U.S. Department of Energy
Office of Civilian Radioactive Waste Management

YUCCA MOUNTAIN PROJECT

Regional Saturated Zone Model Update

Presented to:
Nuclear Waste Technical Review Board

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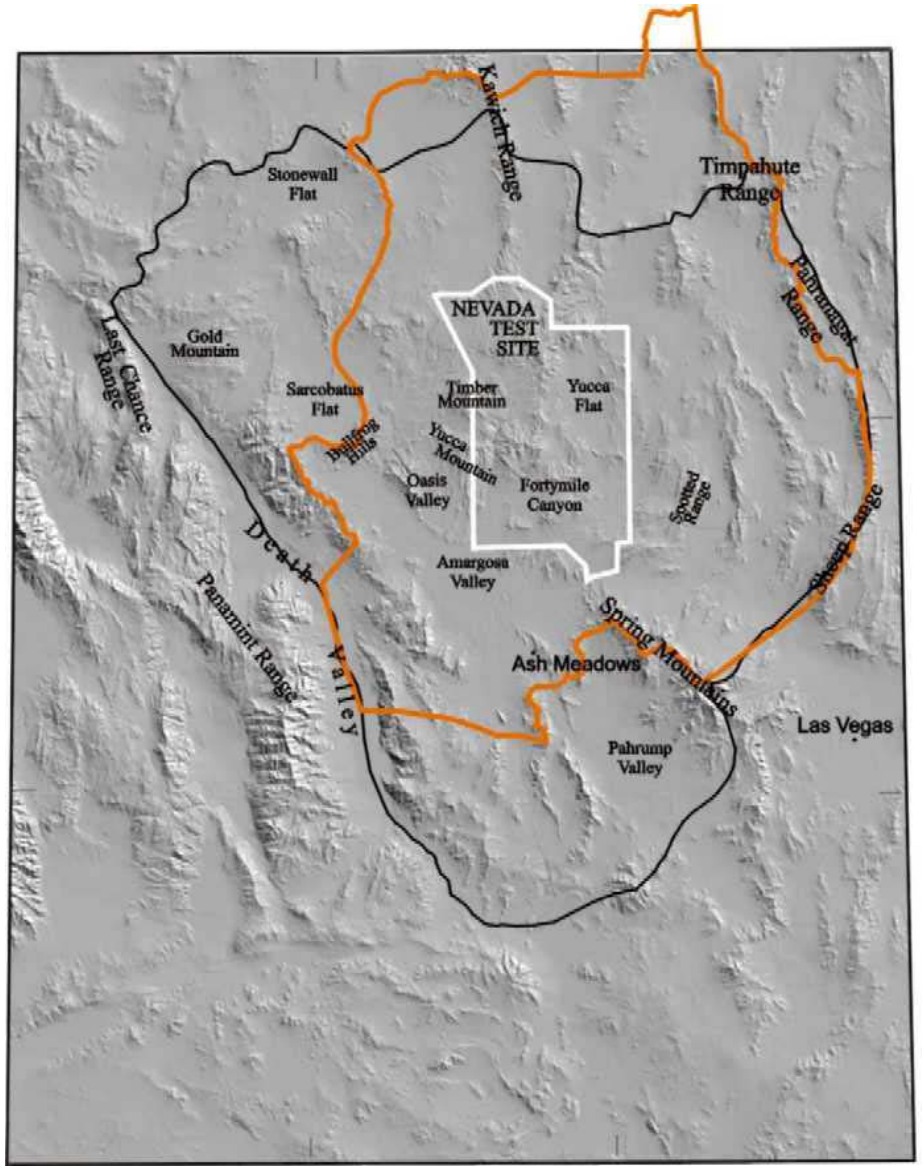
Pahrump, Nevada

Original 3D YMP Regional Model

- **3-layer, steady-state, MODFLOWP**
  - **Published as Water Resources Investigation Report (WRIR) 96-4300; released 1997**
- **Effects of past and future climate changes**
  - **Published as WRIR 98-4041; released 1998**
- **Studies conducted by Nevada Test Site (NTS) - Underground Test Activities (UGTA) Project**
  - **15-layer, steady-state, MODFLOW; released 1998**



