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Title:	A NEW SATURATED ZONE SITE-SCALE FLOW MODEL FOR YUCCA MOUNTAIN
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Intended for:	2007 GSA Denver Annual Meeting (28–31 October 2007)

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Office of Civilian Radioactive Waste Management

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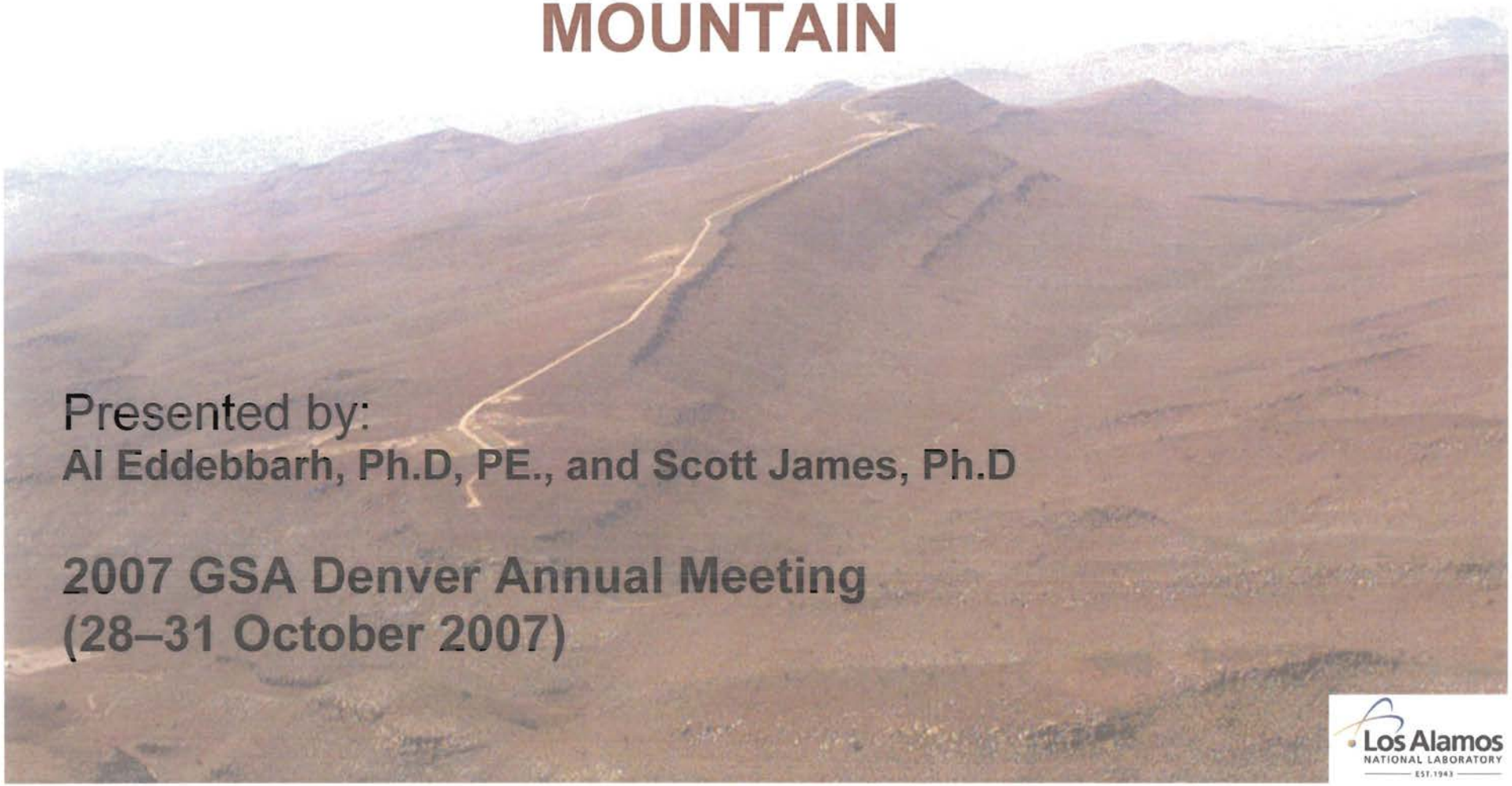
A NEW SATURATED ZONE SITE-SCALE FLOW MODEL FOR YUCCA MOUNTAIN



