SACFEM Model Development

Sacramento Valley

July 11th, 2008

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Model Objectives

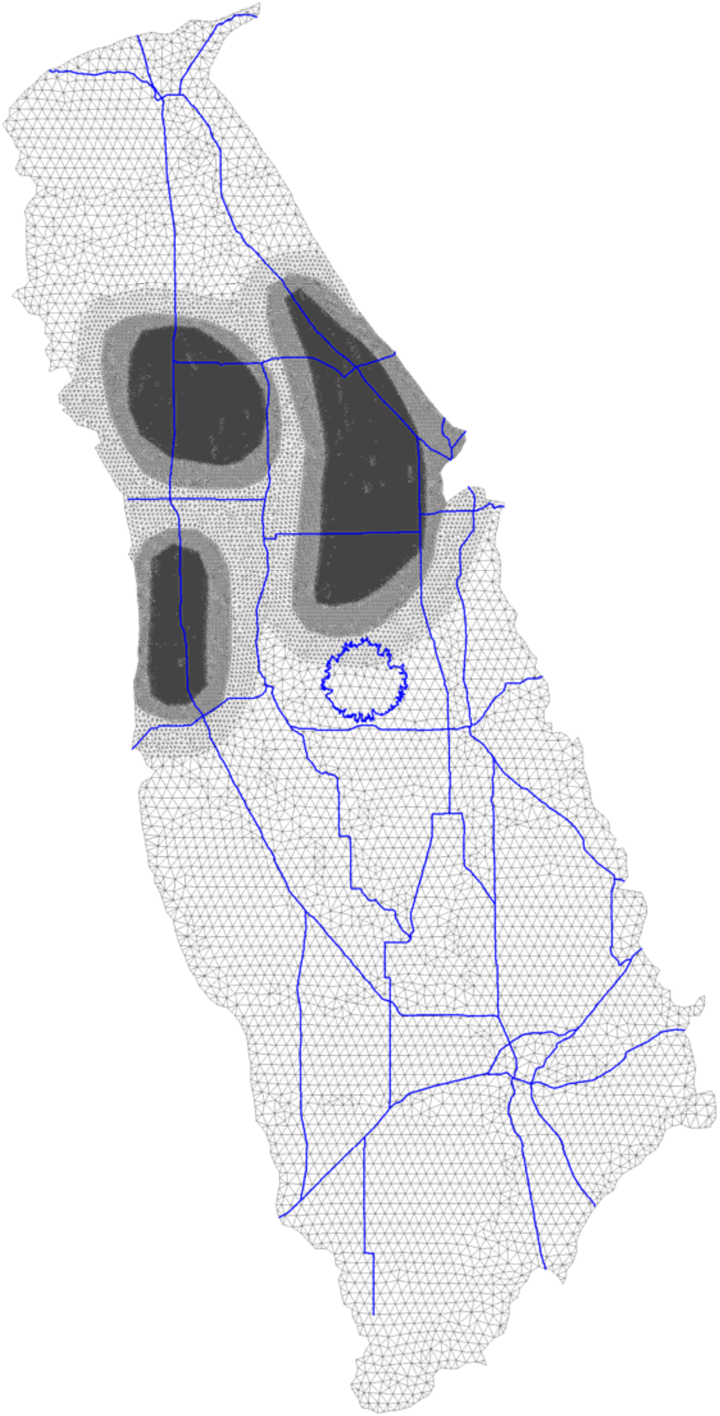
- **Develop a numerical tool with these following characteristics to support the evaluation of conjunctive water management projects:**
  - Sacramento Valley wide coverage
  - Incorporation of detailed surface water processes
  - Provide greater spatial resolution of potential impacts to groundwater levels and stream flow than currently available with existing modeling tools

Approach

- Develop a groundwater model of the Sacramento Valley with sufficient resolution to achieve project objectives
- Link groundwater model with surface water budgeting and root zone model to account for natural and agricultural practices that provide monthly estimates of deep percolation and agricultural pumping quantities on a node by node basis from 1970 through 2003

Model Construction

- Uses Micro-FEM model platform
- 125-meter node spacing in refined areas (89,000 surface nodes)
- Seven layer model extending to base of freshwater
- Lower Tuscan Aquifer explicitly represented by the two lowest layers in the model where present
- Upper layers defined to be consistent with common groundwater producing zones within the basin



Aquifer Properties

- Hydraulic conductivity distribution developed based on a PG&E pump efficiency database that contains specific capacity estimates for about 1000 wells in the model domain
- Eliminated wells less than 100 feet deep and producing less than 100 gpm
- Specific capacity converted to hydraulic conductivity based on empirical relationships