EXPLANATION

NTS boundary

UGTA Regional Model boundary

Regional Model boundary

Yucca Mountain Project (YMP) Hydrologic and Radionuclide Migration Program (HRMP)

Department of Energy Requests Synthesis Regional Model

- **Department of Energy (DOE) – Yucca Mountain Site Characterization Office**
- **DOE – NTS**
  - **Underground Testing Areas**
  - **Defense Programs**
  - **Hydrology Resources Management Program**

Death Valley Regional Flow System Model Objectives - Per DOE

- **Short Term ('99 -'01):**
  - Combine DOE models
  - Characterize 3D flow paths
  - Calibrate steady-state model
  - Estimate flux magnitudes
  - Determine effects of geologic/structural features on regional flow patterns
  - Improve sensitivity and uncertainty analyses
- **Long Term ('02 -'04):**
  - Potentially evaluate climate-change and pumping impacts
  - Provide technical basis for NTS water appropriations
  - Help to design an effective ground-water monitoring network
  - Serve as multi-organizational cooperative natural resource management tool in the Death Valley basin

Consideration of "Recent" Program Reviews and Findings

- **Yucca Mountain Project (YMP) Saturated-Zone Expert Elicitation Panel**
- **UGTA external peer review**
- **Comparison of existing models**
- **Nuclear Waste Technical Review Board "YMP Data Hole" Concerns**
- **Nye County "Early-Warning System"**
- **UGTA Corrective Action Unit studies**
- **USGS Amargosa Valley/Pahrump/Death Valley studies**

A Defensible Flow Model

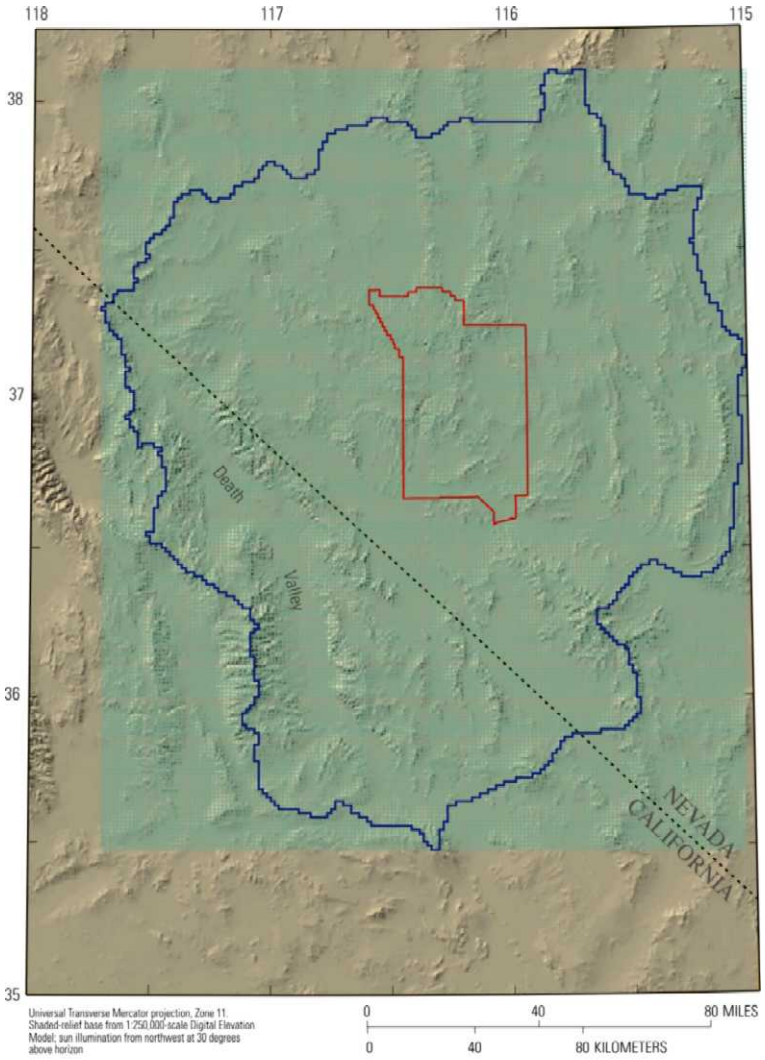
- **Components:**
  - **Integrated Modeling Data Base**
  - **Comprehensive Geologic Interpretation**
  - **3D Hydrogeologic Framework Model**
  - **Regional Hydrologic Conceptual Model**
  - **Calibrated Flow Model**
- **Each Component must:**
  - **Be independently documented**
  - **Have clear quality assurance tracking**
  - **Have clearly documented levels of uncertainty**
  - **Have documented likely alternative hypotheses**

