ASSESSING THE IMPACT OF TRANSIENT FLOW CHARACTERISTICS ON J-RANGE CONTAMINANT TRANSPORT

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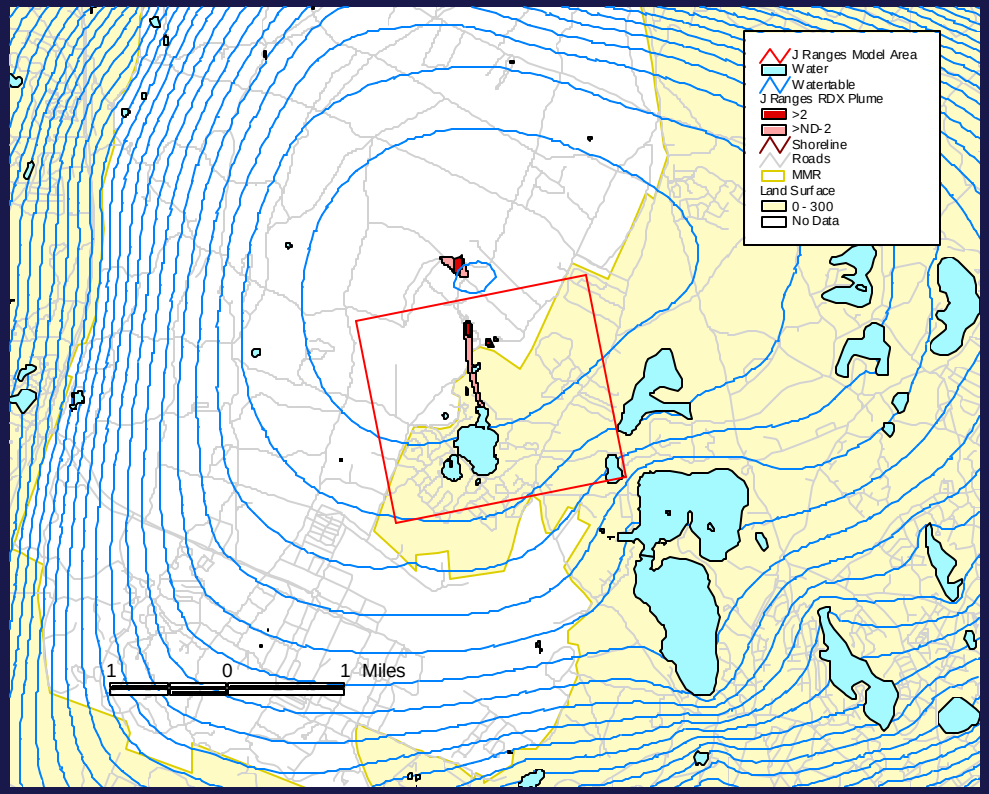
Presented at the 2/5/02 IAGWSP Modeling meeting to the USEPA, MADEP, USACE, NGB, USGS, Jacobs Eng, and AEC (IAGWSP Contact Dave Hill 508-968-5621).

J-RANGE PLUMES IN AREA OF FLOW FIELD TRANSIENTS

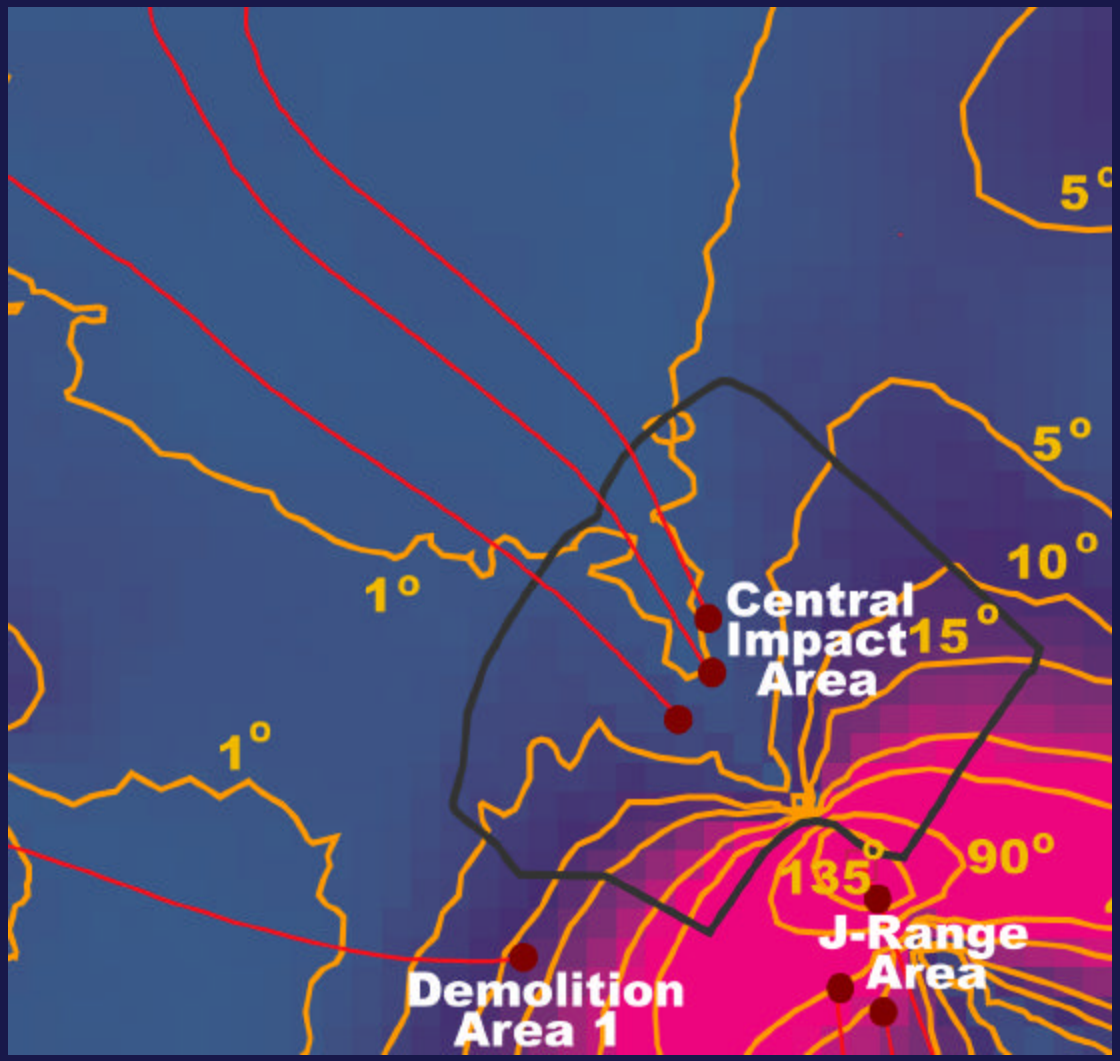
- USGS findings – head gradient transients near water table peak
- J-Range plumes straddle top of mound
- Present understanding of plume does not indicate significant impact of flow field transients