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Aquifer Properties

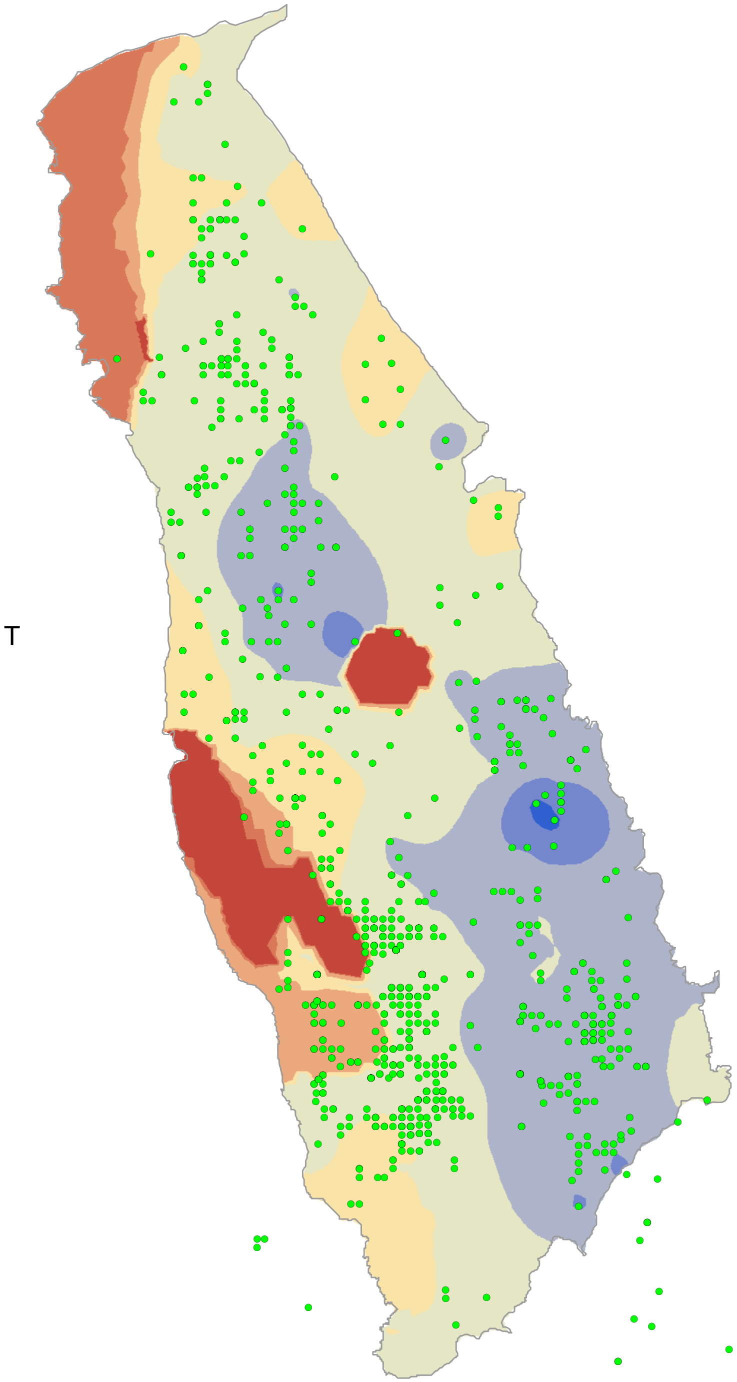
- FORTRAN utility then written to compute a geometric mean for all K estimates within a given critical radius (used 10,000 meters)
- Final product was a smoothed K distribution across the valley
- Bedrock properties assigned manually based on geologic mapping

LEGEND

- HYDRAULIC CONDUCTIVITY DATA POINT
- MODEL BOUNDARY

HYDRAULIC CONDUCTIVITY (feet/day)

