Comparing Field-Estimated & Simulated Transmissivity

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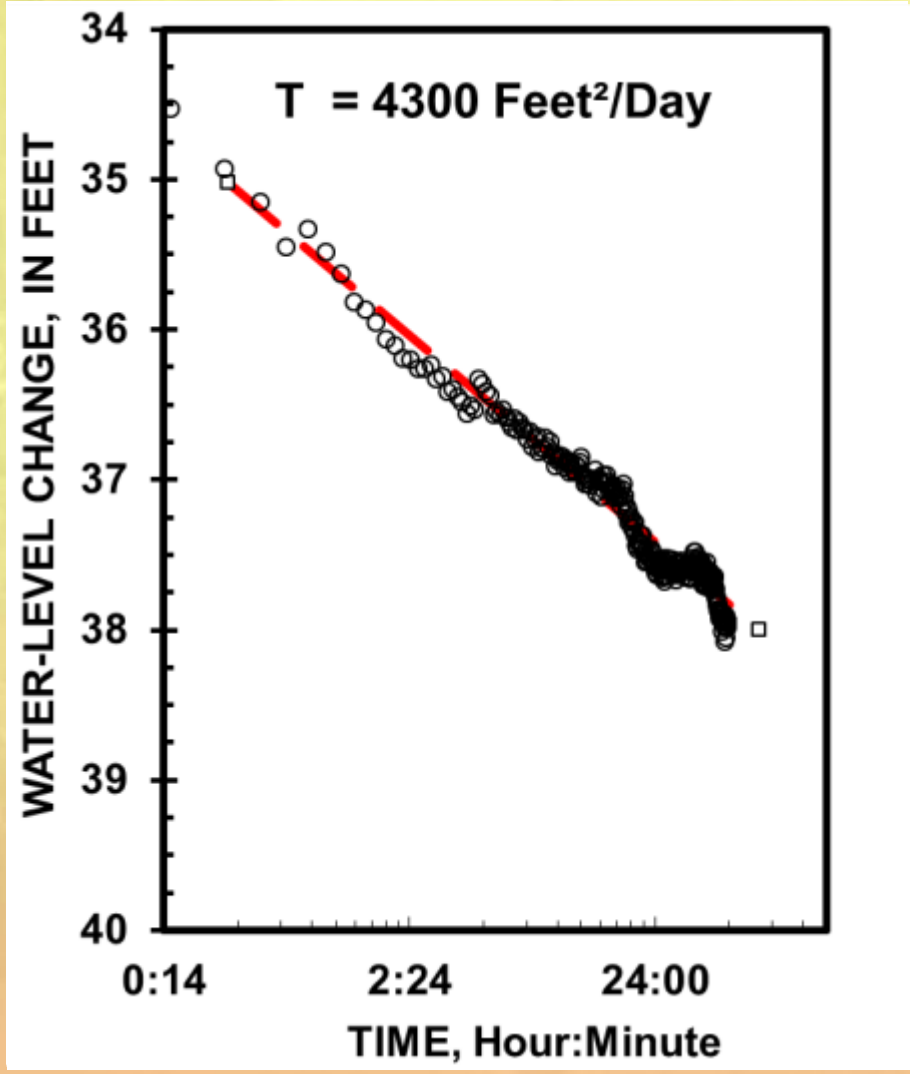
Transmissivity (T)

- Affects predicted drawdown & capture from groundwater-flow models
  - Uncertainty of ***T*** directly affects predictions
  - Specific yield also significant, but well defined
- Comprehensible quantity
  - Collapses to mappable quantities
  - Vertical variations primarily distracts
- Knowable quantity
  - Transmissivity relatively certain
  - Volume investigated is nebulous quantity

Aquifer Tests

- Water pumped
- Rate & ***volume*** known
- Water levels decline
- Transmissivity related to rate of decline
  - Increases as slope decreases
- "Direct" measure of hydraulic property



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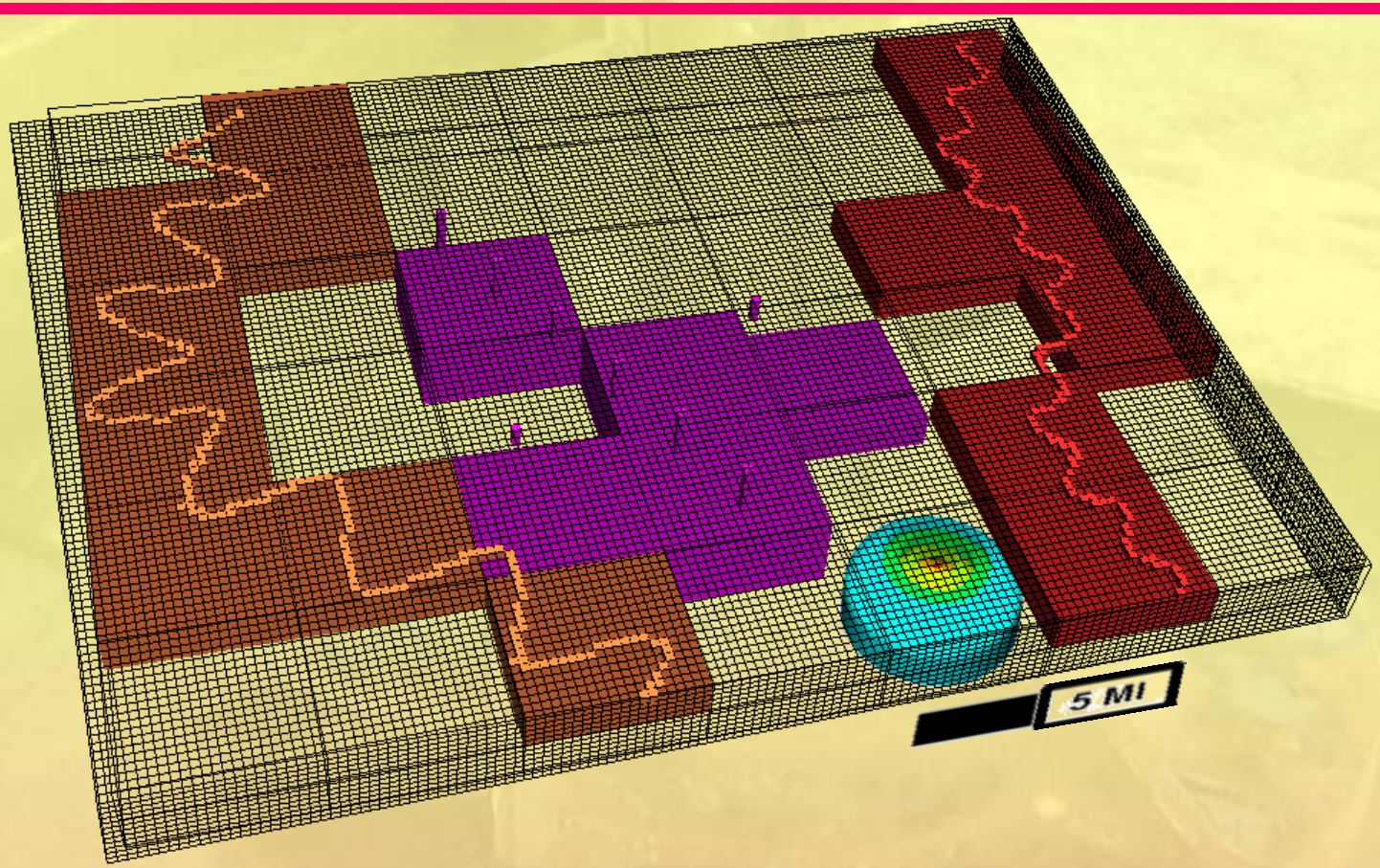
Grid Refinement