J-RANGE REMEDIATION DESIGN CONSIDERATIONS

- How do we locate wells to capture plume in shifting flow field
- How is design effectiveness impacted by low or high recharge conditions
- Can pumping rates be tuned to flow conditions

CHANGE IN GRADIENT DIRECTION 1955-1965



(From USGS, 2001)

NEED TO UNDERSTAND TRANSIENT FLOW CHARACTERISTICS

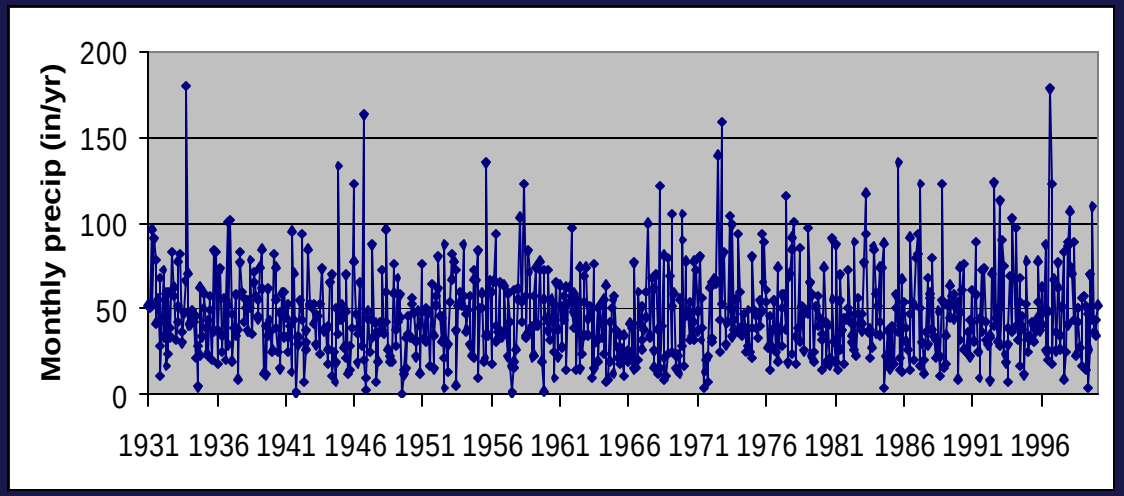
- What are common flow field conditions (top of mound location?)
- Frequency and duration of departures from “common” conditions
- Recharge / other conditions that shift flow field
- Basis for local model transport simulations