- < 0.1
- 0.1 TO 10
- 10 TO 50
- 50 TO 100
- 100 TO 200
- 200 TO 300
- 300 TO 400
- 400 TO 450



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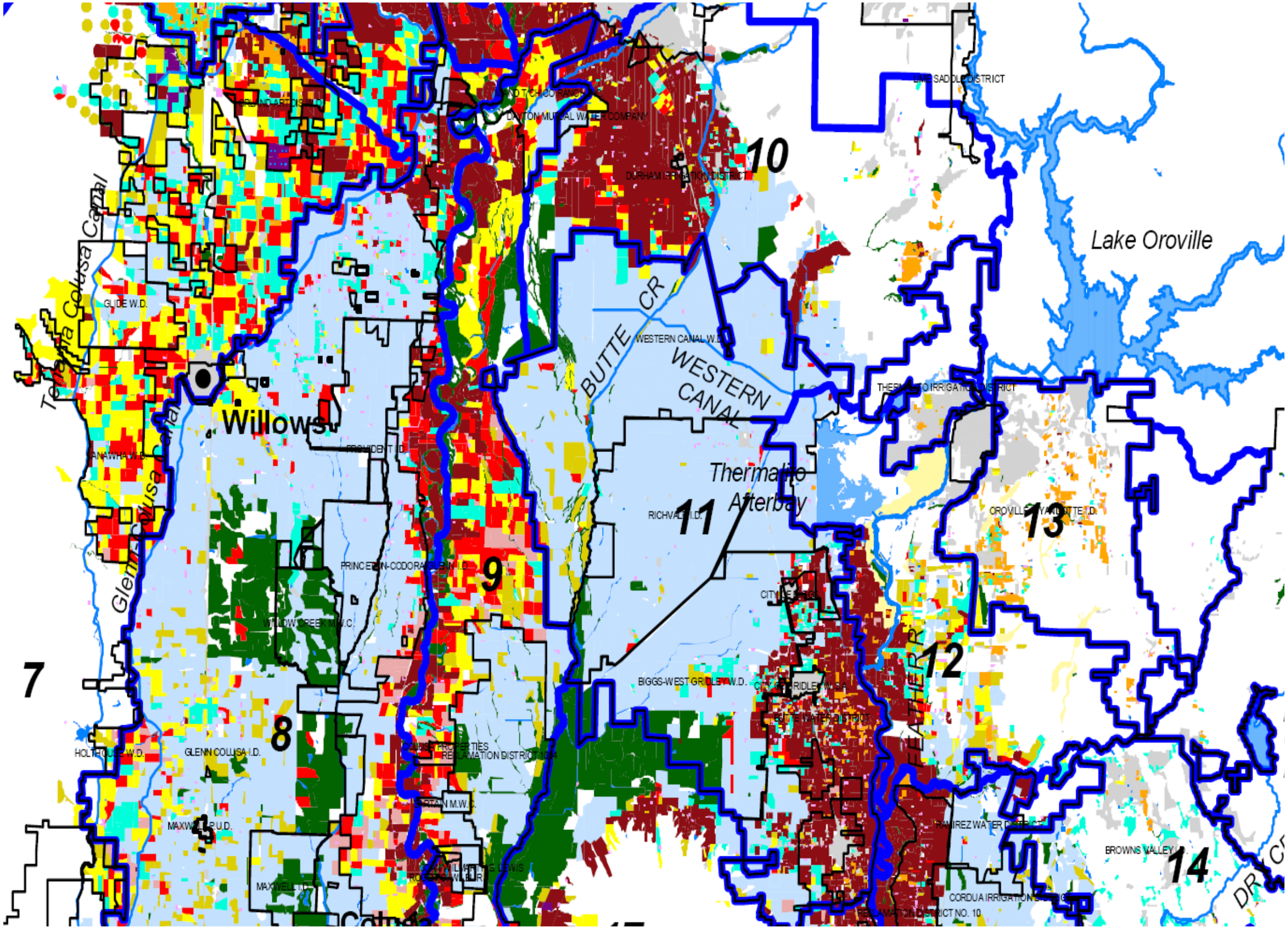
Surface Water Budgets

- **Surface water budgets developed by considering the following factors in each nodal polygon:**
  - Land use data
  - Cropping patterns
  - Sources of irrigation water
  - Surface water availability in different year types
  - Spatial and temporal distribution of precipitation
- **Water budgets developed for each model node on a monthly time step for the period 1970 through 2003**

