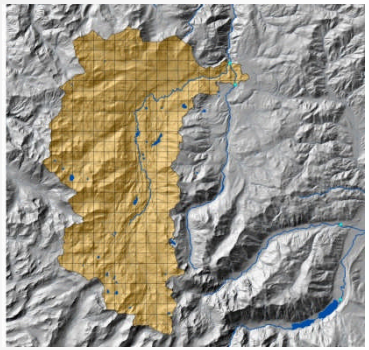
EXHIBIT 119

Walker River Decision Support Tool Groundwater Model Component

Greg Pohll

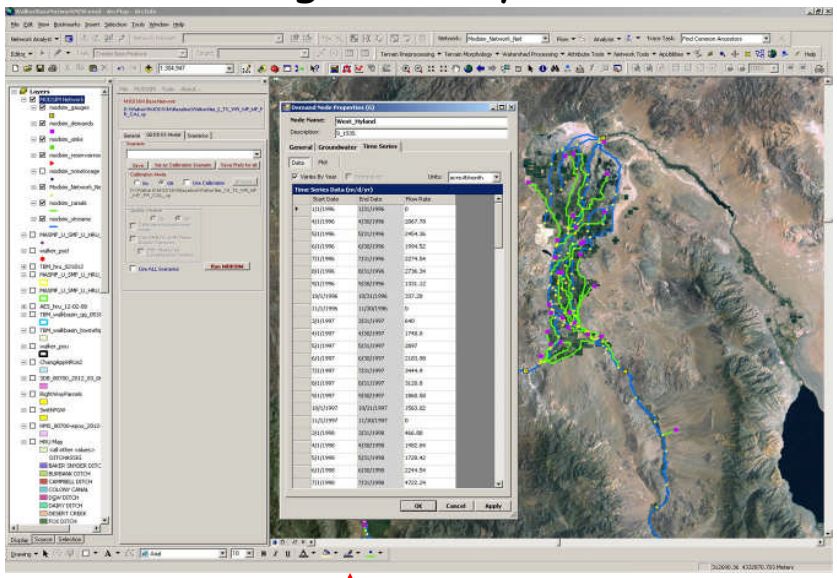
Desert Research Institute

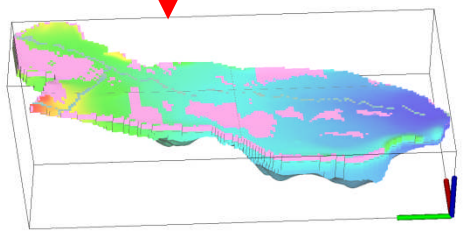
DST 2.0 Model Components



PRMS models of headwater areas (Supply Side)