- Field volume fits in old cells, Easy comparison
- Not anymore, comparison takes work

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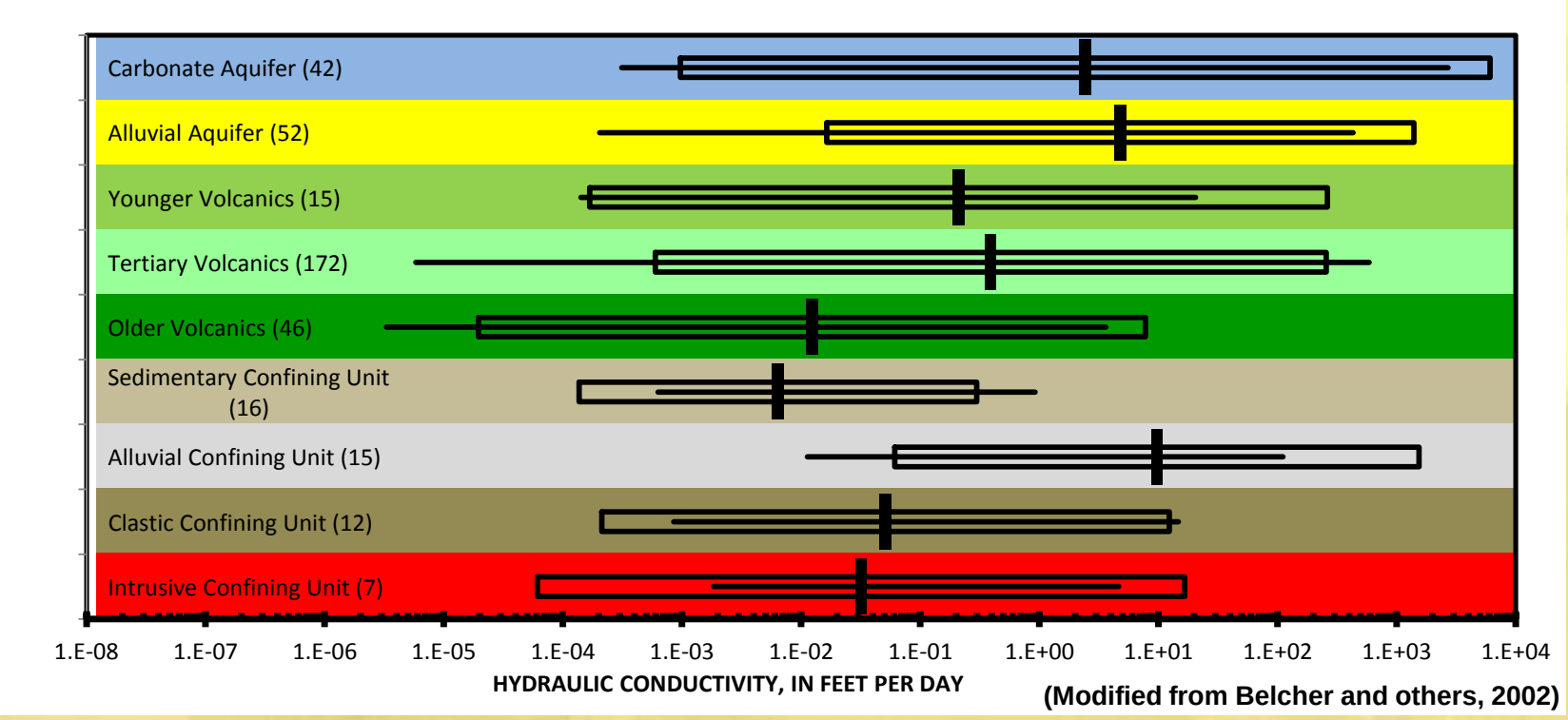
Compare K



- **K = T / b, No worries — Not quite**
  - Mean K contradicts expected order
  - Units hydraulically similar
  - Limits span 4 to 7 orders of magnitude

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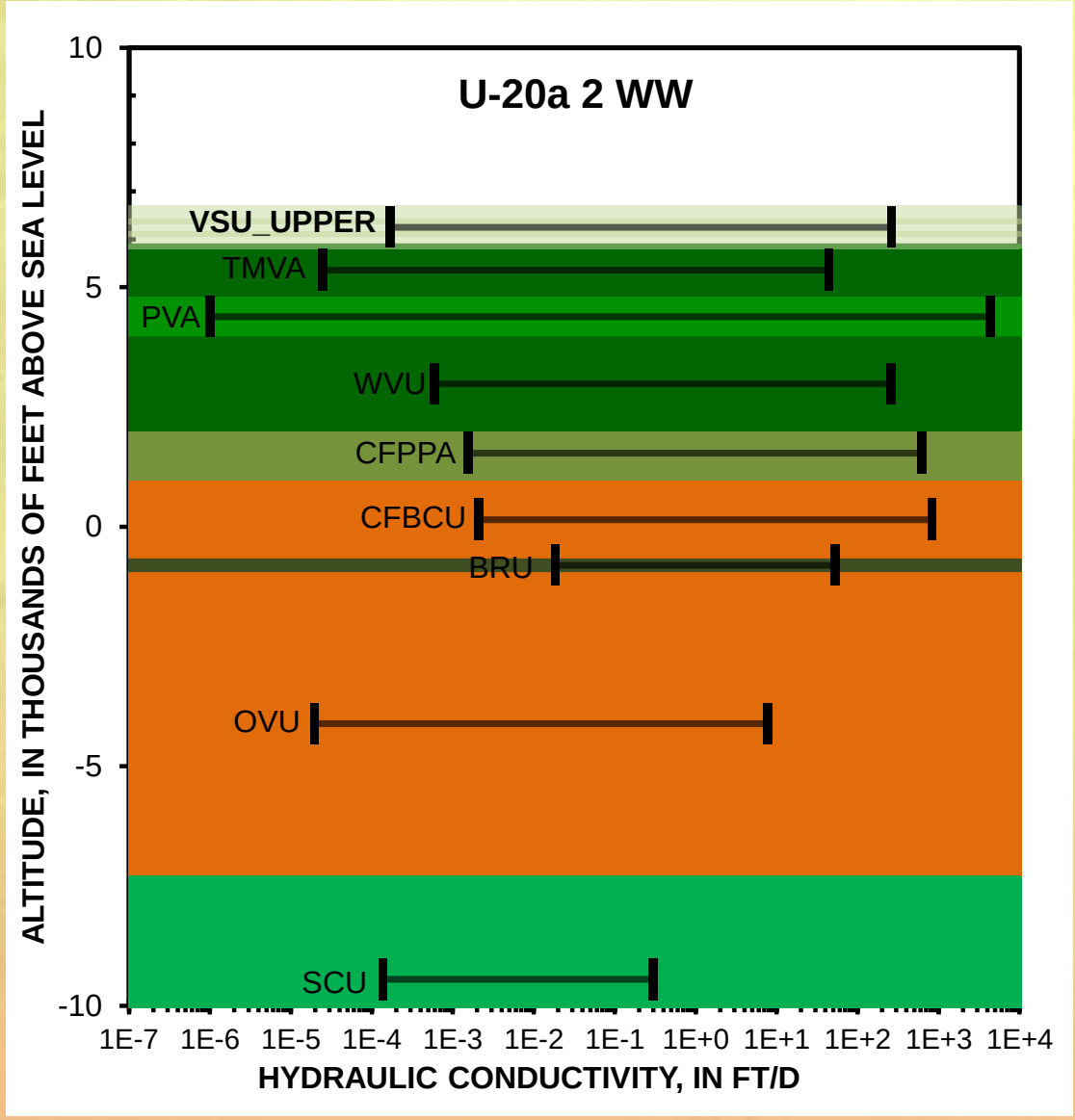
K Limits in Calibration