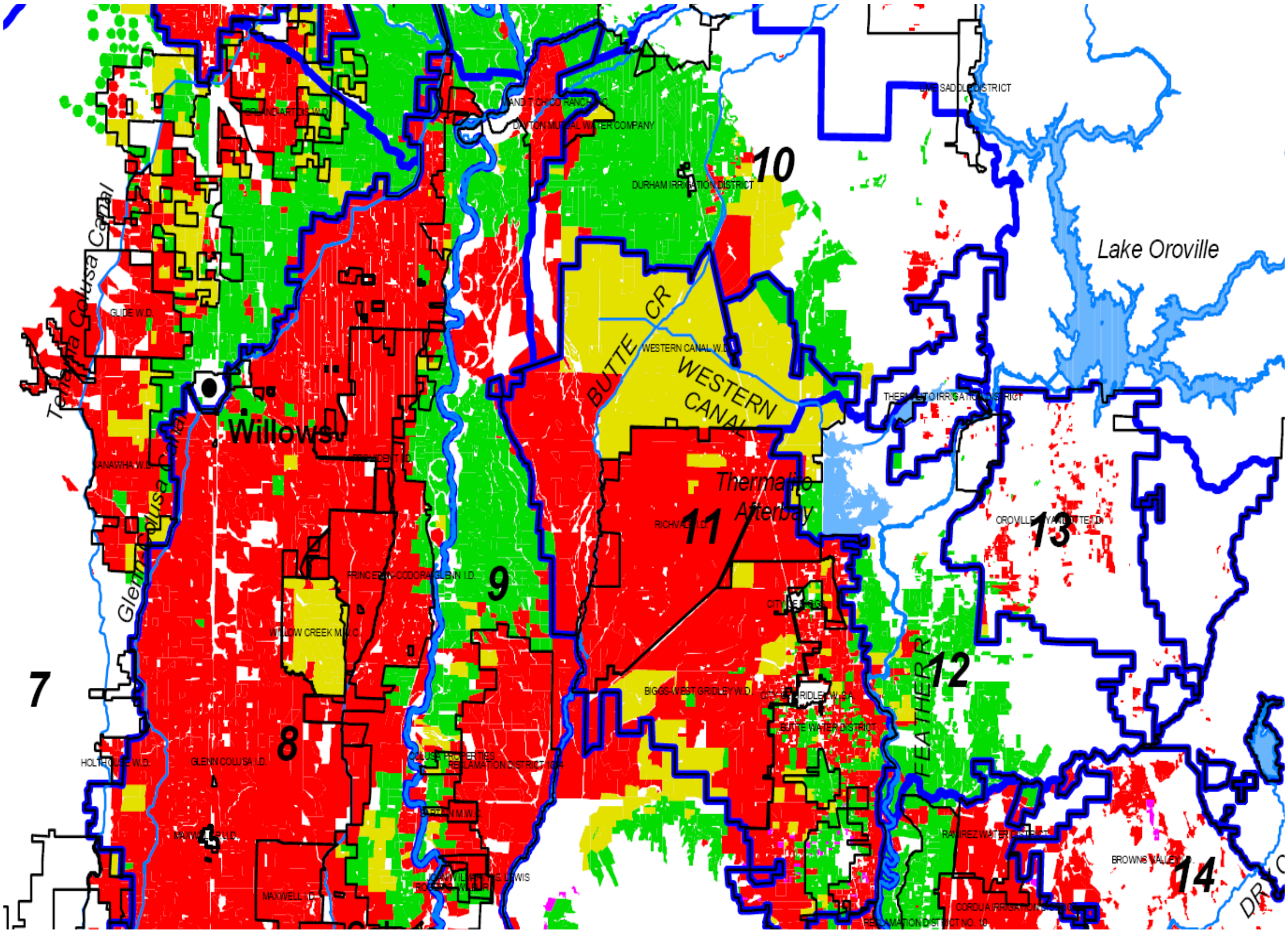
Surface Water Budgets

- IWFM root zone model was used to estimate resulting monthly deep percolation rates to the water table from surface water budgets
- Agricultural pumping quantities were estimated as the difference between the available surface water for irrigation in a given month and the monthly crop demand

Land Use Data



Water Source Data



Additional Water Budget Components

- Urban pumping – based on population estimates from the 2000 Census
- Mountain front recharge – delineated drainage areas outside of the model domain that drain to streams not explicitly simulated in the model
- Deep percolation rates then modified during calibration efforts

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Calibration

- The current available resources limited calibration to a steady-state analysis
- The model was calibrated to steady-state conditions for calendar year 2000 - the most recent average water year where water budget data was available
- The groundwater model was calibrated to average 2000 groundwater elevations for 257 wells across the model domain