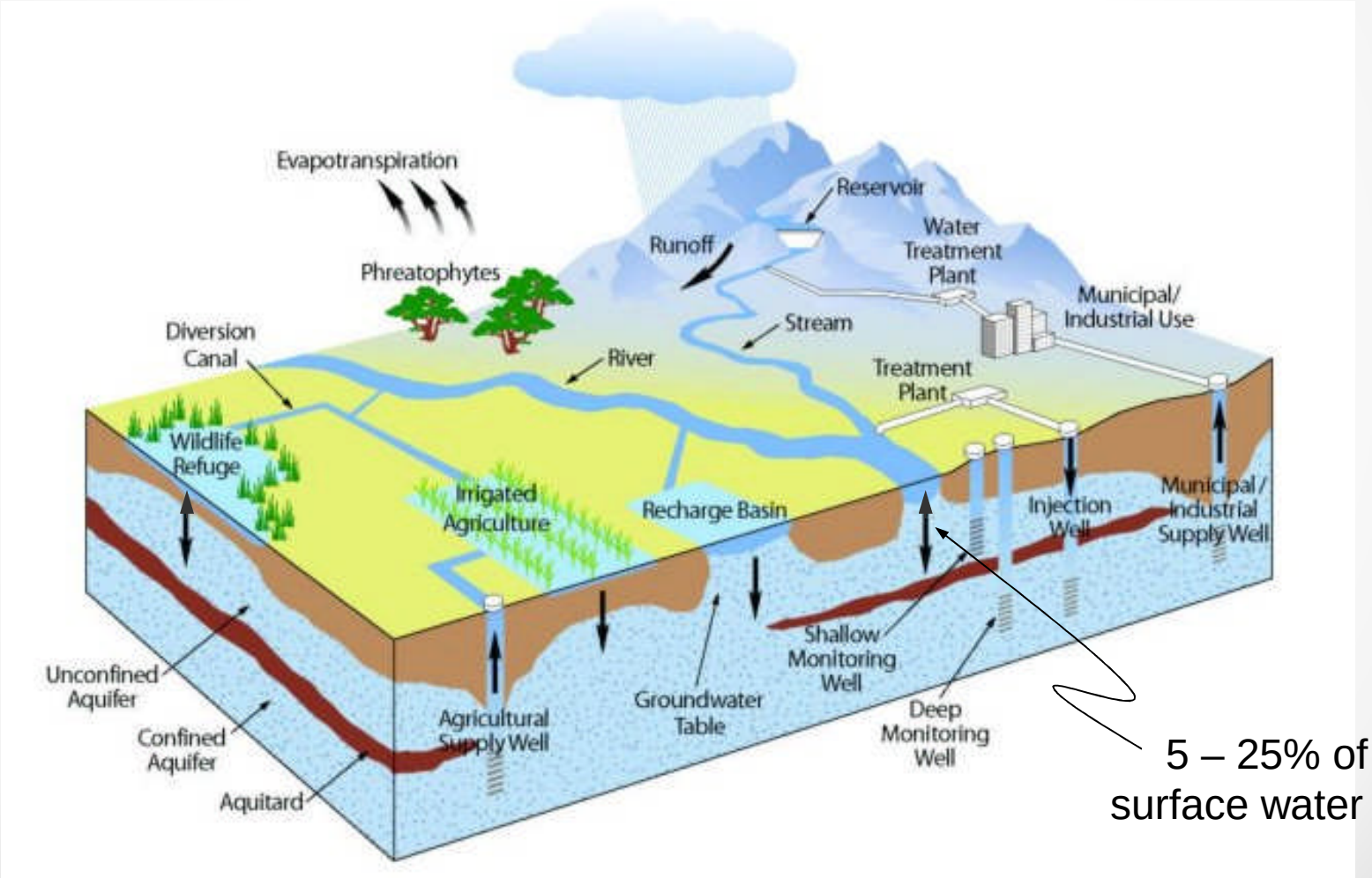
MODSIM River Basin Management system



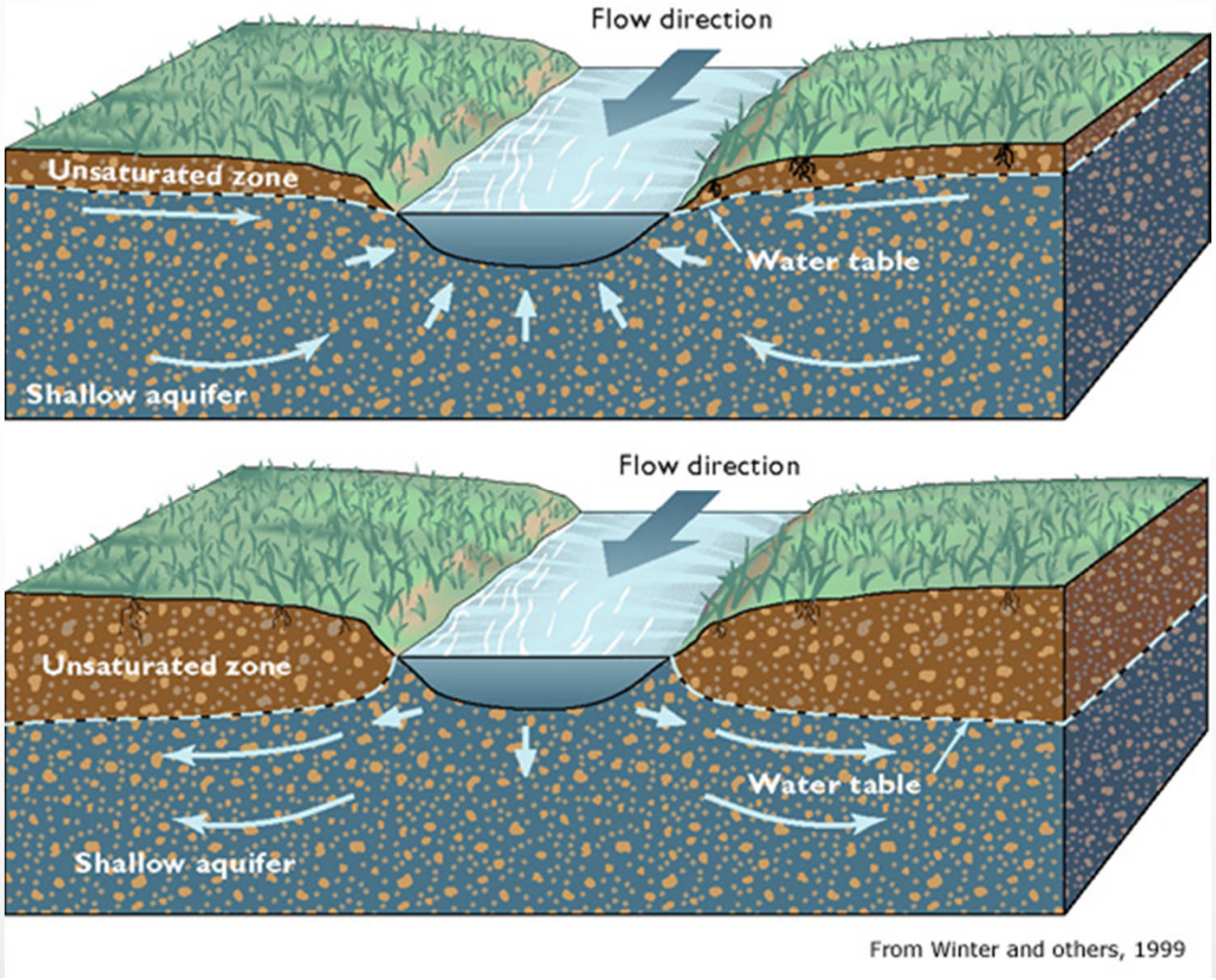


MODFLOW models of Mason & Smith (Demand Side)