- Hydrogeologic units defined
- Ranges specified
  - By unit
  - Min-max = 95%
- Equal probability within ranges
- 0 probability outside of ranges



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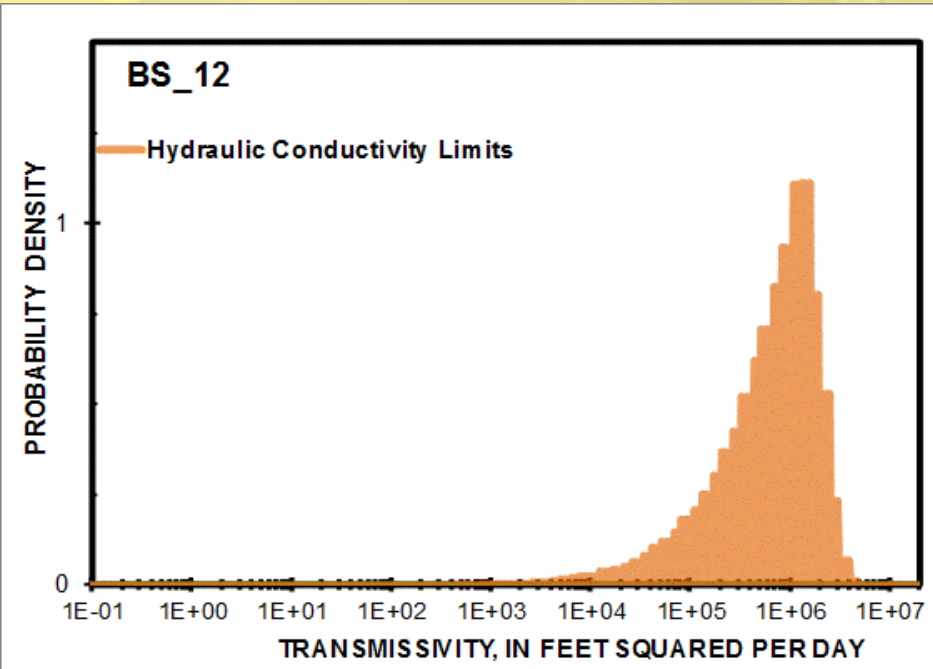
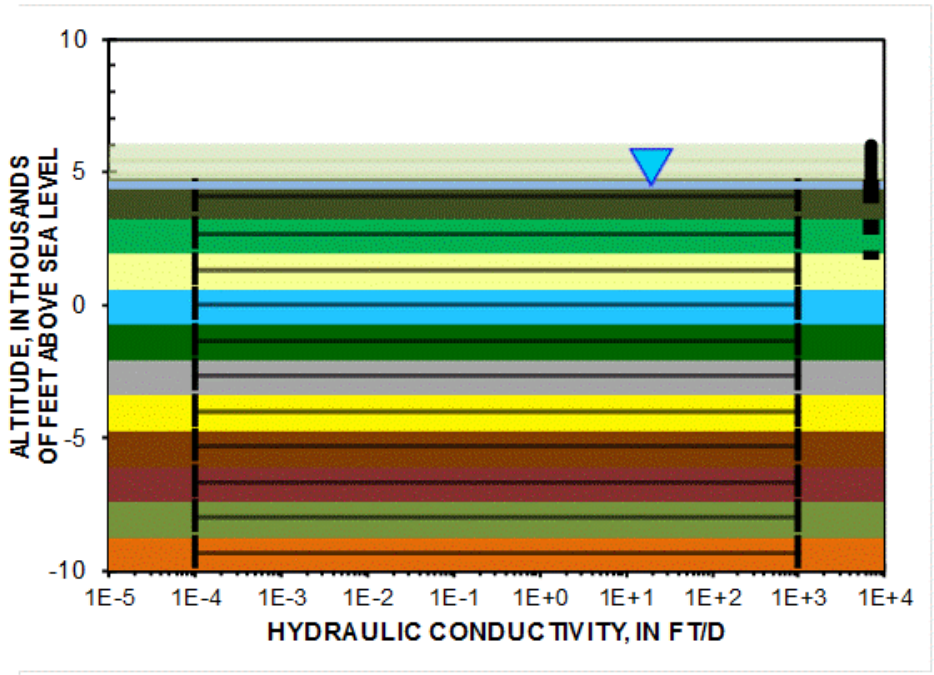
K Limits on Transmissivity





- Transmissivity PDFs from K limits
  - –Square wave for single hydrogeologic unit
  - –All distributions span several orders of magnitude
  - –High transmissivity hydrogeologic units control distribution