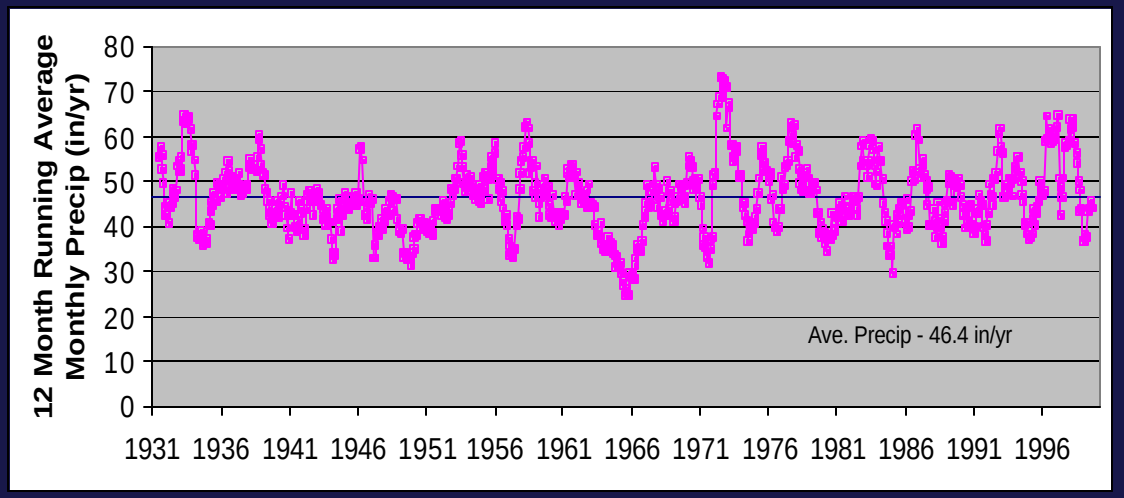
CONSTRUCTION OF A TRANSIENT MODEL

1. Estimate recharge
2. Estimate aquifer storage characteristics
3. Interpret results as they relate to J-Range plume

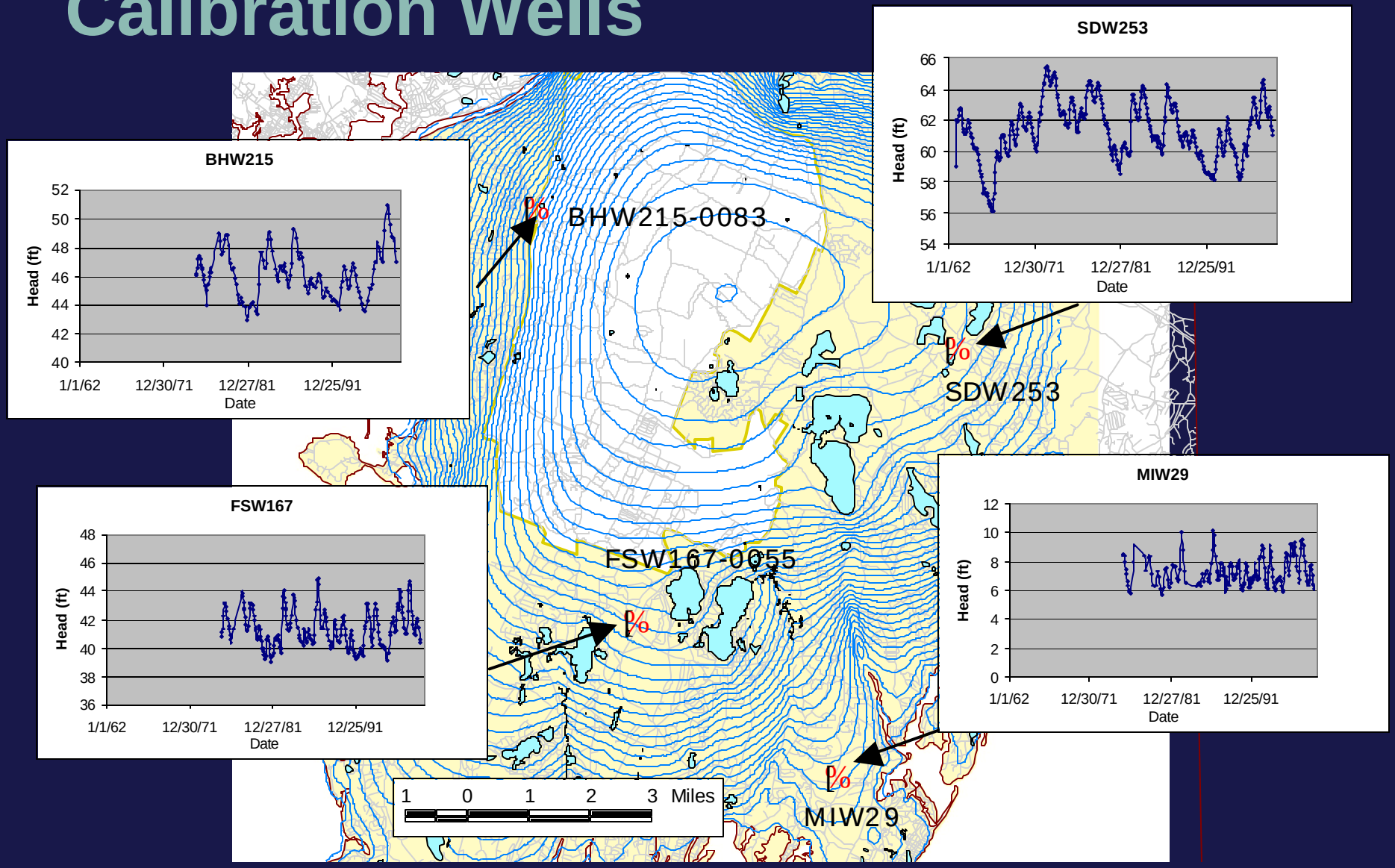
ESTIMATE RECHARGE: HIGH VARIABILITY IN RAIN FROM ONE MONTH TO THE NEXT

- Hatchville Rain Gauge
  - 1931-1999
- Periods of Drought
  - mid 60's
  - late 70's
- Elevated Rain
  - early 70's
  - mid 90's