Groundwater/Surface Water – One Resource

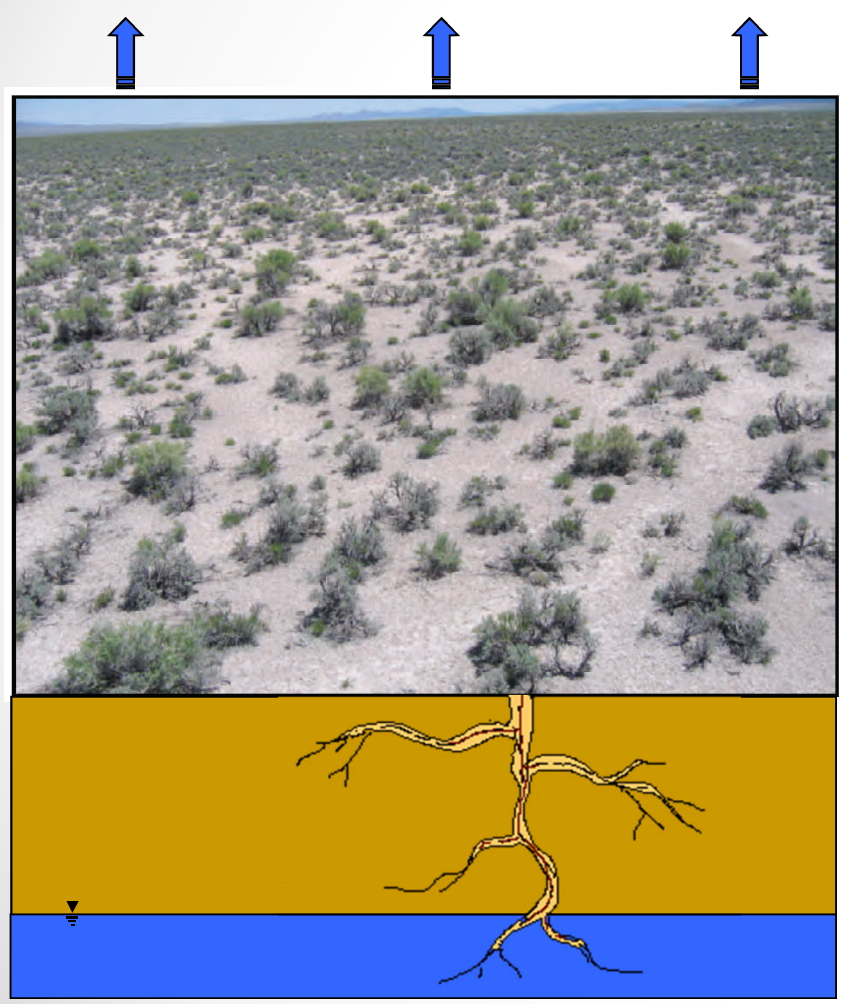


Stream/Aquifer Interaction

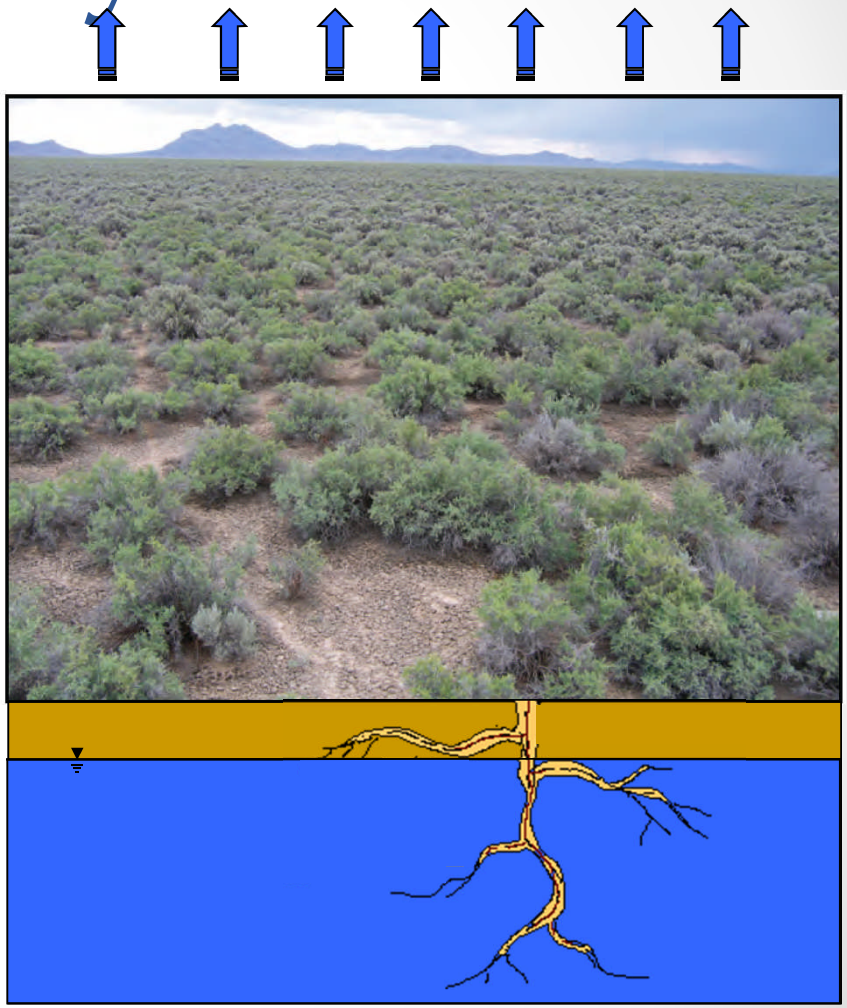


From Winter and others, 1999

Phreatophyte ET



Deep Water Table



Shallow Water Table

Groundwater Model Construction

- Two groundwater models were built
  - Smith Valley
  - Mason Valley
- Key inputs
  - Recharge
  - Well information
  - Hydraulic conductivity
  - Phreatophyte ET
  - Stream and ditch information

Groundwater Model Revisions

- Two groundwater models were built
  - Smith Valley
  - Mason Valley
- Key inputs
  - Recharge
  - Well information
  - Hydraulic conductivity
  - Phreatophyte ET
  - Stream and ditch information

Groundwater Model Revisions

- NDOW properties included and ponds simulated using General Head Boundary (GHB package
- Smith Valley model initial conditions adjusted to yield better agreement with measured water levels
- HRU water balance, which includes calculations of groundwater pumping rates is handled in MODSIM