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Legend

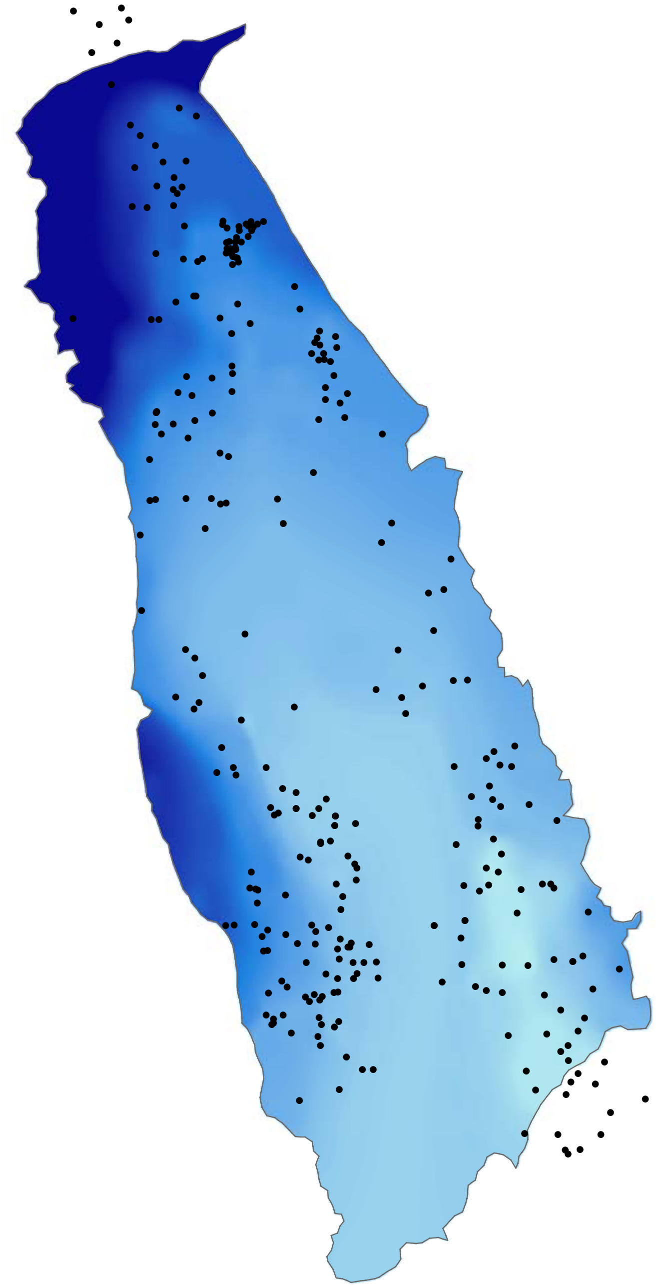
● GROUNDWATER ELEVATION TARGETS (meters msl)

MODEL BOUNDARY

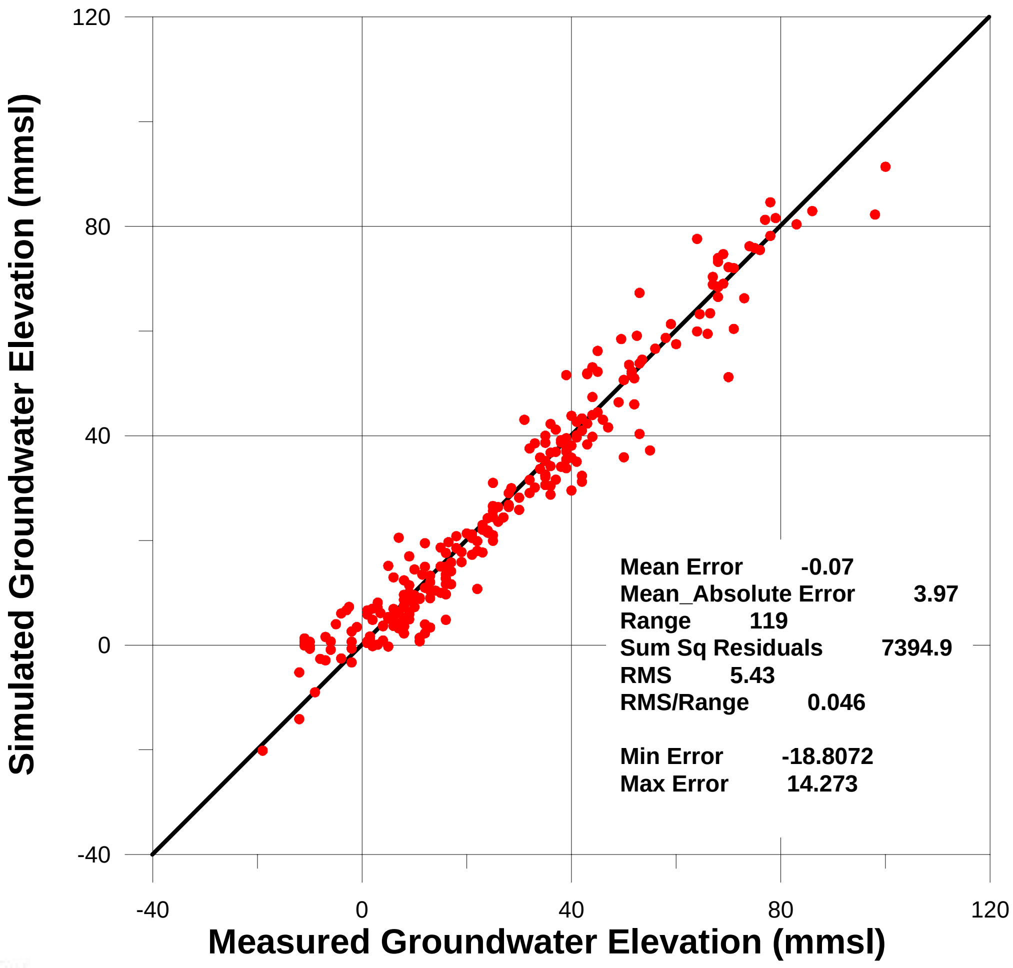
AVERAGE 2000 GROUNDWATER ELEVATION (meters msl)