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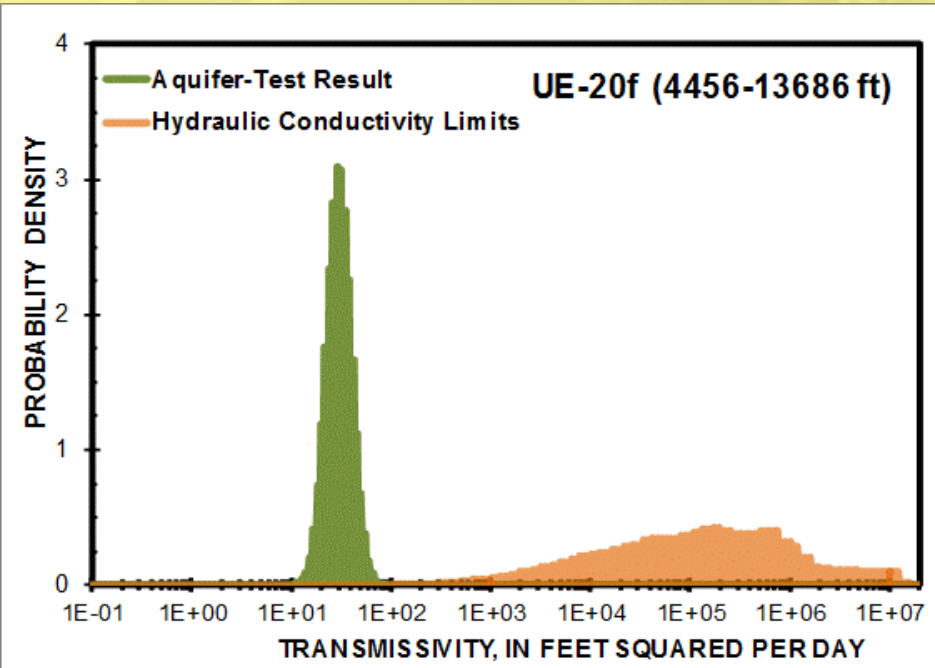
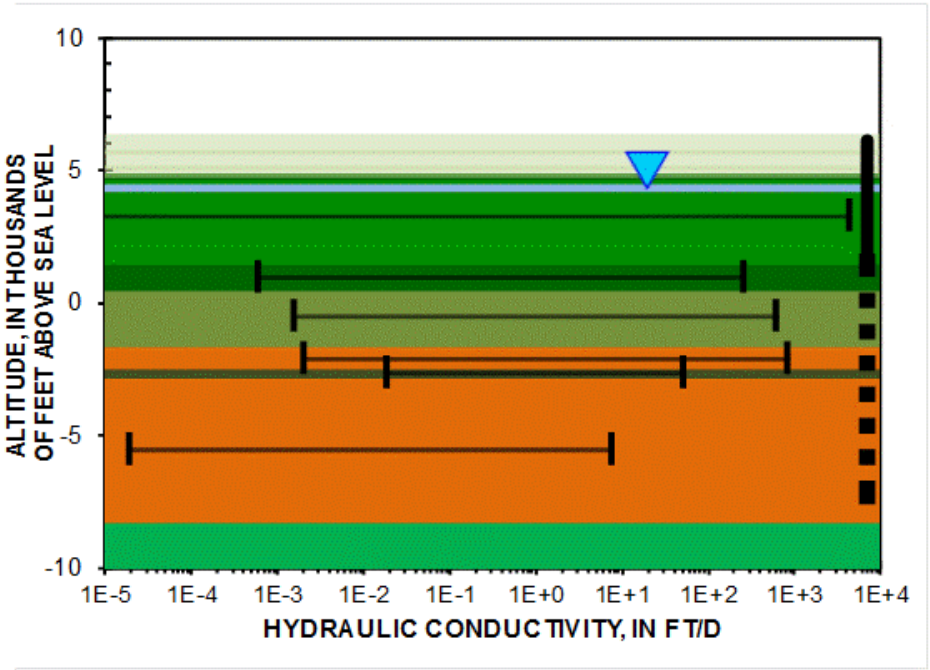
Transmissivity Constrains





- Hydraulic conductivity limits
  - –Site specific comparisons are lost
  - –Transmissivity bounds are biased high
- Need to preserve aquifer-test results—Not happening

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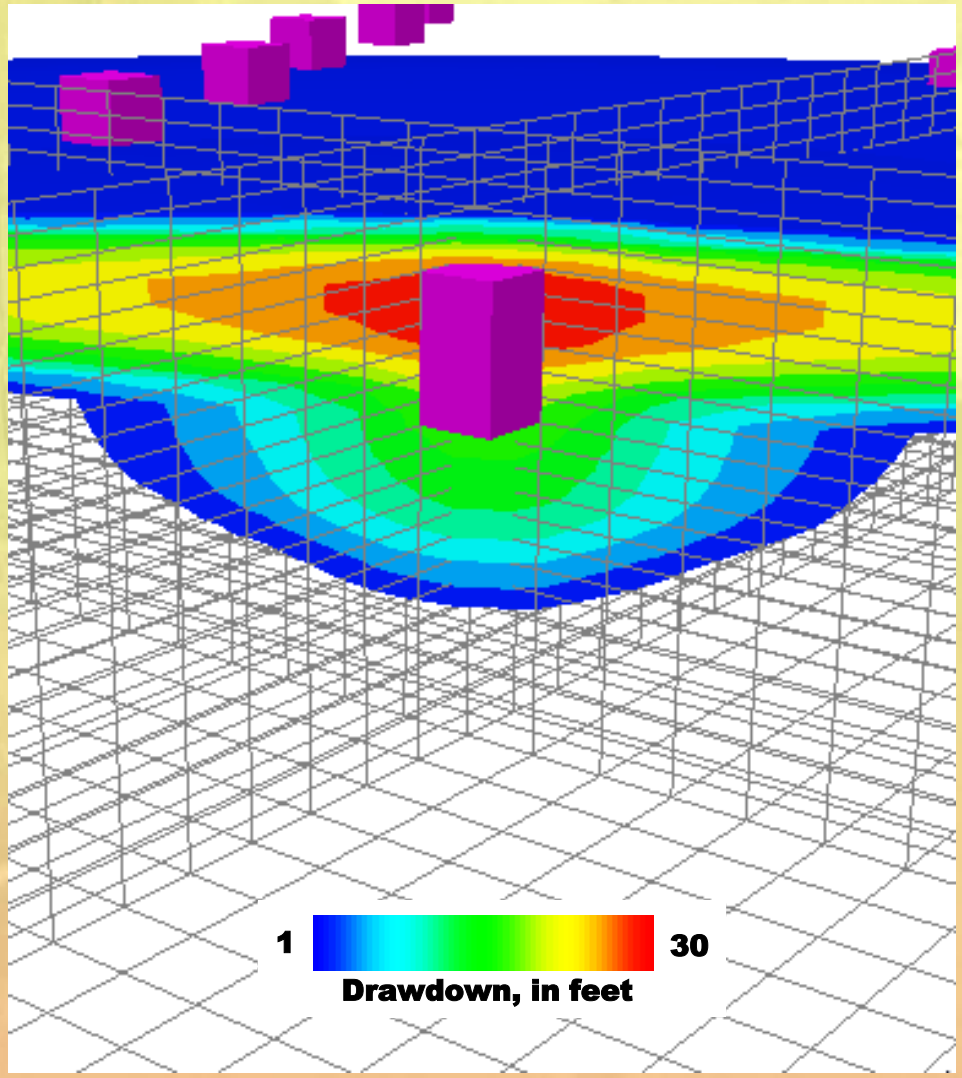
Compare Transmissivity

- Model, all is known
  - Hyd. Properties
  - Dimensions
- Model transmissivity
  - Drawdown, Volume investigated
  - Average laterally
  - Sum vertically
- Consistent & less wrong, even w/ fuzz