Other Regional Stakeholders

- Department of Defense - Nellis Air Force Base
- Nye County, Nevada
- Pahrump, Beatty, Amargosa Valley, Nevada
- Death Valley National Park
- U.S. Fish and Wildlife Service
- Bureau of Land Management
- Bullfrog Mine
- Las Vegas Valley
- Inyo County, California

Major Activities

- **Waste Package (WP) #1: Regional data base integration and analysis**
  - Merge integrate existing data bases into GIS
  - Conduct analyses
  - Share data / ideas
- **WP#2: Comprehensive geologic interpretation**
  - Geologic Maps
  - Tectonic Maps
  - Cross-Sections
  - Geophysics
- **WP#3: 3D hydrogeologic framework model**
  - 3D digital representation
- **WP#4: Reduce uncertainty**
  - Evapotranspiration
  - Recharge
  - Water Use
  - Hydraulic Properties
- **WP#5: Flow model**
  - Calibration and evaluation
  - Parameter sensitivity/uncertainty

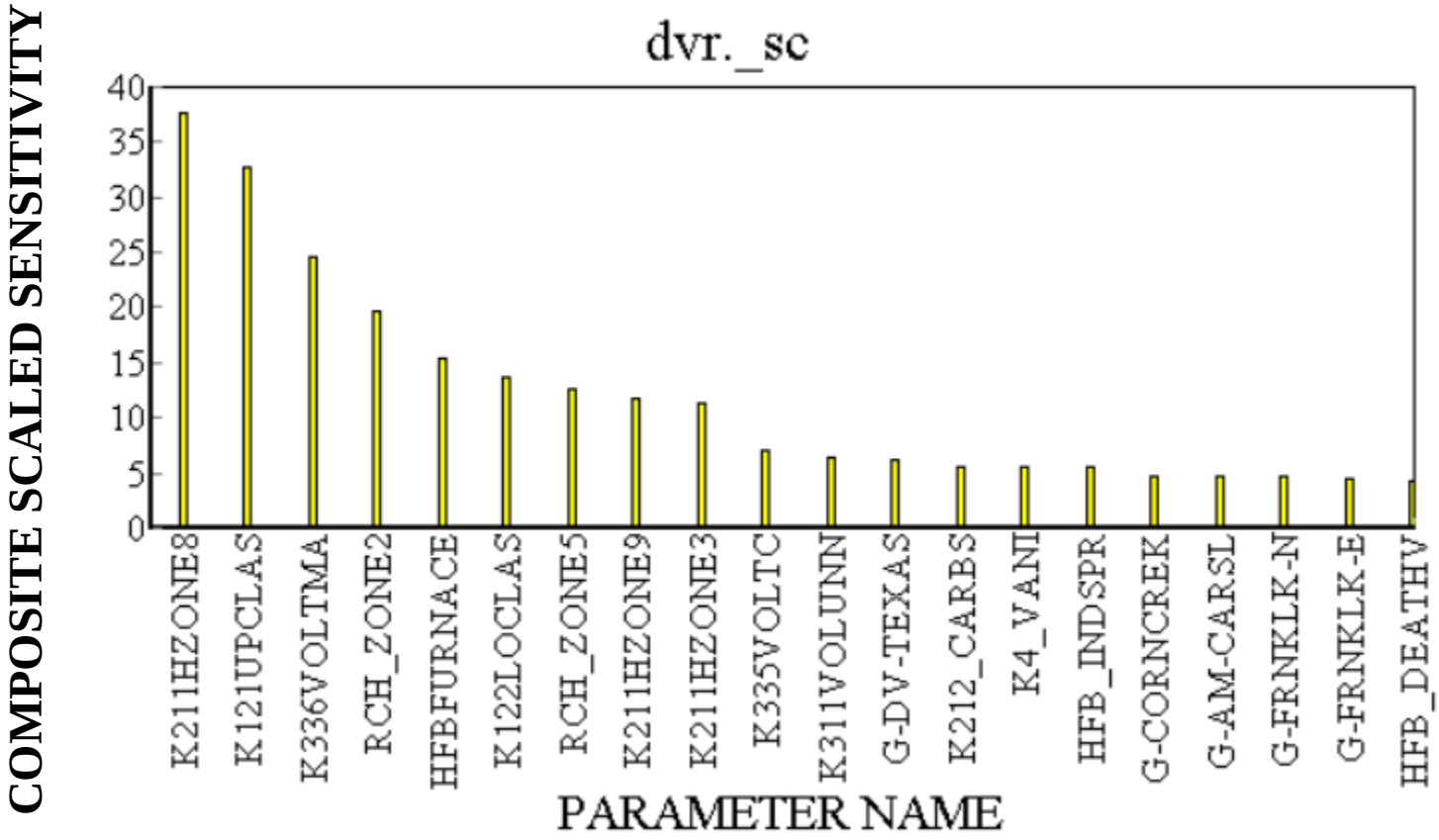


Location of Death Valley Regional Flow System Model Grid

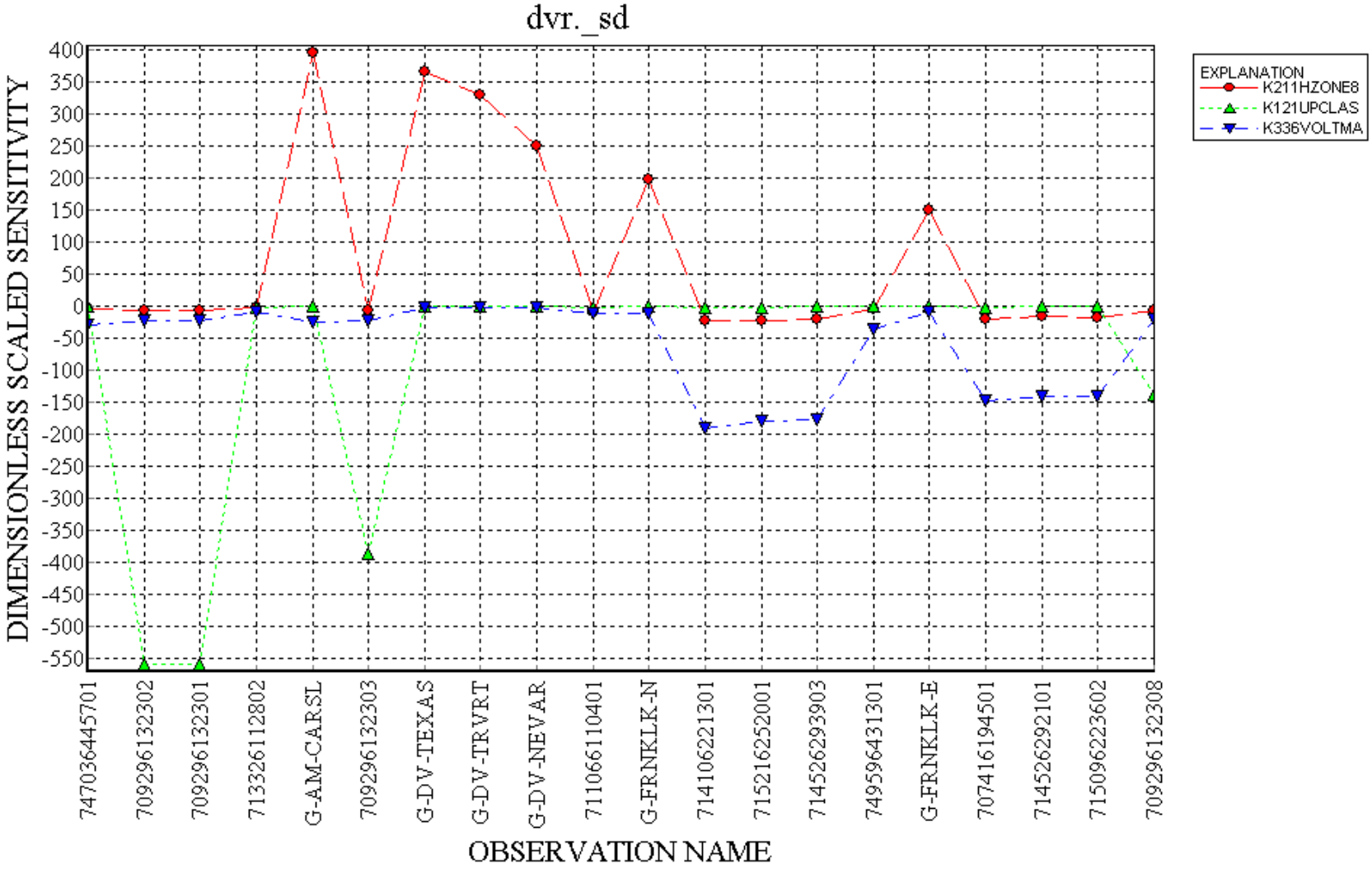
Short-Term Goals Achieved: Death Valley Regional Flow System Steady-State Model