Presented by:
Al Eddebbarh, Ph.D, PE., and Scott James, Ph.D

2007 GSA Denver Annual Meeting
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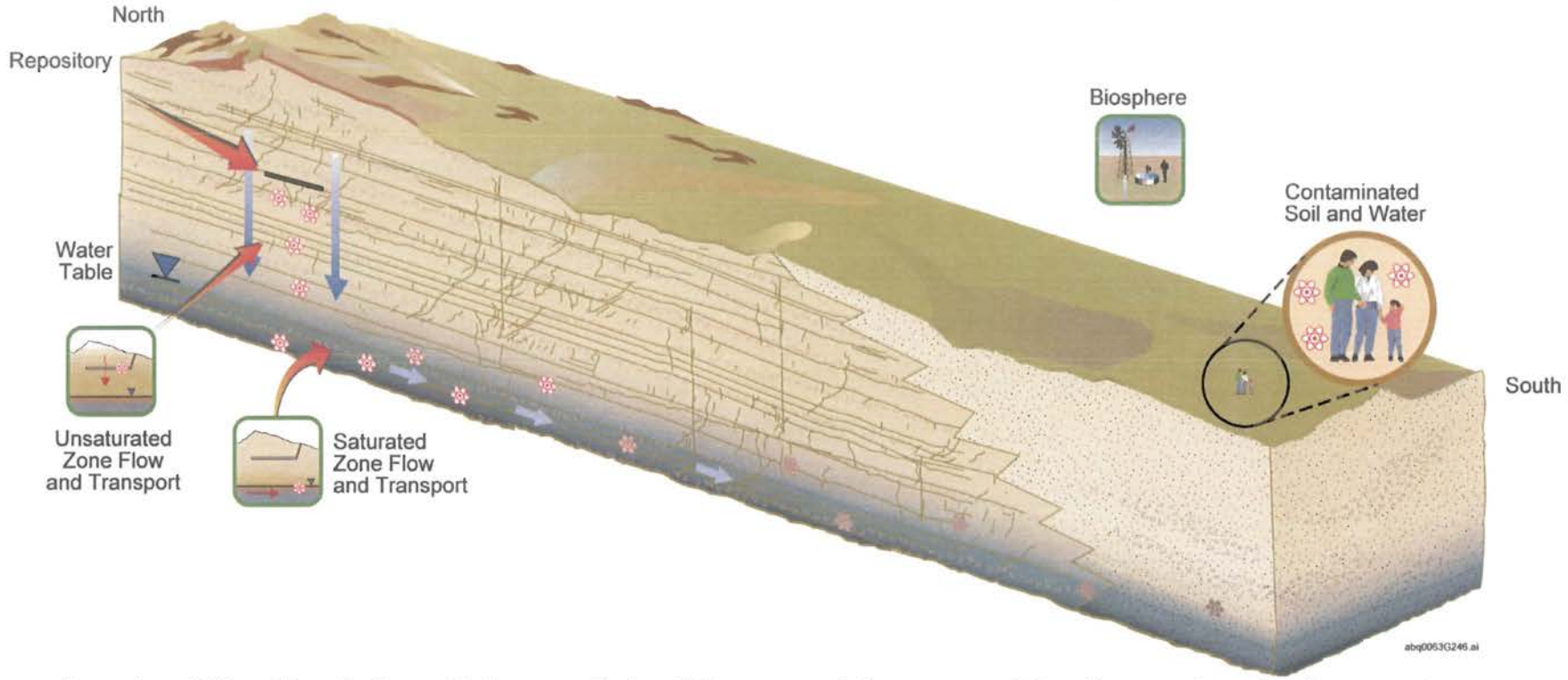
Topics of Discussion

- Role of the saturated zone
- Saturated zone flow model
  - Model development and data feeds
  - Model results
- Confidence Building Activities
- Summary