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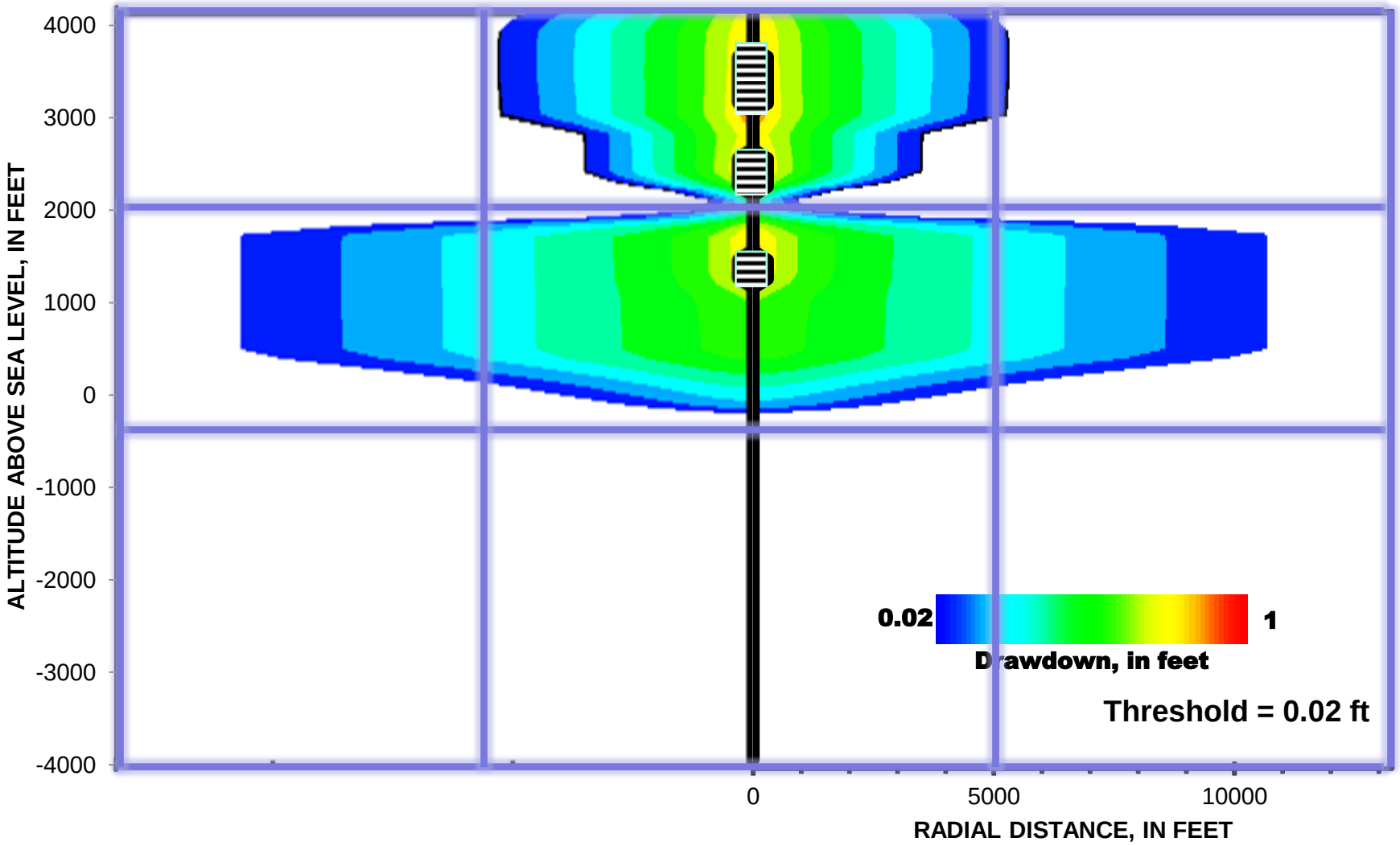
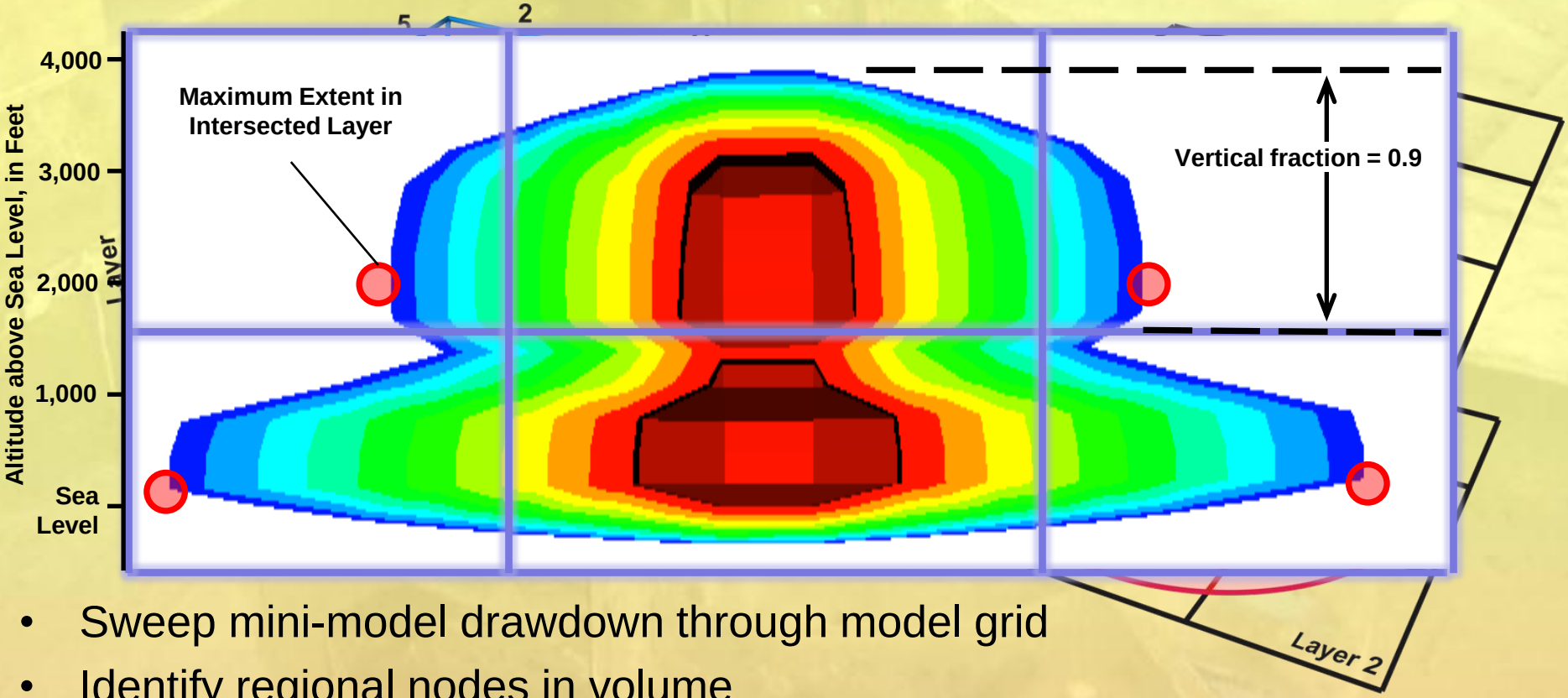
T-COMP