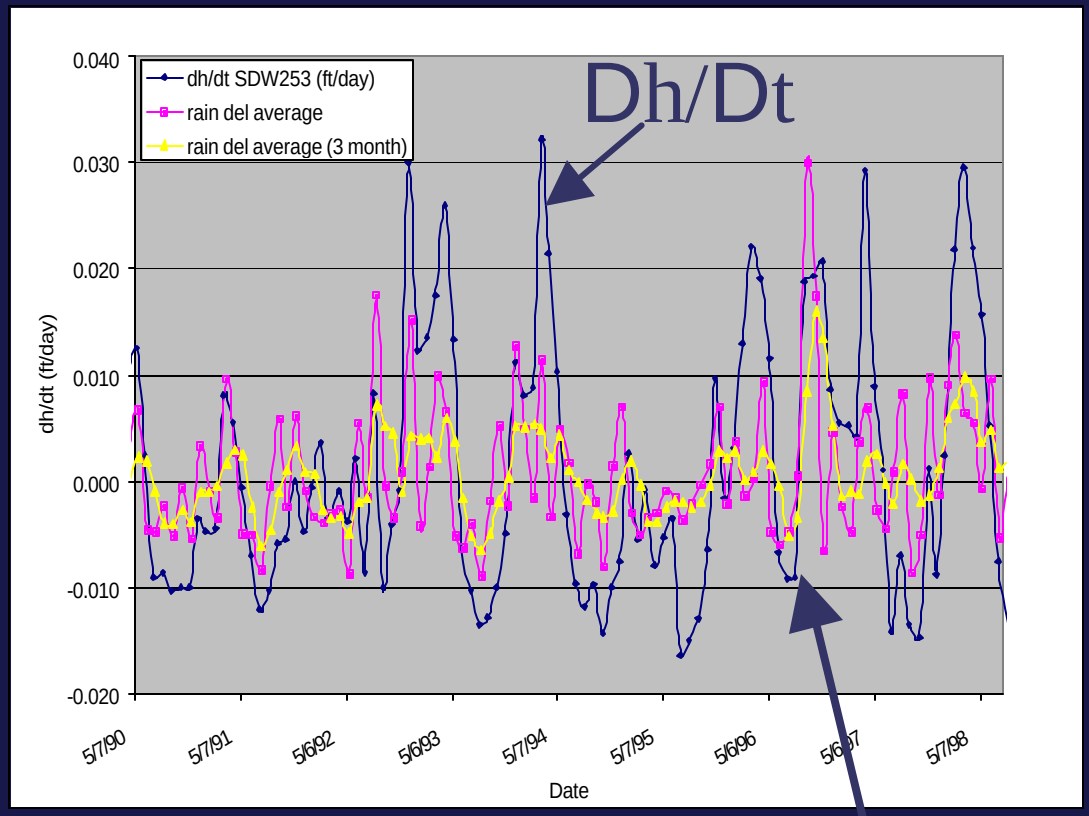


Calibration Wells



ESTIMATE RECHARGE: HEAD RESPONDS SLOWLY TO CHANGES IN PRECIPITATION

- Monthly variability in rain not evident in dh/dt
- dh/dt indicator of recharge
- In general greater than avg. rain over extended periods coincides with dh/dt>0

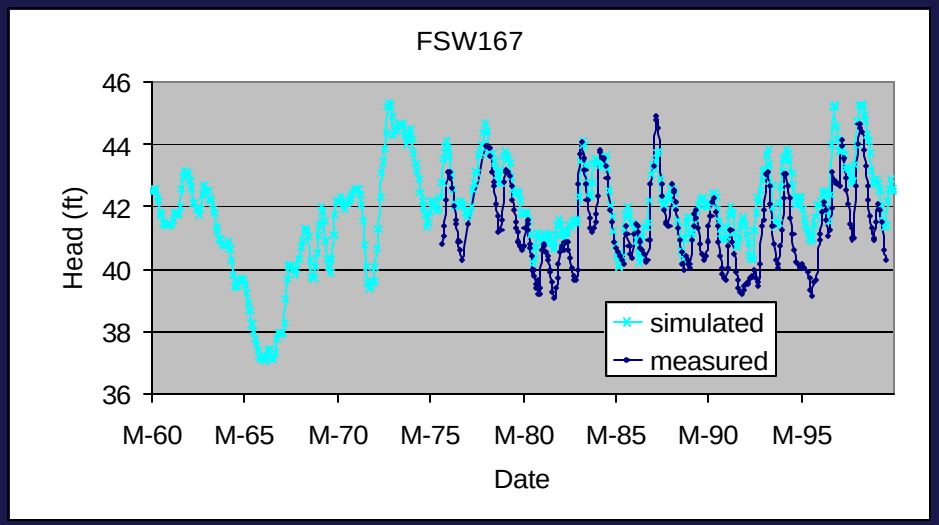


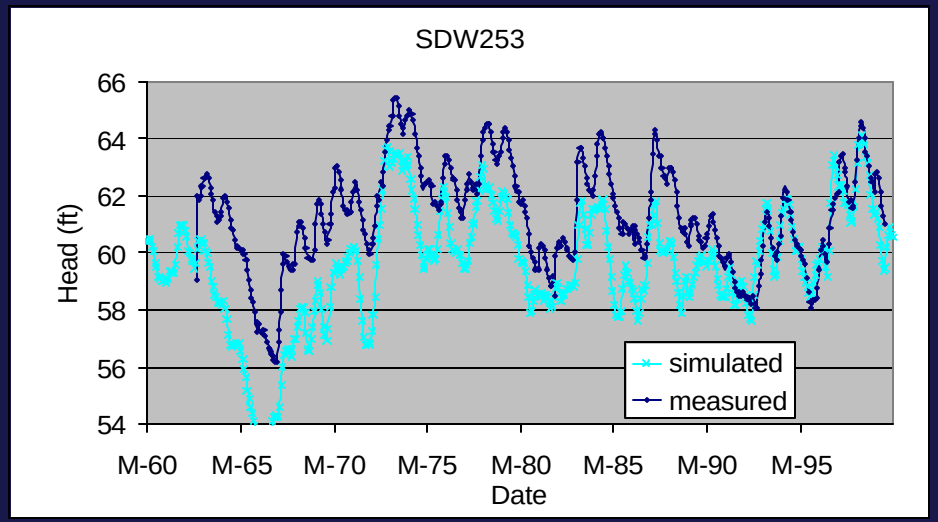
ESTIMATE RECHARGE: TRAVEL TIME TO WATER TABLE ON ORDER OF 3 MONTHS

- Water from storm events moves through unsaturated zone as front
- Predictions made by Green-Ampt with Brooks-Corey relative permeability characterization