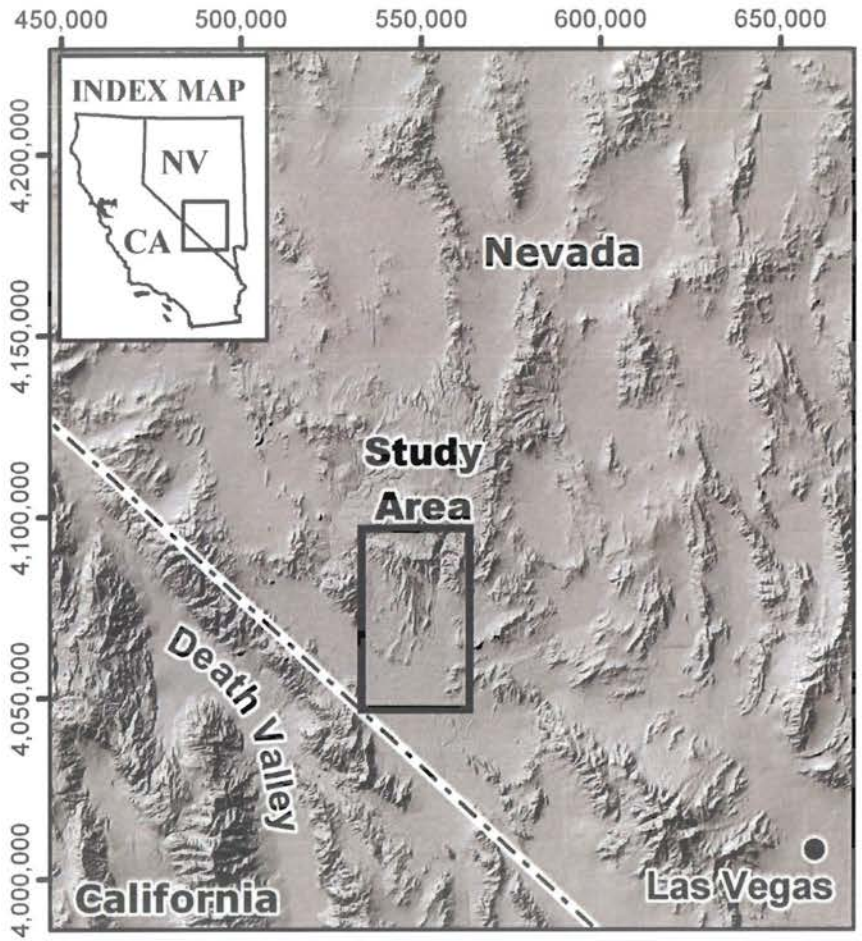
Saturated Zone Flow & Transport Barrier



A scientifically defensible model of flow and transport in the saturated zone is required to assess the ability of the natural system to retard the migration of radionuclides escaping the engineered system and reaching the groundwater. Travel times and concentrations under specified water-use scenarios must be predicted.

- **Model must be supported by characterization data**
- **Reasonably conservative assumptions must be made when data are lacking**