- T-COMP, suite of 3 FORTRAN codes
- T-COMP_Create,
  - Define volume with mini MODFLOW model
- T-COMP_Extract,
  - Identify regional model cells in volume
- T-COMP_Simulated,
  - Sample simulated transmissivity to calibrate
- Directly calibrating to aquifer-test results possible with T-COMP programs

T-COMP_Create



T-COMP_Extract



- Sweep mini-model drawdown through model grid
- Identify regional nodes in volume
- Fractional contribution –
  - Average in layer, areal fractions total 1.0
  - All fractions reduced where full layer thickness not investigated
- Write site name, number of nodes, node number, & fraction

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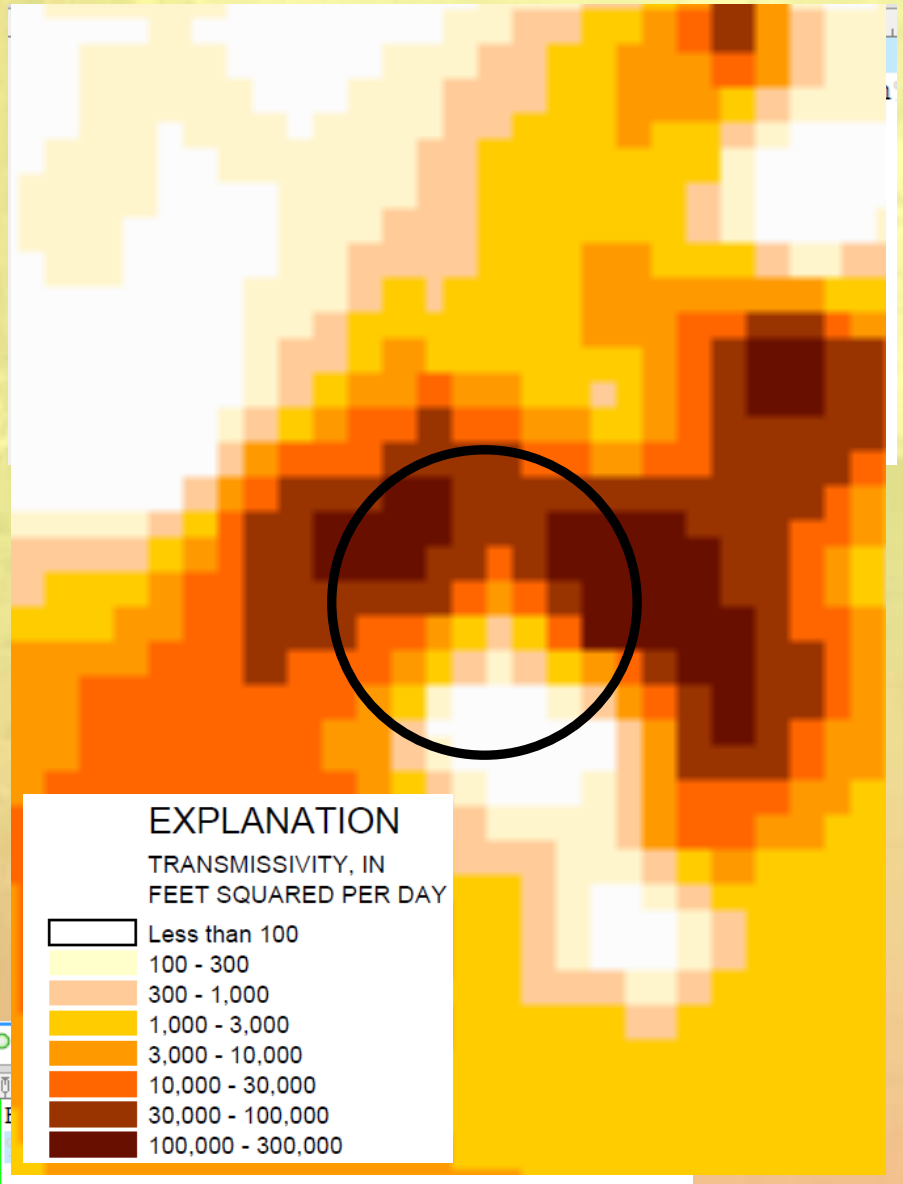
T-COMP_Simulated

- Read transmissivities from cell conductances
- Sum transmissivities times fraction for all contributing cells
- Write simulated transmissivity & log(T)
- Revise if things change drastically
- Significant variability can exist in sample



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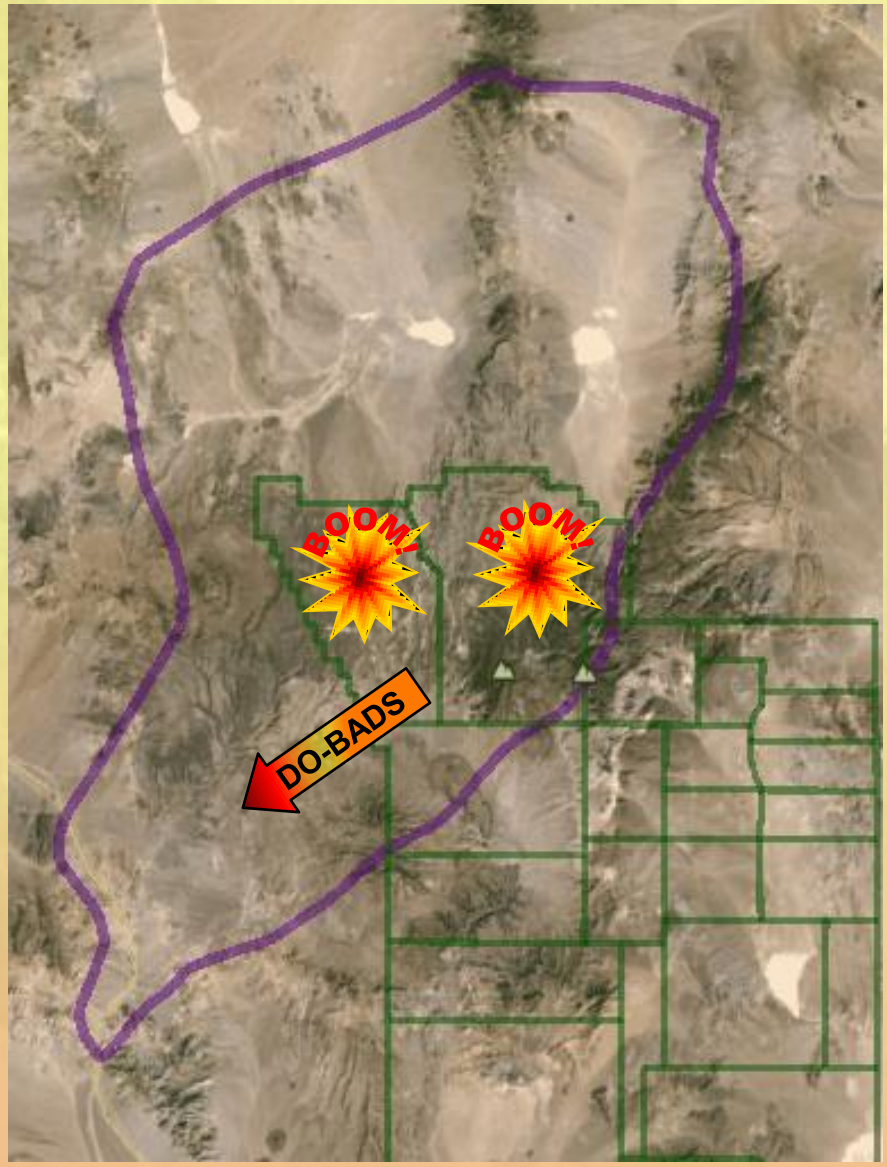
Pahute Mesa-Oasis Valley