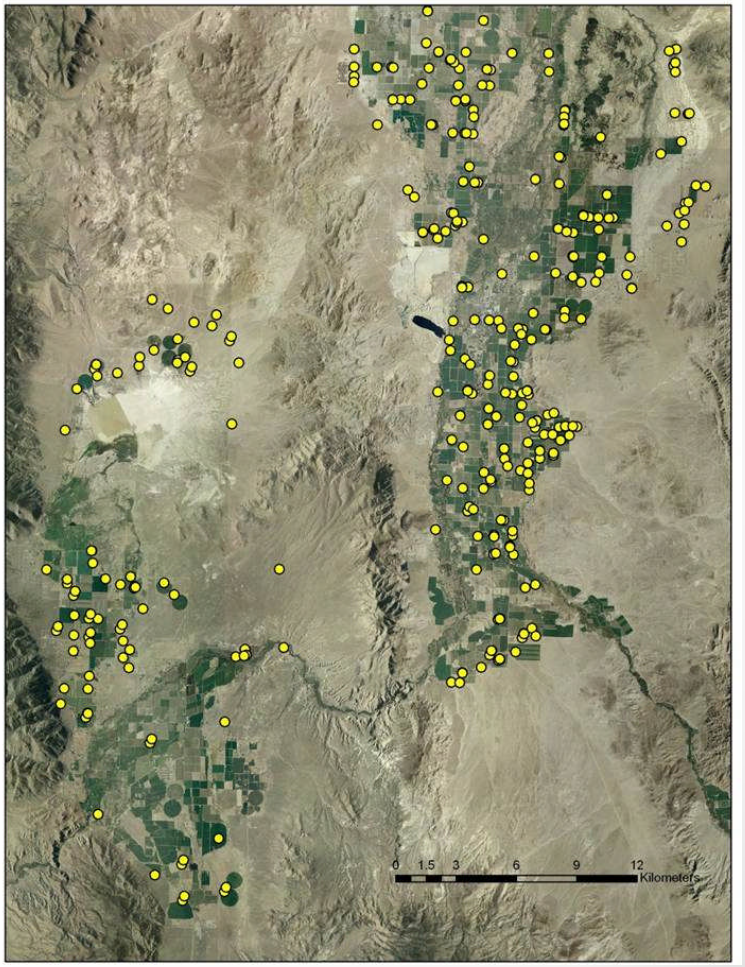
Recharge

Irrigation Excess

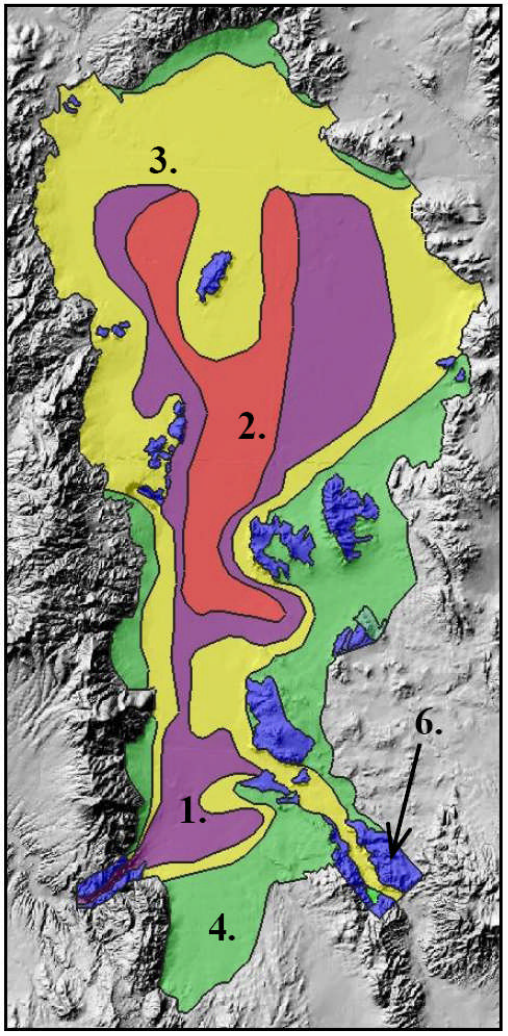
Ditch & Drain Losses

Mountain Block Recharge

Well Information

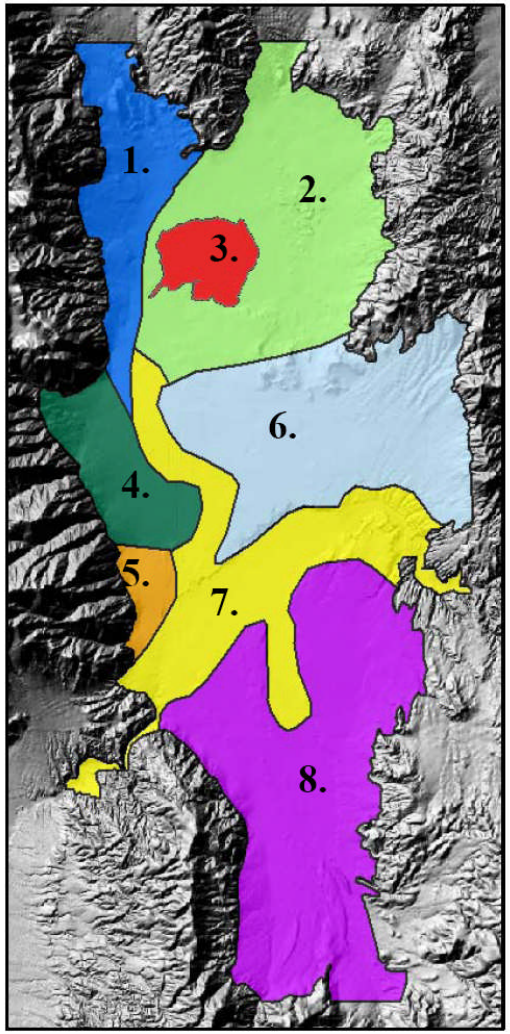


Hydraulic Conductivity



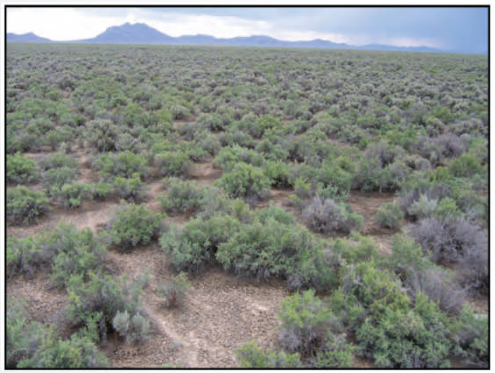
Mason

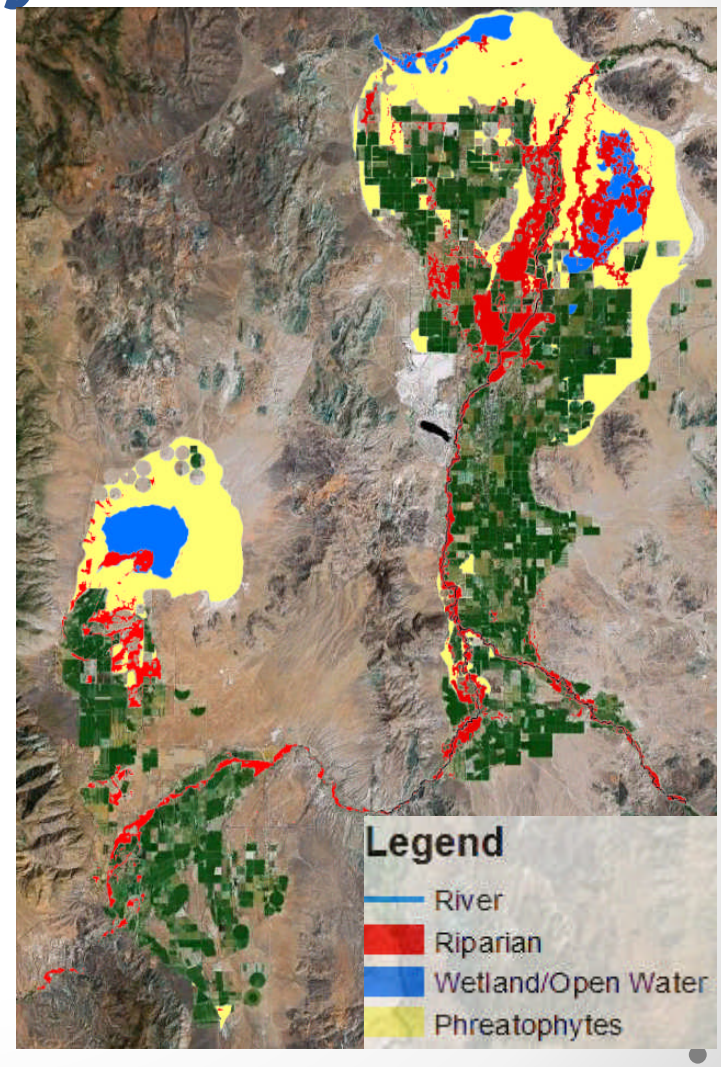
	Zone	Unit	K (m/d)
Mason Valley	1	Upper River	3.76
	2	Lower River	25.0
	3	Younger Alluvium	1.0
	4	Younger Fans	1.0
	5	Older/Burried Alluvium	0.5
	6	Bedrock	0.01
Smith Valley	1	Northwest Sediments	3.0
	2	Northeast Sediments	6.0
	3	Artesia Playa	2.41
	4	West Central Sediments	9.62
	5	West Central above River	1.6
	6	East Central Sediments	1.6
	7	River Gravels	9.62
	8	Southern Sediments	1.6