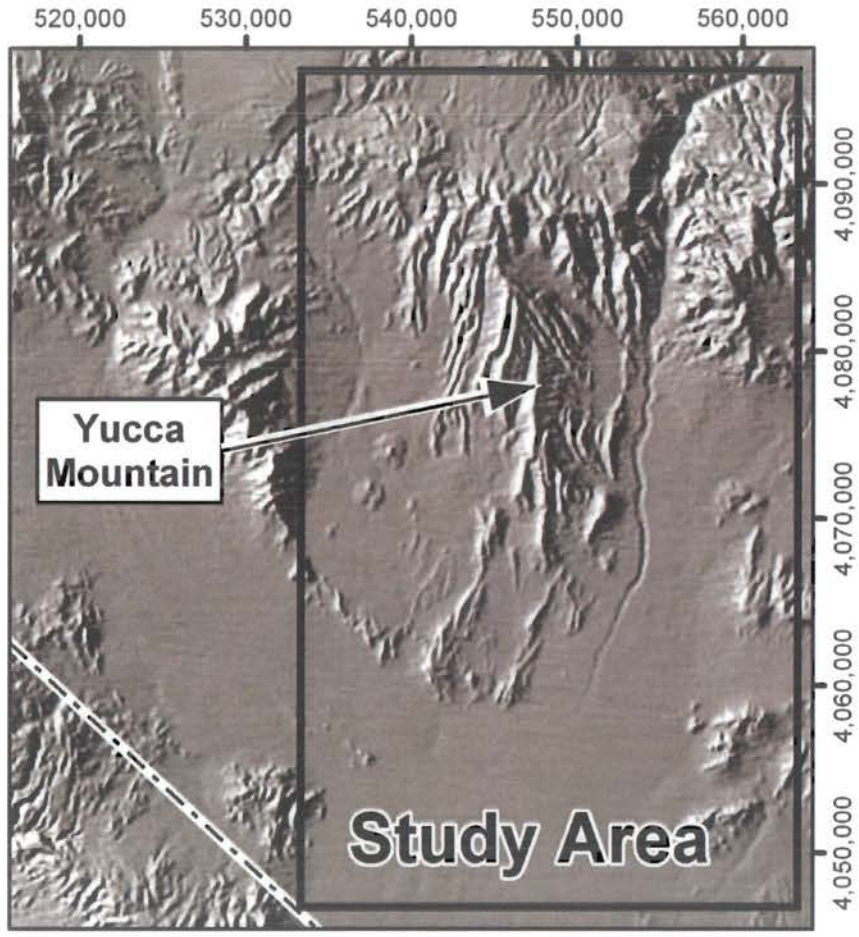
Yucca Mt. Study Area



Universal Transverse Mercator
NAD 1927, UTM Zone 11N

0 25 50 75 100 Kilometers

0 25 50 75 Miles



0 10 20 30 Kilometers

0 5 10 15 20 Miles

Regional Flow Models

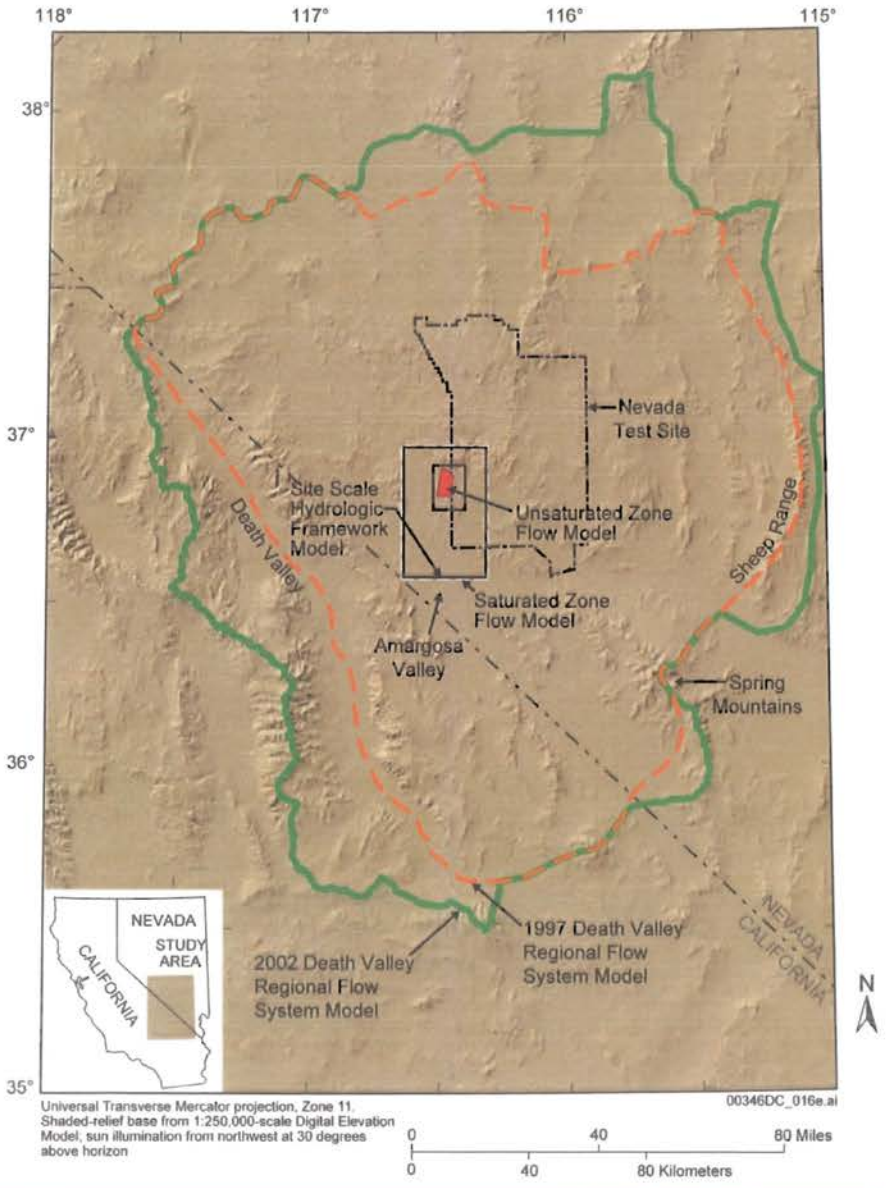
DRVFS Regional Flow Model (Belcher, 2004)