- Potential radionuclide transport of interest
- Define Oasis Valley groundwater catchment
- No-flow boundary
- Test data consistency with 1-layer flow model
  - PMOV model
- Constrain simulated transmissivity w/ T_COMP, Not K-limits



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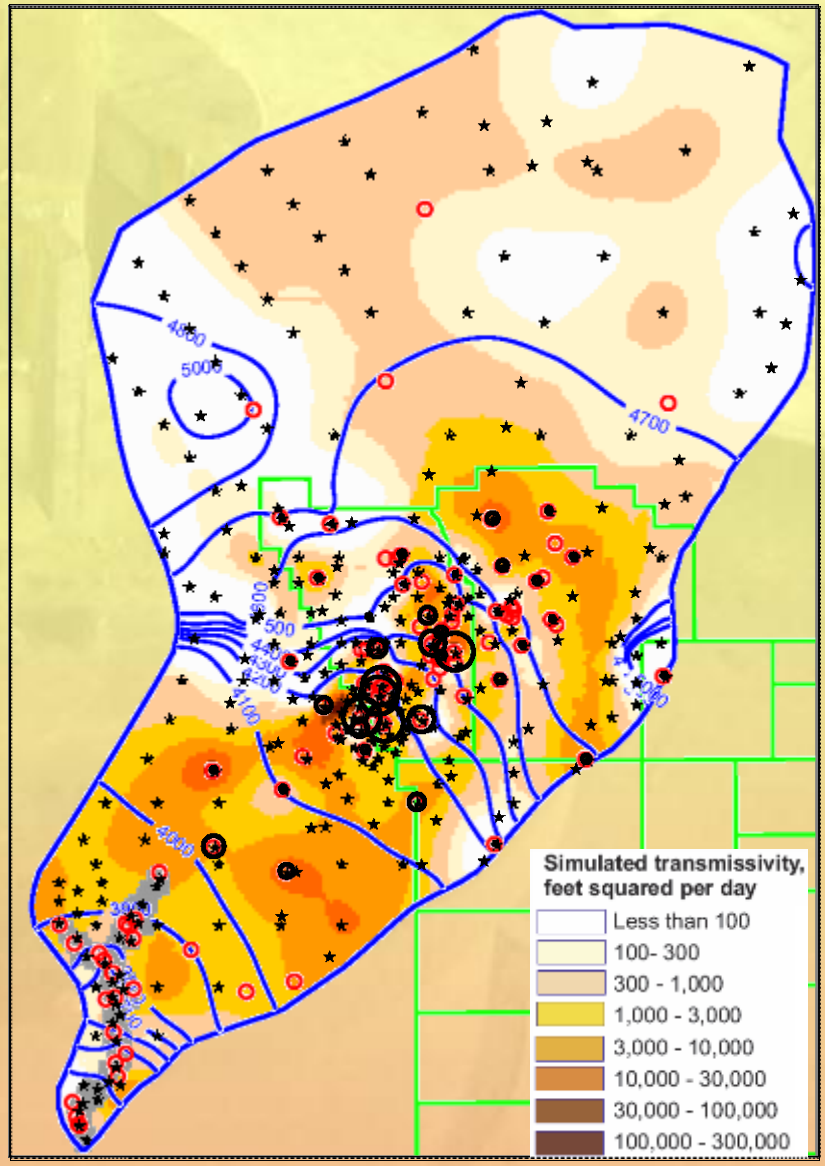
PMOV Calibration

- Reduce differences
  - Water levels in wells
  - Water table in ET area
  - Transmissivity in circles
- Adjust knobs
  - Recharge points &
  - Transmissivity points
- Constrain with wishes
- Estimate transmissivity & simulate water levels



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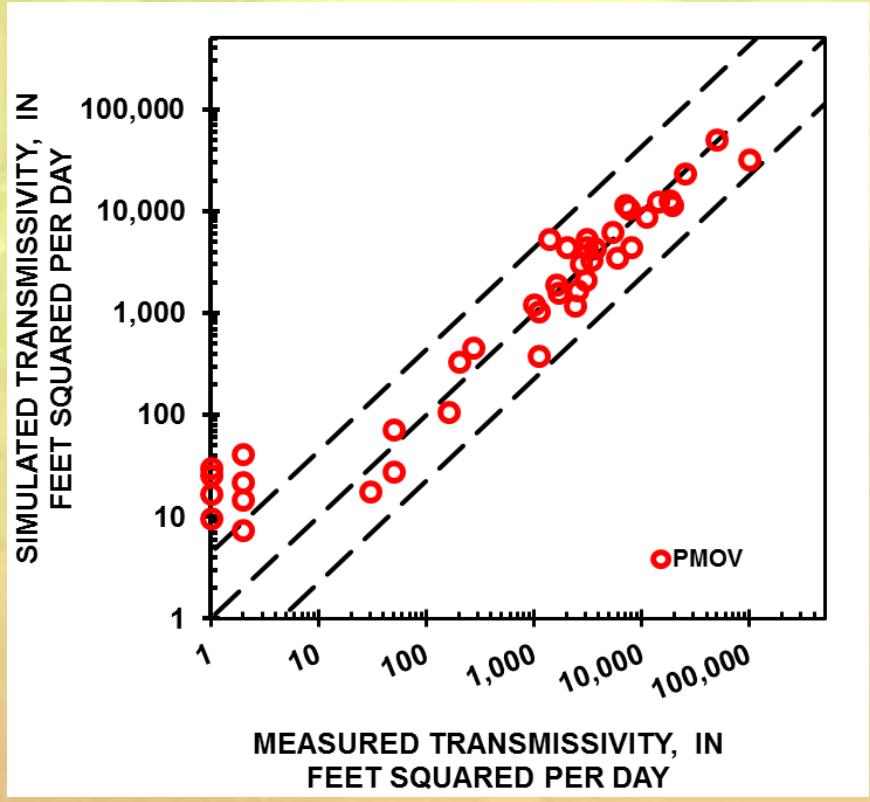
Goodness of Fit

