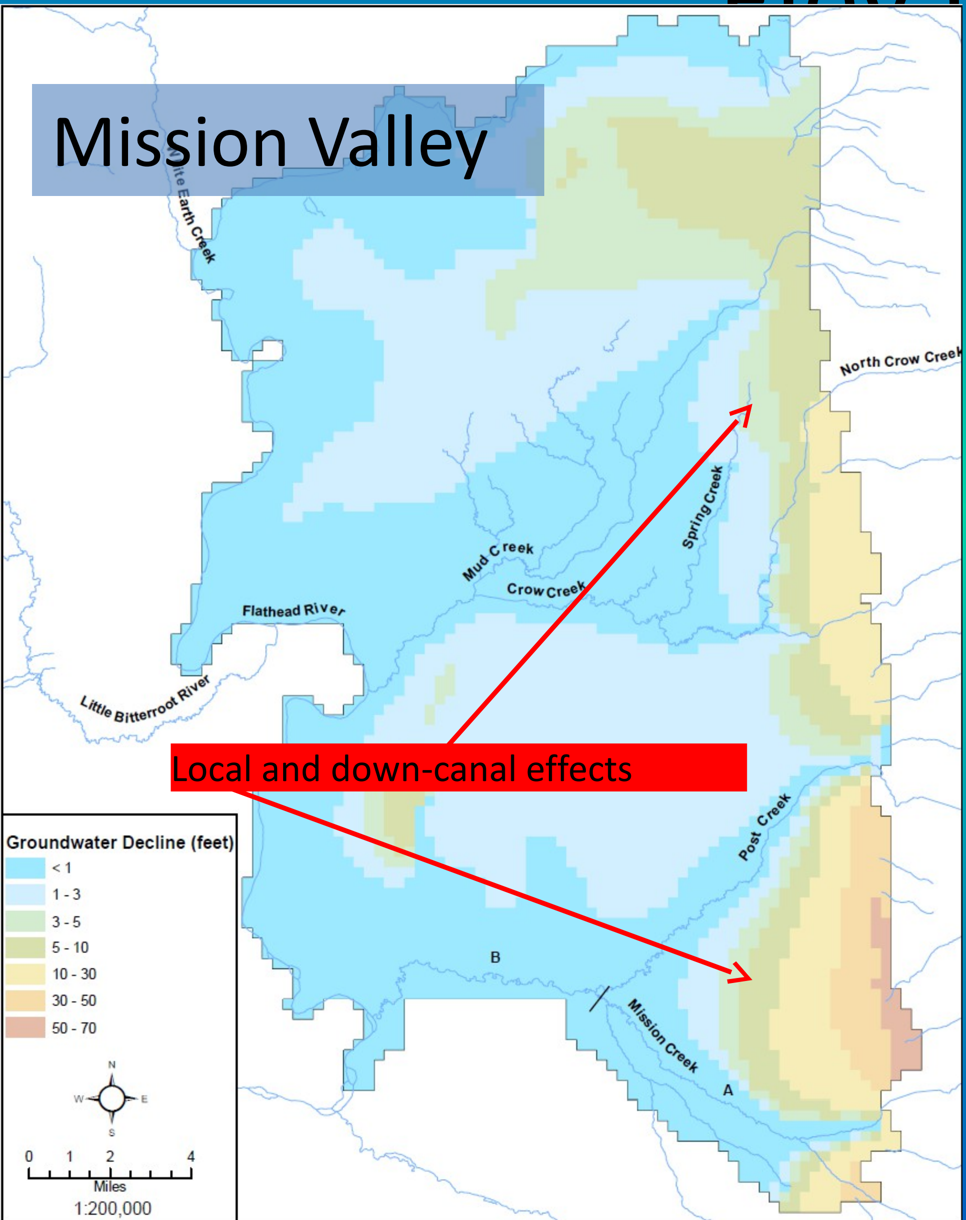
With diversion

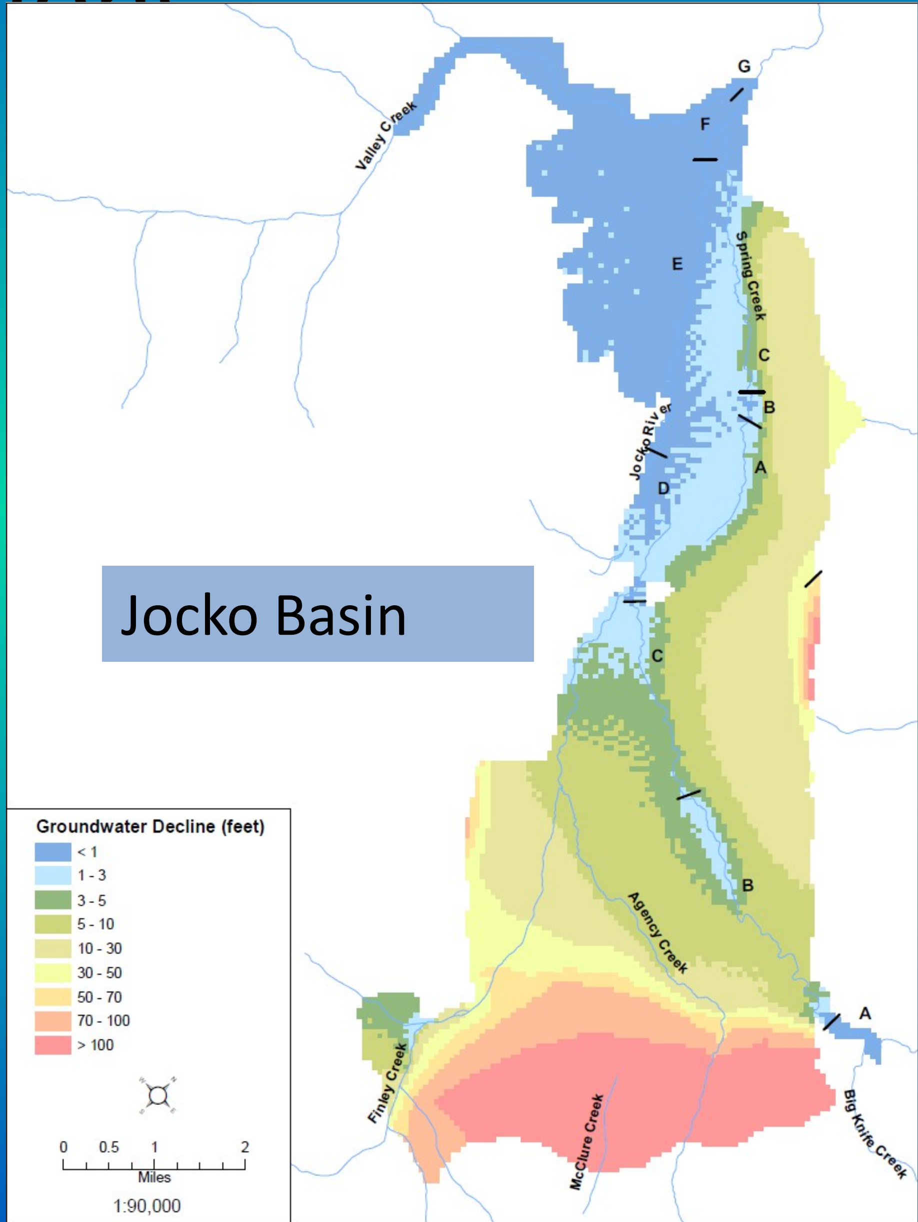


Augmented river



Declines in Groundwater Elevations

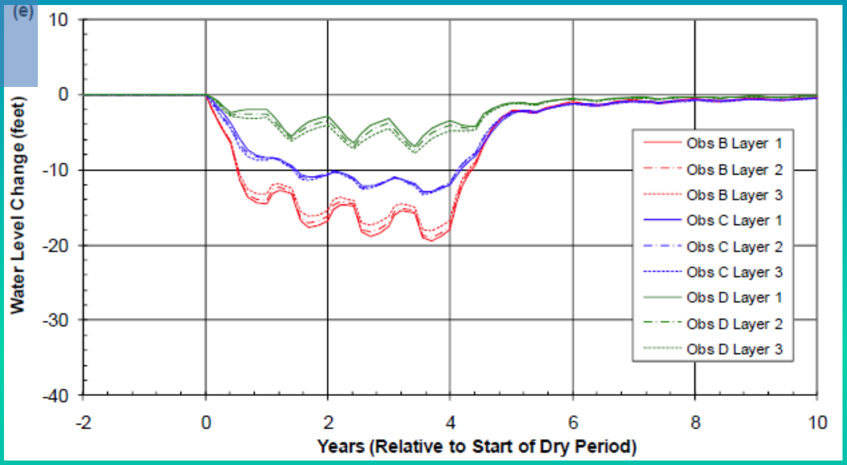




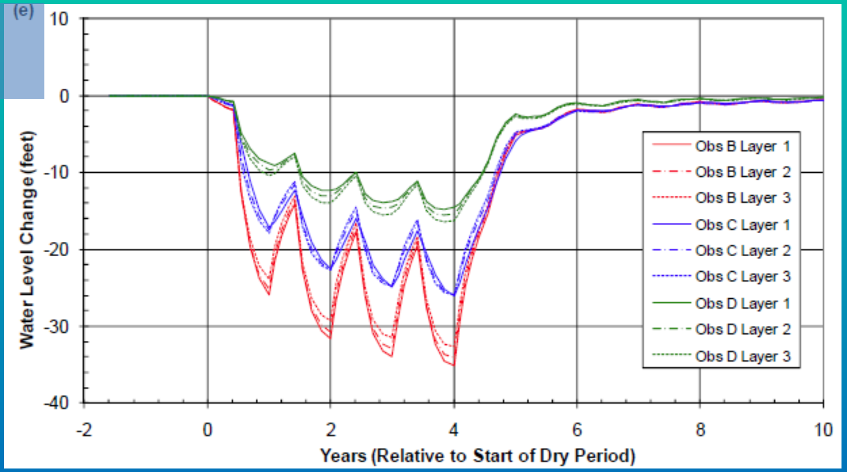
Does The Dry Year Water-Level Response Change?

- Less canal seepage, so less water budget moving through the ground
- Dry year conditions
  - Lower river stage, less seepage/recharge
  - Increased pumping
- Combined affect
  - Water levels drop more