Smith

Phreatophyte ET

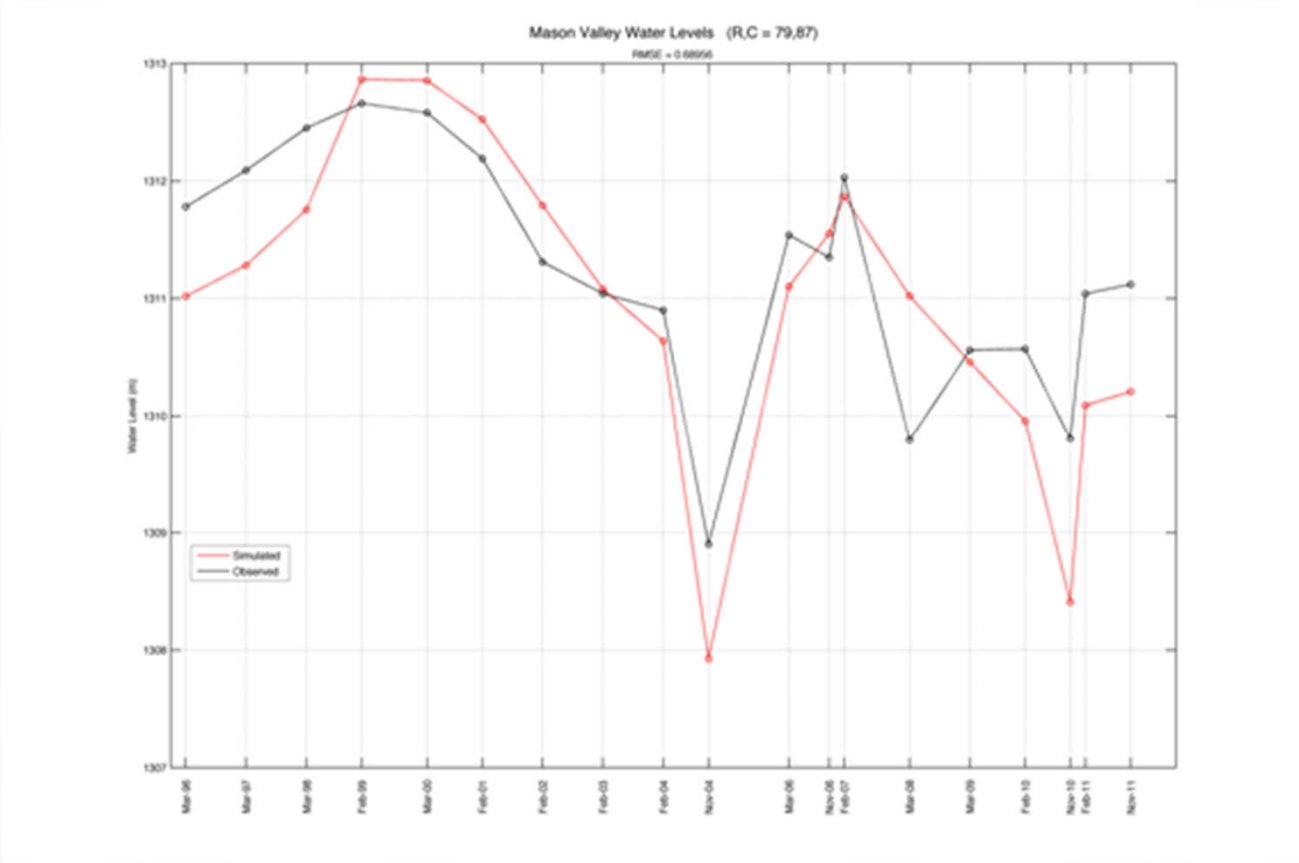




Stream & Ditch Information

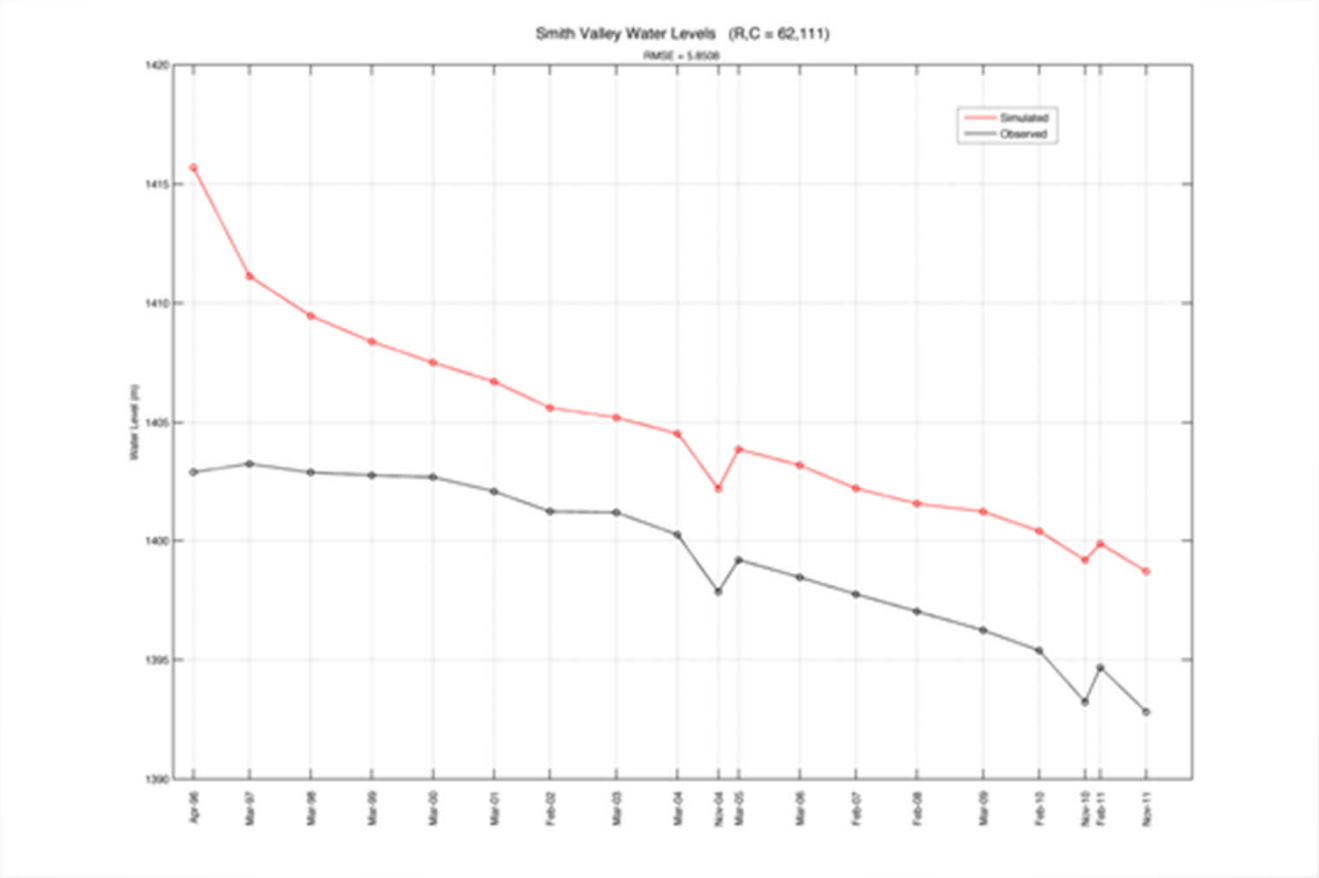
- A complete water budget is calculated using the SFR package within MODFLOW for the Walker River and agricultural drains
- Losses from irrigation ditches are handled separately in MODSIM and are treated as a fluid source term in MODFLOW