- RMS-water levels = 24 ft
- Water-level scatter OK
- ET scatter shows structural error
- Field & simulated transmissivities agree to a factor of 5
- Some bias for low T tests



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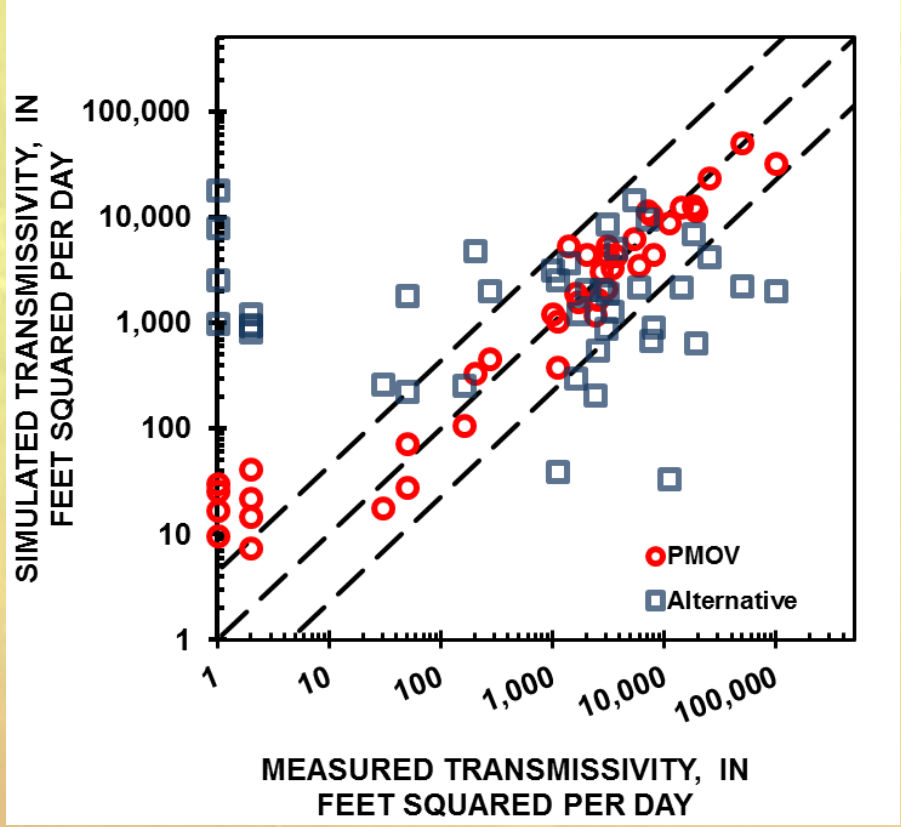
Remove Transmissivity

- Effect of transmissivity observations unknown
- Remove & recalibrate,
  - RMS = 15 ft, NO-T model
- General features remain
- Low & high T transpose
- Transmissivity more smoothed
  - Wishes control outcome
- Simulated transmissivities
  - Low T ignored more



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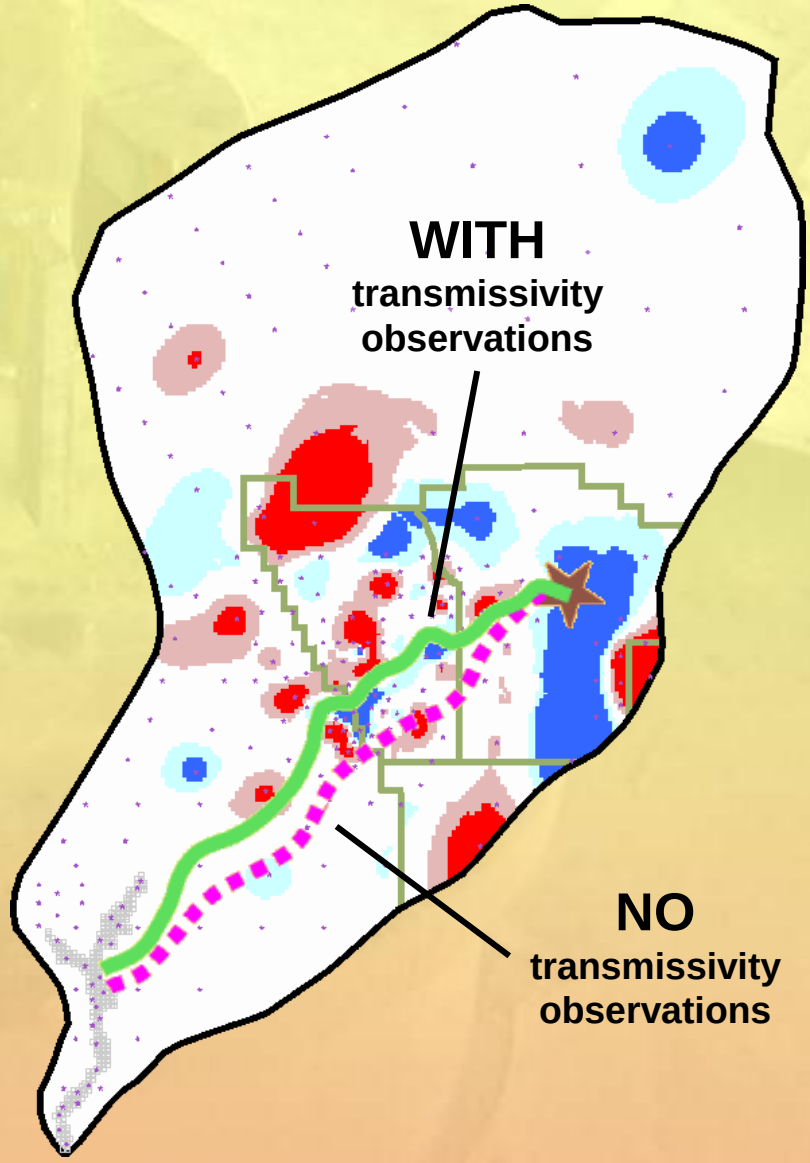
Results Affected

- Differences in transmissivity affect transport
- Compare pathlines
  - Thickness*porosity = 30 ft
  - ***T*** & recharge differ
- Paths differ by 3 miles
- Travel times differ
  - **WITH** ~ 600 years
  - **NO** ~ 1,600 years
- Affects drawdown & spring depletion also



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CONCLUSIONS

- Hydraulic-conductivity limits
  - Splintering hydraulically similar units harmful
  - Biases PDF towards greater transmissivities
  - Ignores site-specific, aquifer-test results
- Transmissivity observations
  - Can define volume of investigation
  - Minimal data requirements
  - Some subjectivity, but less wrong than ignorance
- Critically affects results
  - Greatly affects monitoring locations
  - Not including weakens results of interest; all scales