High : 249.9

Low : -14.9658



Calibration Scattergram



Water Budget Summary

Recharge	**Acre-Feet**	**CFS**
Deep Percolation of Precipitation	1,398,461	1,932
Deep Percolation of Applied Water	865,131	1,195
Mountain Front Recharge	495,507	684
Seepage from Streams to Groundwater	816,848	1,128
Total Recharge	**3,575,947**	**4,939**
Discharge	**Acre-Feet**	**CFS**
Agricultural Pumping	2,417,506	3,339
Urban Pumping	451,507	624
Groundwater Discharge to Streams	705,999	975
Total Discharge	**3,575,012**	**4,938**

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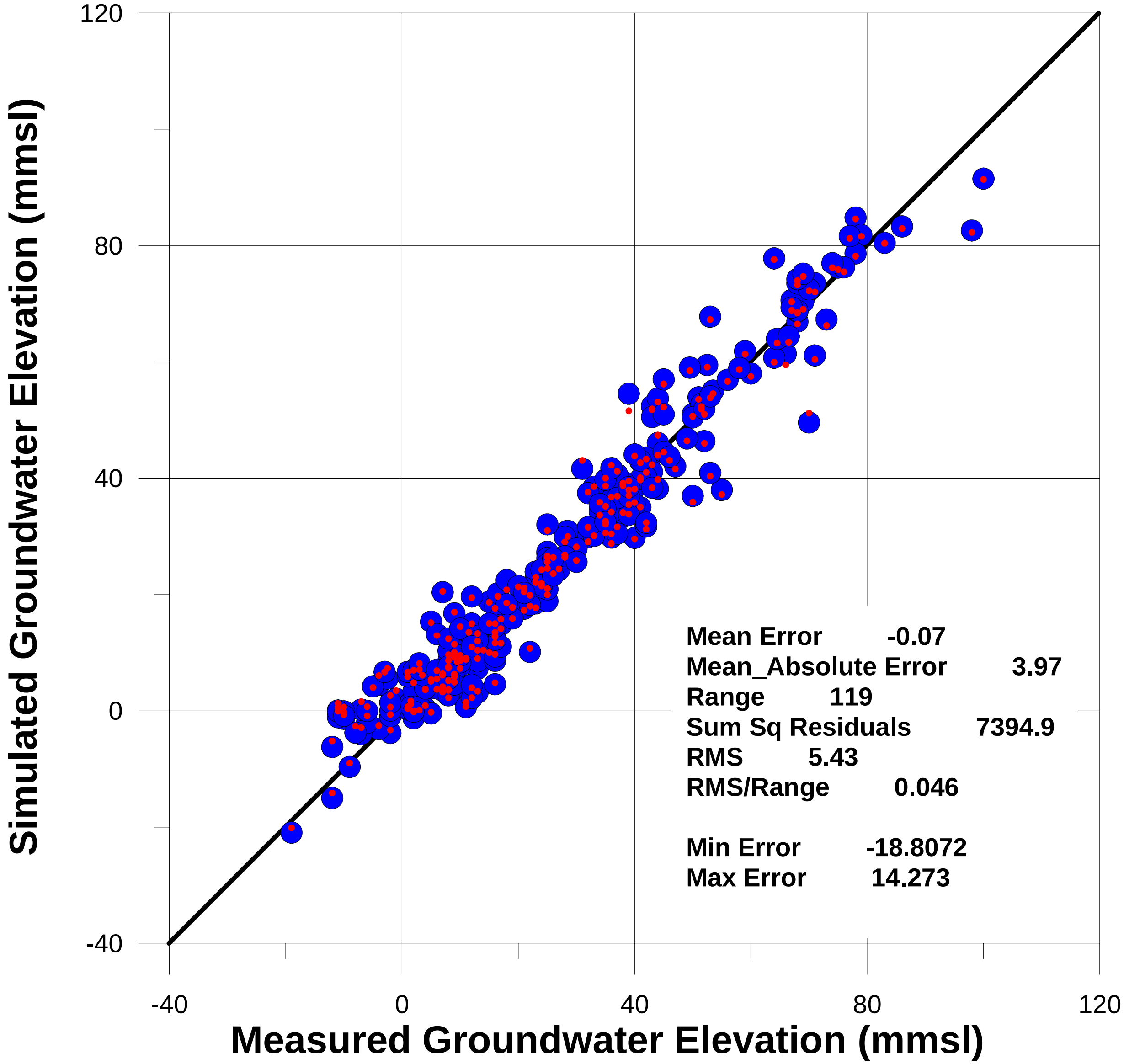
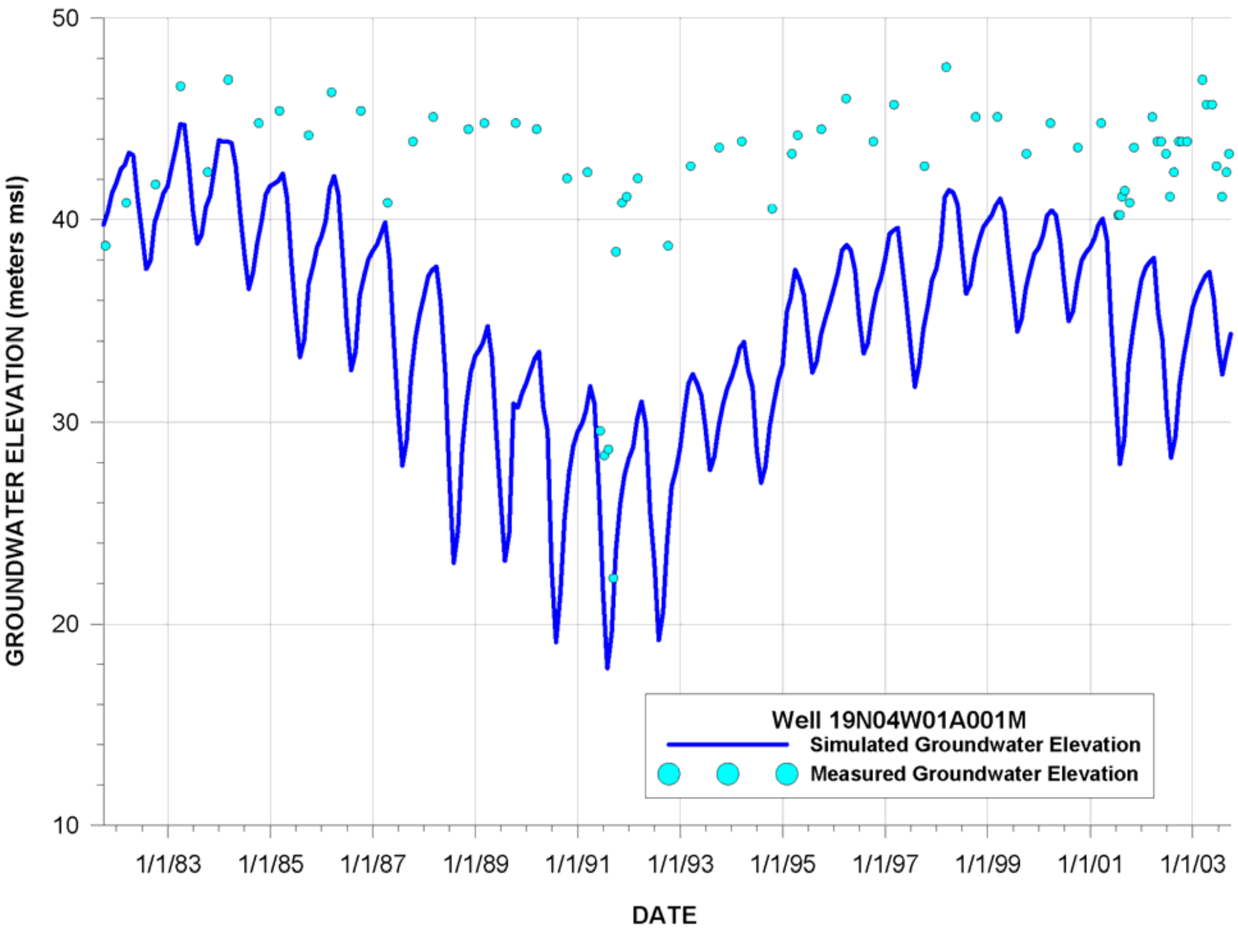
Transient Validation