ESTIMATE RECHARGE: SET AS PROPORTION OF 3-MONTH AVG. RAINFALL

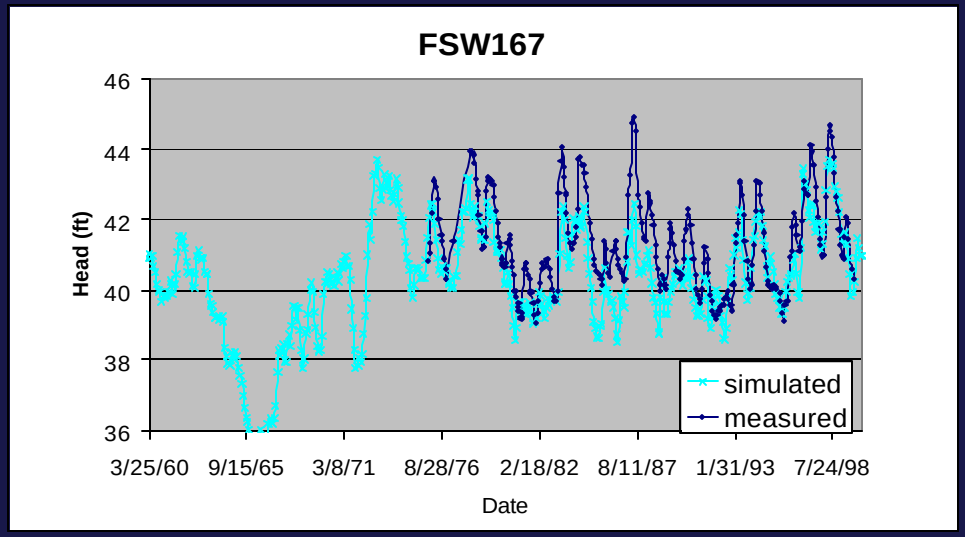
- Used 3-month average rainfall as estimate of recharge
- Calibrated to 54% of rainfall recharges groundwater
- Dynamics of system largely independent of no. of months used in recharge estimate