- **Delivered to Site Saturated Zone (SZ) Model with updates**
  - **Mid Fiscal Year (FY) 2001, Late FY2001, Early FY2002**
- **Synthesize all regional hydrogeologic data**
- **“Hard-merge” of 1997 YMP and 1998 UGTA geologic models**
- **Many hydrogeologic units / Faults explicit**
- **Quantified uncertainty in discharge and water levels**
- **Fifteen flow model layers**

Parameter Sensitivities



Dimensionless Scaled Sensitivities



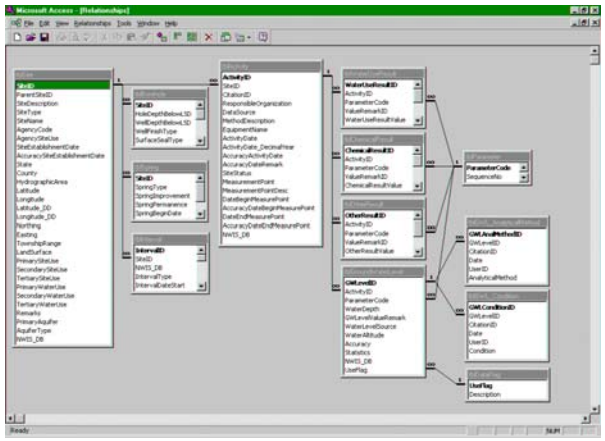
Long-Term Goals Progress: Death Valley Regional Flow System Transient Model

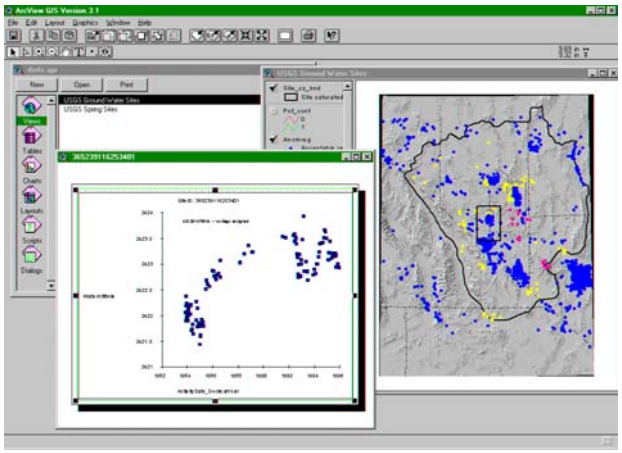
- **Incorporation of new comprehensive geologic interpretation (consistent with site SZ model)**
- **Even more detail for hydrogeologic units**
- **Improved hydrogeologic database including:**
  - **Recent Nye County and UGTA data**
- **Combined steady-state and transient simulations with uncertainty/sensitivity analyses**
- **Final report and all data available through Internet**