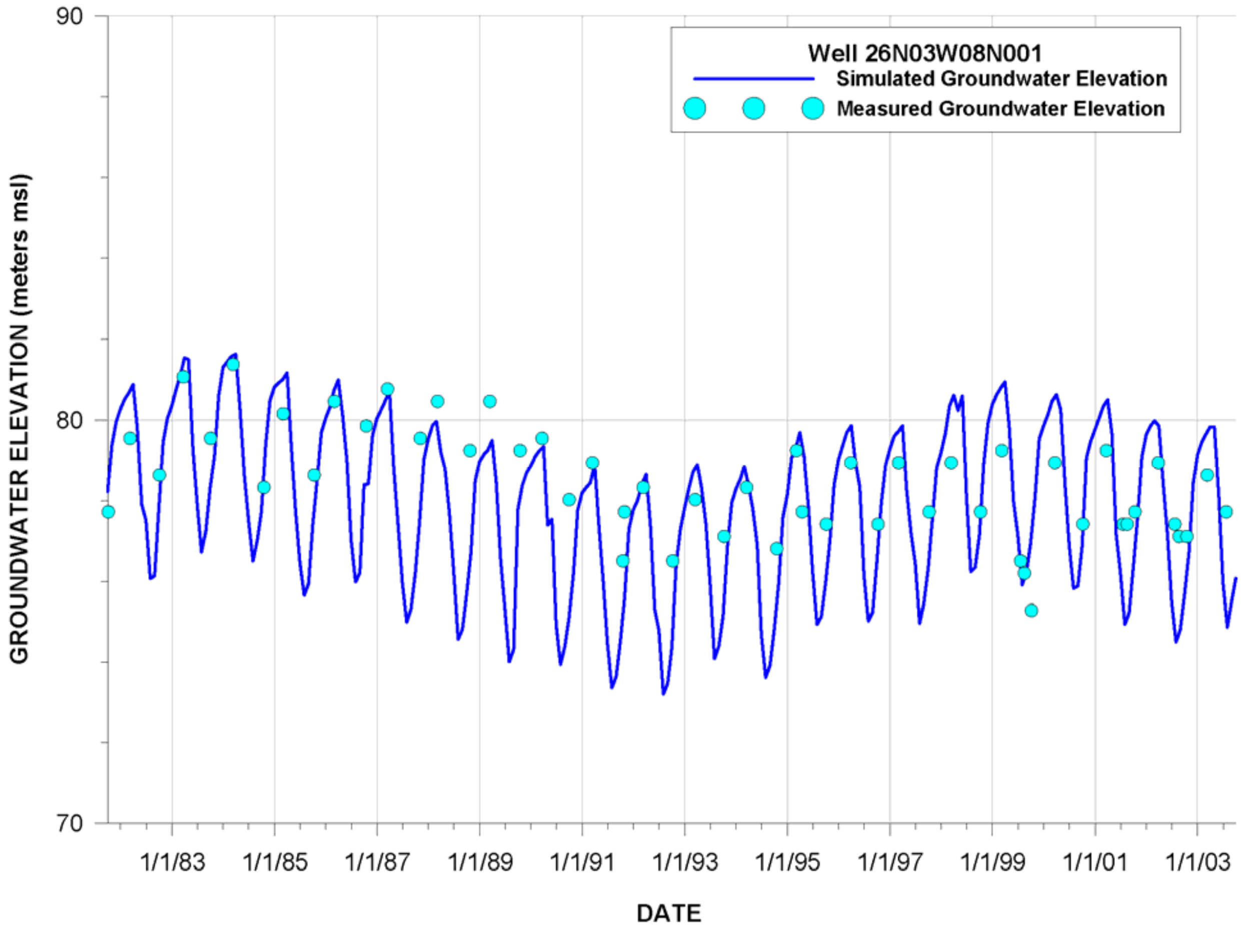
Comparison of Observed CY2000 Avg Heads and Average of Monthly CY2000 Heads from Transient 1982 through 2003 Simulation



Well 19N04W01A001M



Well 26N03W08N001



Conclusions

- Model water budget methodology seems to result in acceptable steady-state calibration
- Limited transient testing also suggests a reasonable match with observed transient water levels – further refinement needed
- Water budget components defined on a nodal basis – high resolution input
- Model provides higher resolution estimates of stream and groundwater level impacts than any currently available valley-wide tool

Questions/Comments?

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