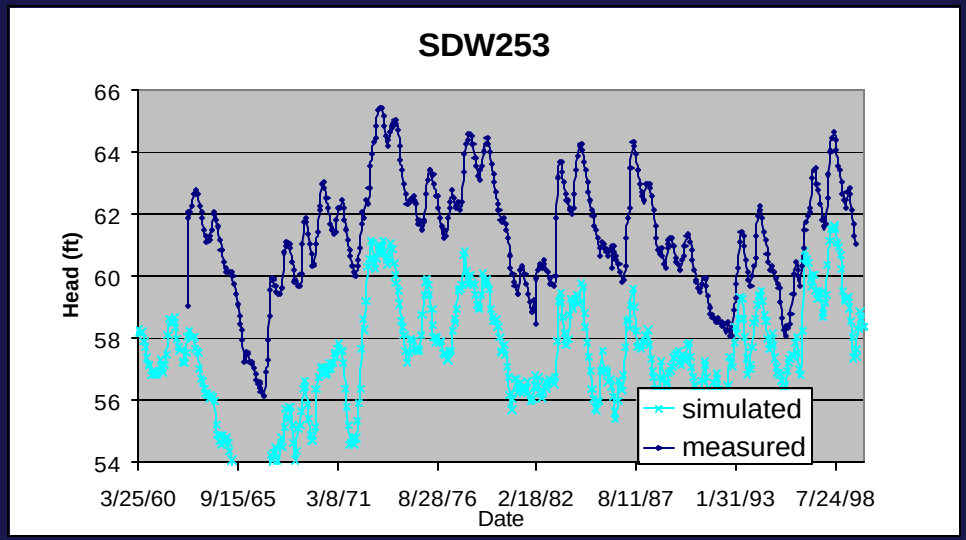




ESTIMATE RECHARGE: SENSITIVITY ANALYSIS

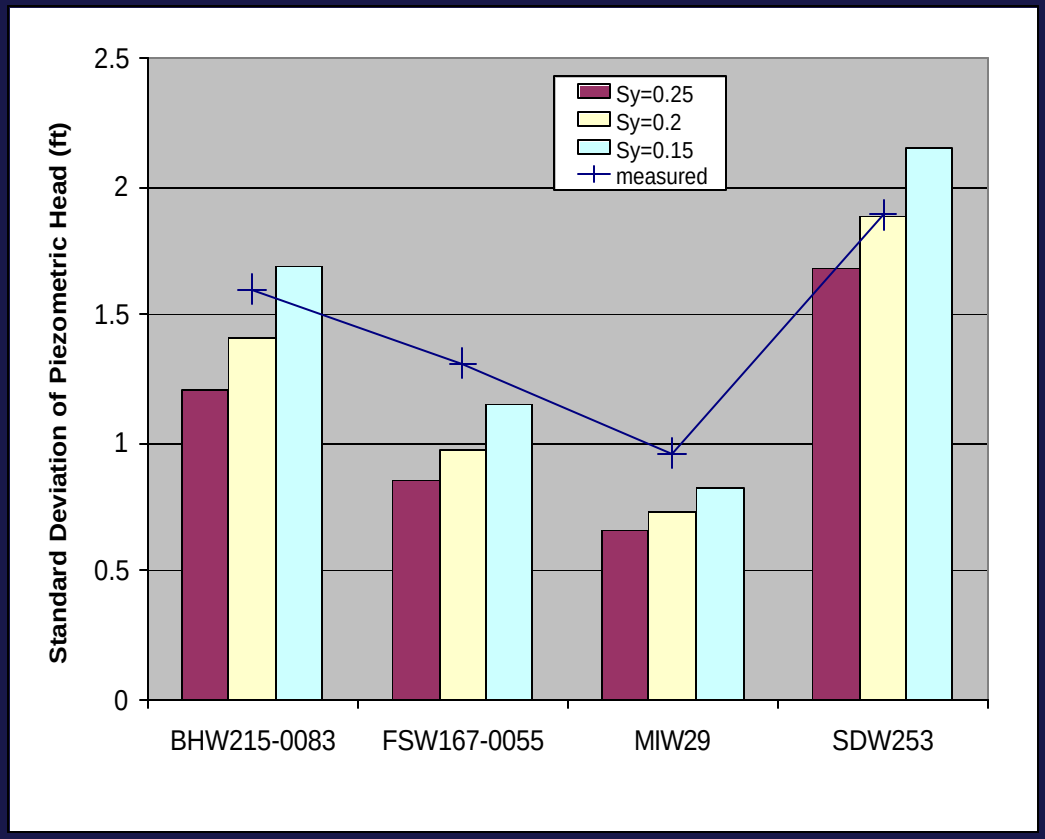
- USGS (1996) report recharge is 45 – 48% of rainfall
- Using recharge as 48% of 3 month rainfall average
  - OK at FSW167
  - significant departures at SDW253





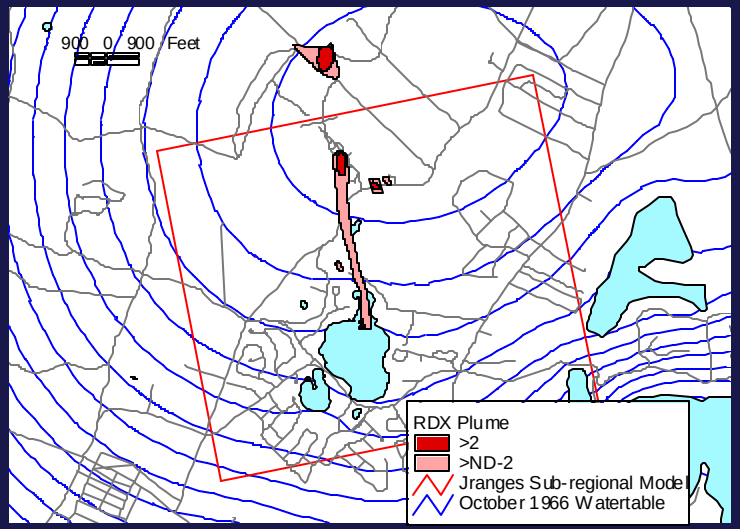
ESTIMATE SPECIFIC YIELD: CALIBRATE TO HEAD VARIANCE OVER TIME

- Response time of aquifer function of T/Sy (aquifer diffusivity)
- Calibrated Sy using standard deviation of head over time
- Calibrated Sy = 0.15
- Consistent with Earth Tech water supply pump test

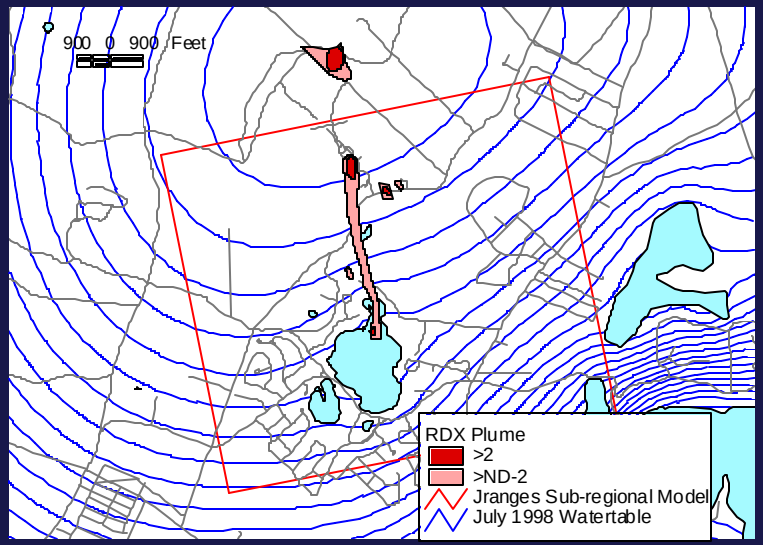


WATER TABLE TRANSIENTS

- Peak head range ~15 ft
- Direction of flow near peak dependent on water table elevation