Model Accuracy



Model Accuracy

Model Accuracy

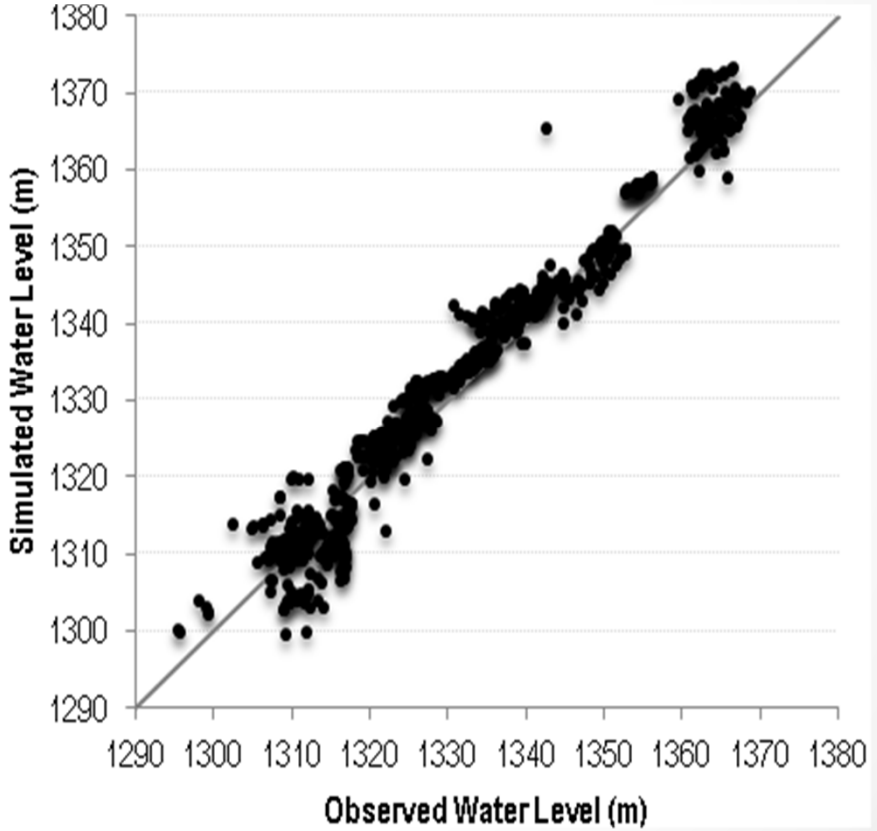


Model Accuracy

Mason Valley

RMSE = 3.7 m

Relative Error = 1.98%

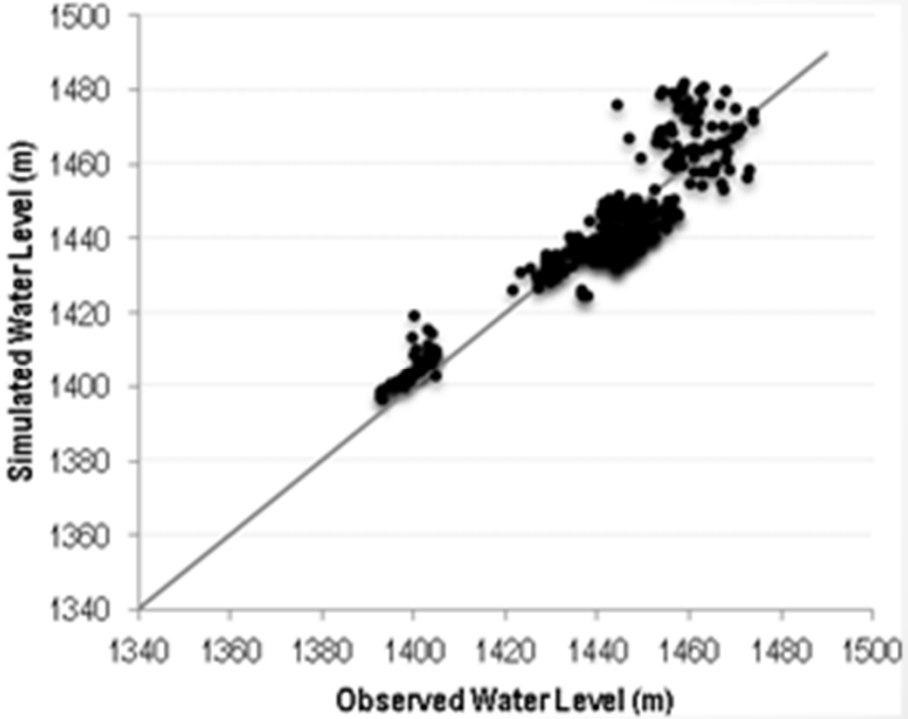


Model Accuracy

Smith Valley

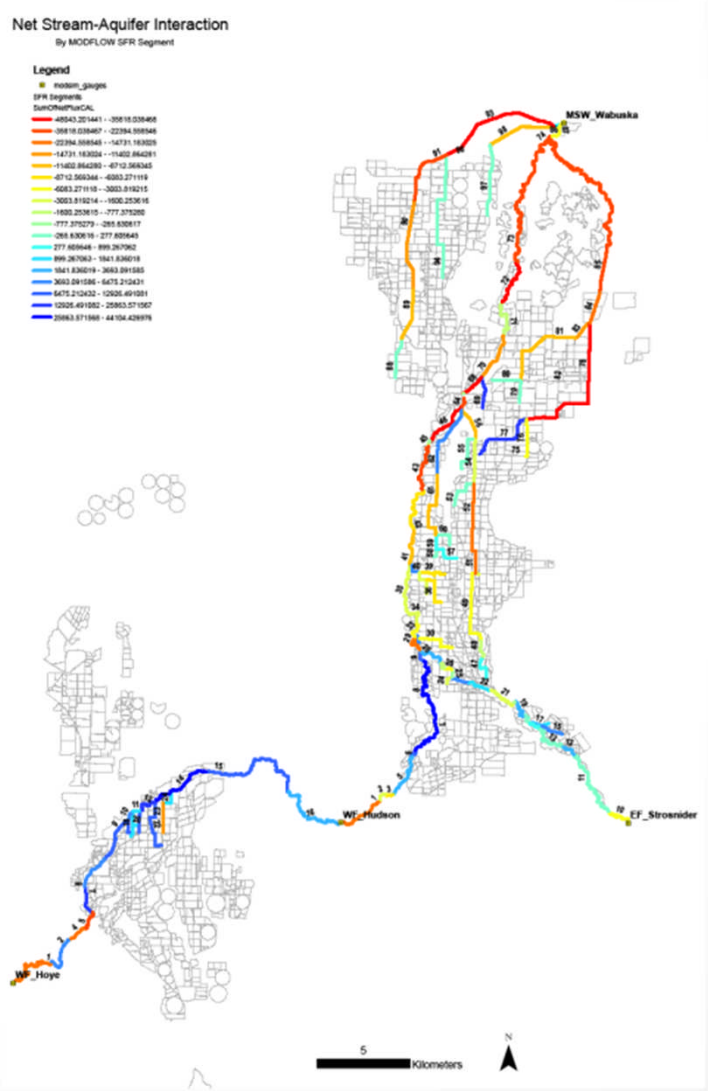
RMSE = 8.8 m

Relative Error = 5%



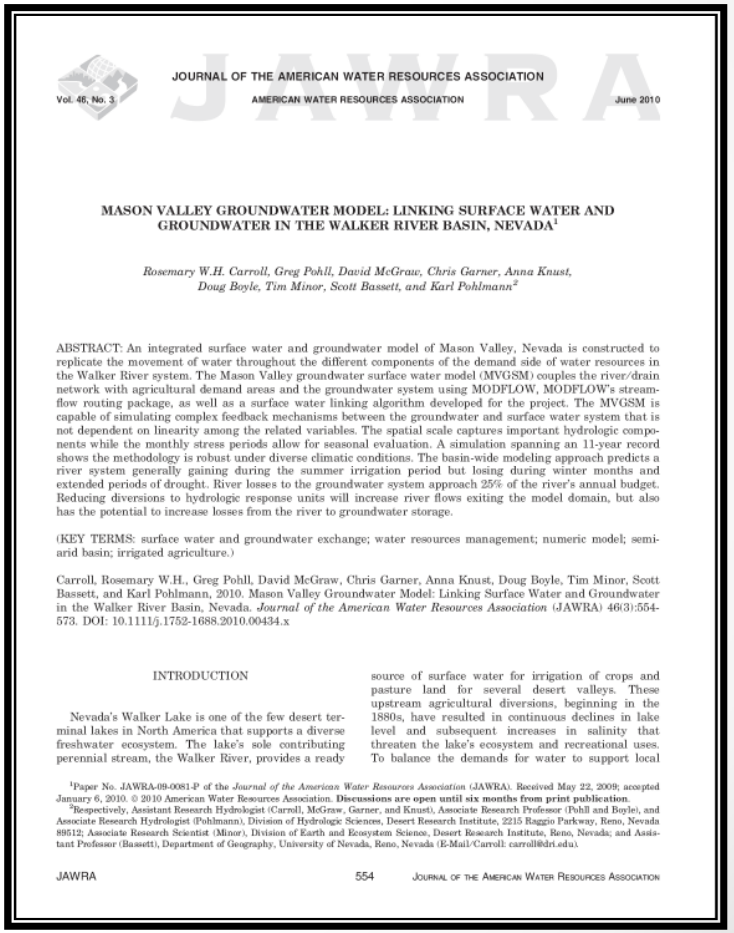
Stream Gains and Losses

- Warm Colors – Losing
- Cool Colors – Gaining



Conclusions

- Two groundwater models were constructed for use in the DST
- These models were calibrated, validated, and peer-reviewed
- The models are integrated into the DST to provide groundwater flux information at every time step



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Vol. 46, No. 3 AMERICAN WATER RESOURCES ASSOCIATION June 2010

MASON VALLEY GROUNDWATER MODEL: LINKING SURFACE WATER AND GROUNDWATER IN THE WALKER RIVER BASIN, NEVADA[1]

Rosemary W.H. Carroll, Greg Pohll, David McGraw, Chris Garner, Anna Knust, Doug Boyle, Tim Minor, Scott Bassett, and Karl Pohlmann[2]

ABSTRACT: An integrated surface water and groundwater model of Mason Valley, Nevada is constructed to replicate the movement of water throughout the different components of the demand side of water resources in the Walker River system. The Mason Valley groundwater surface water model (MVGSM) couples the river/drain network with agricultural demand areas and the groundwater system using MODFLOW, MODFLOW's stream-flow routing package, as well as a surface water linking algorithm developed for the project. The MVGSM is capable of simulating complex feedback mechanisms between the groundwater and surface water system that is not dependent on linearity among the related variables. The spatial scale captures important hydrologic components while the monthly stress periods allow for seasonal evaluation. A