Backup

WP #1: Data Base Integration and Analysis

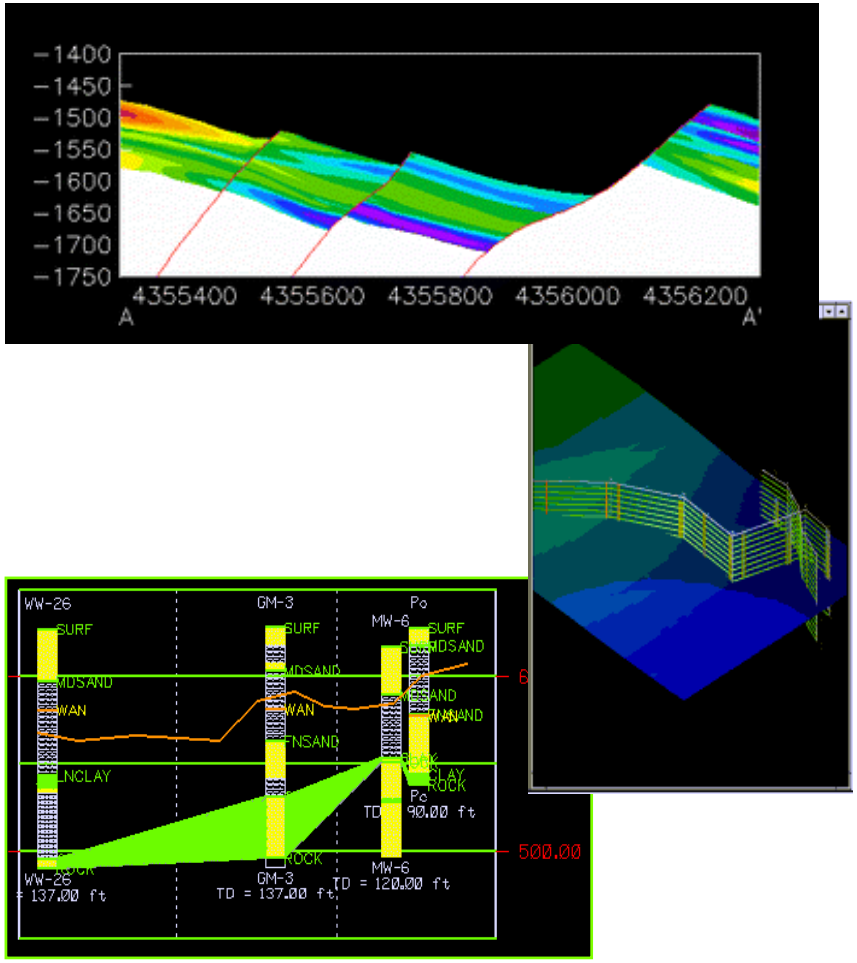
- **Activities:**
  - **Merge integrate existing data bases into GIS**
  - **Conduct analyses**
  - **Share data / ideas**
- **Use in Model:**
  - **Model development**
  - **Model observations**
  - **Analyze error in every model component**





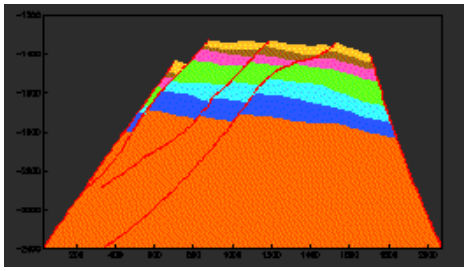
WP #2: Comprehensive Geologic Interpretation

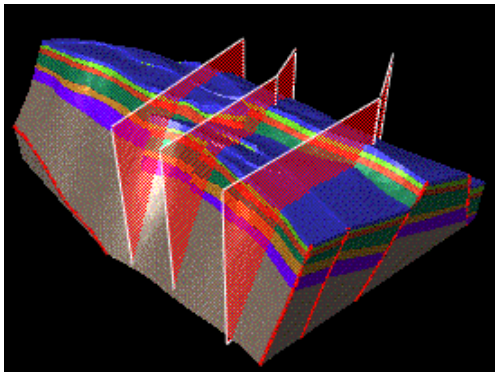
- **Activities:**
  - **Develop 3D geologic interpretation**
    - **Geologic Maps**
    - **Tectonic Maps**
    - **Cross-Sections**
    - **Geophysics**
- **Use in model:**
  - **Unit geometry and extents**
  - **3D subsurface distributions**
  - **Multiple conceptual models**