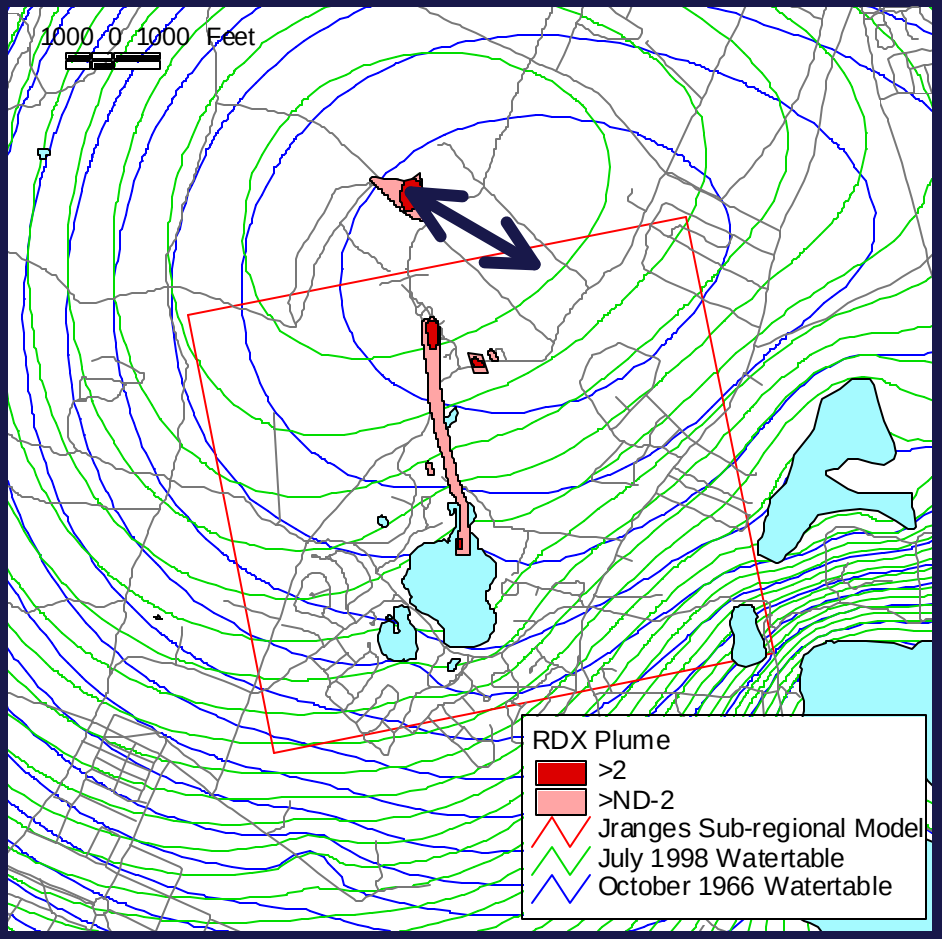
Oct. 1966 Peak Head 57.9 ft



Jul. 1998 Peak Head 73.0 ft

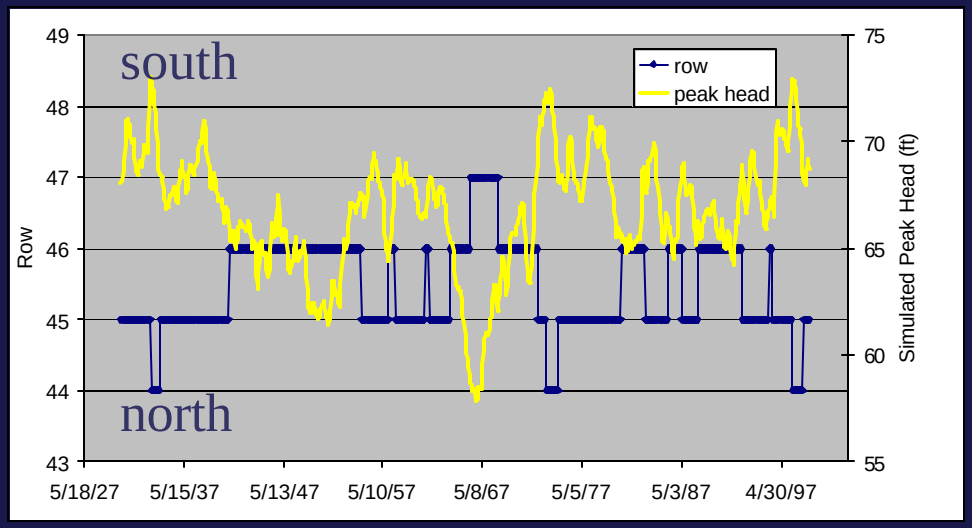
WATER TABLE TRANSIENTS

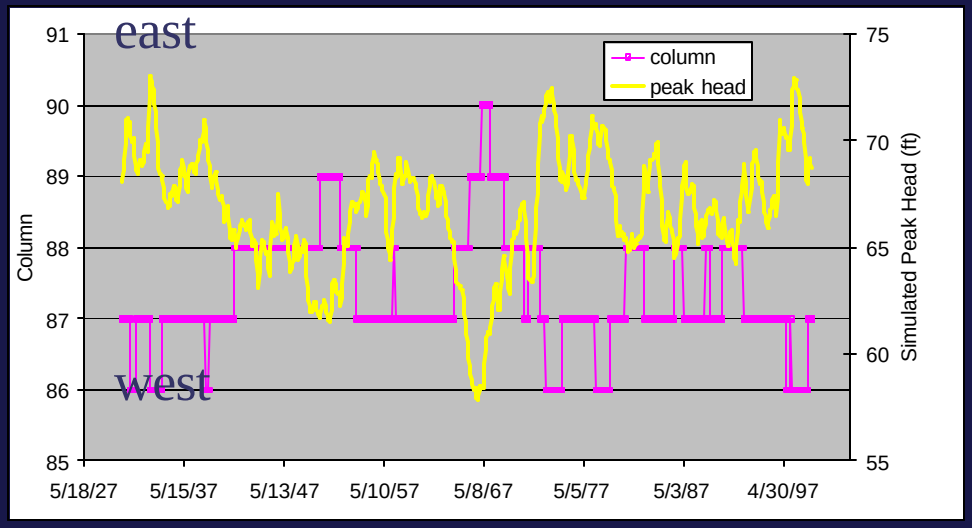
- Low K Moraine more responsive to changes in recharge
- Mound peak moves toward low K units (north and west) during high water table
- Horizontal range ~3000 ft