simulation spanning an 11-year record shows the methodology is robust under diverse climatic conditions. The basin-wide modeling approach predicts a river system generally gaining during the summer irrigation period but losing during winter months and extended periods of drought. River losses to the groundwater system approach 25% of the river's annual budget. Reducing diversions to hydrologic response units will increase river flows exiting the model domain, but also has the potential to increase losses from the river to groundwater storage.

(KEY TERMS: surface water and groundwater exchange; water resources management; numeric model; semi-arid basin; irrigated agriculture.)

Carroll, Rosemary W.H., Greg Pohll, David McGraw, Chris Garner, Anna Knust, Doug Boyle, Tim Minor, Scott Bassett, and Karl Pohlmann, 2010. Mason Valley Groundwater Model: Linking Surface Water and Groundwater in the Walker River Basin, Nevada. *Journal of the American Water Resources Association* (JAWRA) 46(3):554-573. DOI: 10.1111/j.1752-1688.2010.00434.x

INTRODUCTION

Nevada's Walker Lake is one of the few desert terminal lakes in North America that supports a diverse freshwater ecosystem. The lake's sole contributing perennial stream, the Walker River, provides a ready source of surface water for irrigation of crops and pasture land for several desert valleys. These upstream agricultural diversions, beginning in the 1880s, have resulted in continuous declines in lake level and subsequent increases in salinity that threaten the lake's ecosystem and recreational uses. To balance the demands for water to support local

[1]Paper No. JAWRA-09-0081-P of the *Journal of the American Water Resources Association* (JAWRA). Received May 22, 2009; accepted January 6, 2010.
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