  - Water levels recover slower
  - Streams stay gaining longer
- Without the canal seepage losses there is less of a buffer to the system….. **What is your goal?**

Jocko Basin (Original)

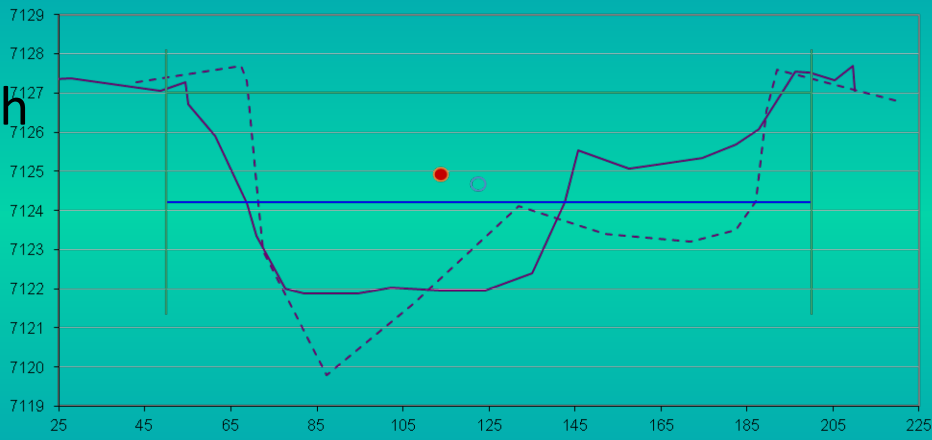


Jocko Basin (Modified)



Lesson For Colorado: Channel Change Impacts?

- If we rechannel a river
  - Same low flow stage, but
  - channel 2/3 original low-flow width
- At low flow
  - Seepage is 2/3 of original
  - Water budget is 2/3 original
- Compare to canal lining
  - Balance the water budget
  - Demand is unchanged, supply has decreased
  - How will supply/demand adjust?



Summary

- Canal lining
  - Reduces canal infiltration
  - More water stays in the river
- Water budget adjusts
  - Groundwater levels drop
  - Higher river stages
  - Net result: less river gains/more river losses
- Drought response: water levels tend to drop more and recover more slowly
- For Colorado rechanneling projects:
  - How do seepage conditions change?
  - What will be the water budget adjustments?