TOP OF MOUND MOVES IN RESPONSE TO LONG-TERM HEAD CHANGES

- Prolonged departures from average head coincide with largest movement of peak head location
- No seasonal pattern in location of top of mound
- Infrequent departure of mound to extreme southeast position – twice in 70 yrs

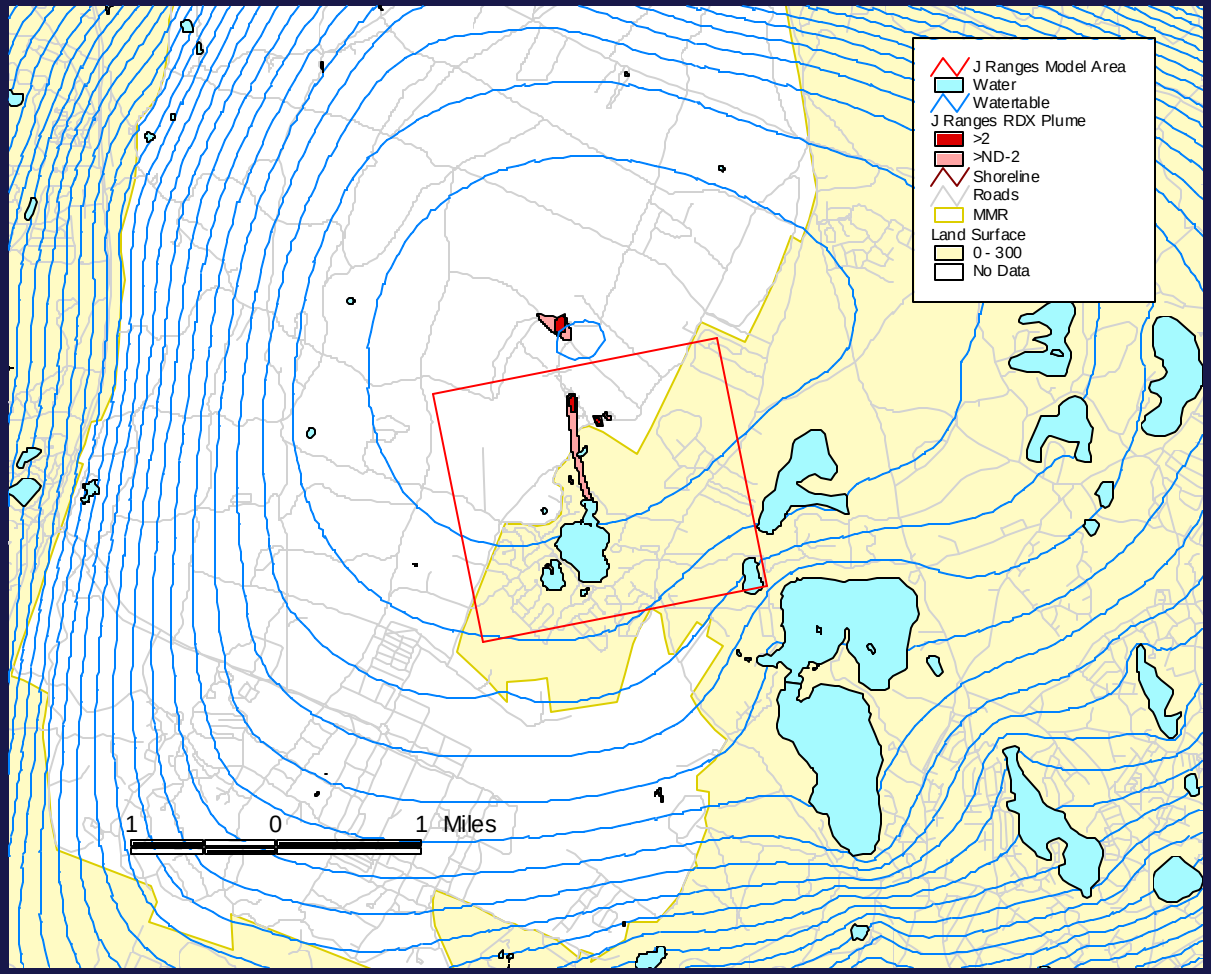




INITIAL TRANSPORT RESULTS: LOCAL MODEL DOMAIN

- Includes:

1. Snake Pond
2. FS-12 wells
3. southern J-Range plume



IMPLICATIONS FOR TRANSPORT / REMEDIATION

- Horizontal velocity near mound: ~150 ft/yr
- Zone of impact for south plume ~1500+ ft
- Departures from typical conditions ~3yrs
- Steady state flow field OK approximation (?)
  - need to confirm with particle tracking
- Capture zone analysis should be conservative