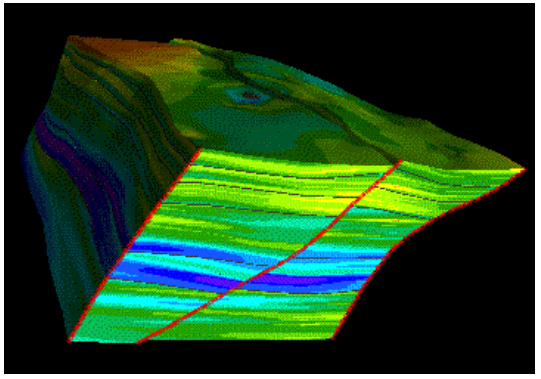


WP #3: Hydrogeologic Framework Model

- **Integration of interpretations**
- **Most feasible interpretation given data**
- **Determine location and type of data required to reduce uncertainty**
- **Query interconnection of units**
- **Multiple conceptual models**
- **Hypothesize aquifer heterogeneities**





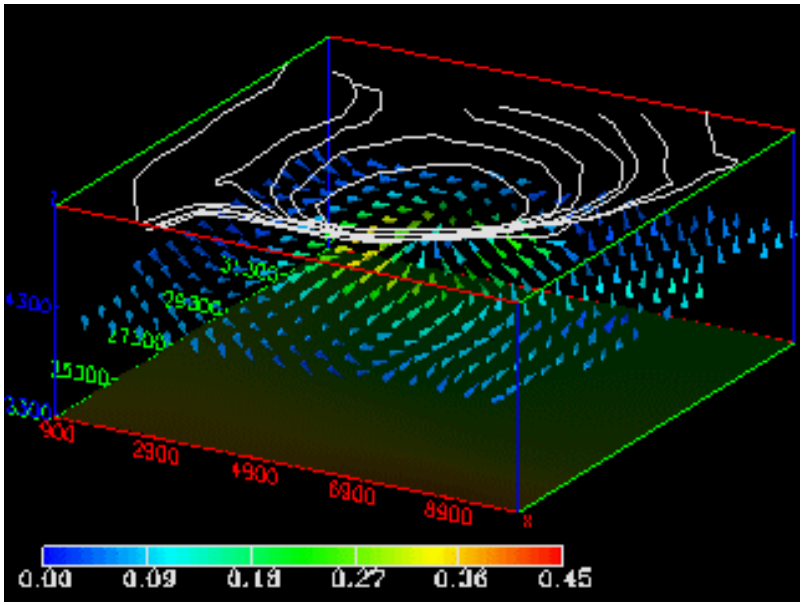


WP #4: Reduce Uncertainty Hydrologic Conceptual Model

- **WP#4A: Evapotranspiration Work**
- **WP#4B: Recharge Work**
- **WP#4C: Ground-water Withdrawals**
- **WP#4D: Aquifer Hydraulic Properties**

WP #5: Predictive Groundwater Flow Model

- **Model Development**
- **Calibration / Sensitivity Analysis**
- **Assess Uncertainty**
- **3D Visualization/Animation**
- **Product:**
  - **Pre-development and Transient Model**
- **Use:**
  - **Communication**
  - **Decision-making Tool**
  - **Qualified Predictions**



Steady-State vs. Transient

- **Steady-state Model:**
  - No representation of time-dependent stresses
  - Only one distribution and rate allowed for each stress simulated
  - Changes calculated only as difference between two simulations
  - Cannot represent the history of stresses that vary with time
  - Time and travel of contaminants represented along one set of flow paths
- **Transient Model:**
  - Simulates over a specified period of time
  - The distribution and rate of each stress can change during the simulation
  - Changes calculated at selected times throughout the simulation
  - History of all stresses can be represented
  - Time and travel of contaminants represented along flow paths that change with time