•Embraces Natural Boundaries

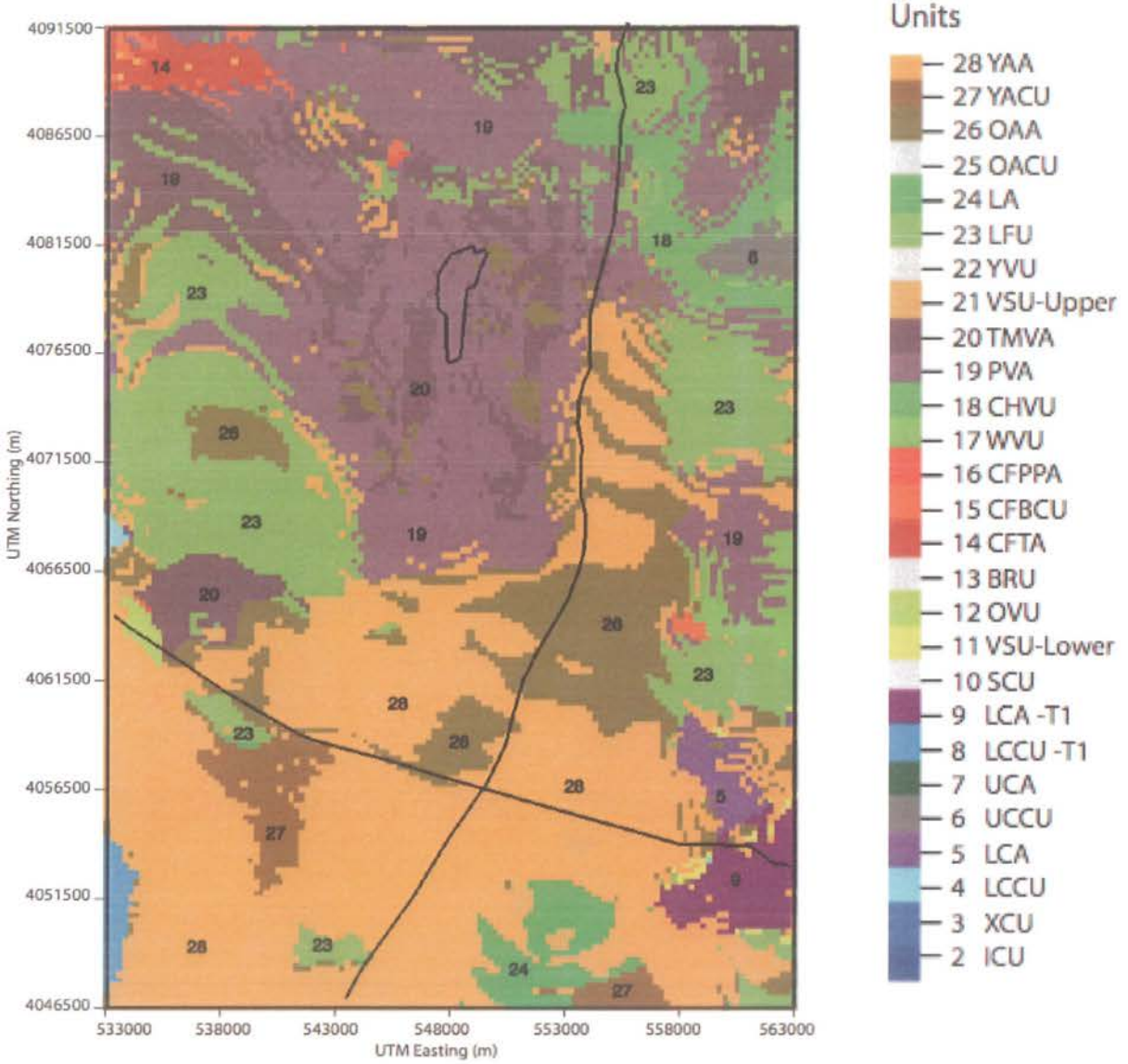
•Provides:

1. Recharge over the model Domain Except in the UZ model Domain Foot print and Forty-Mile Wash

2.Target Fluxes Along the site-scale boundary conditions



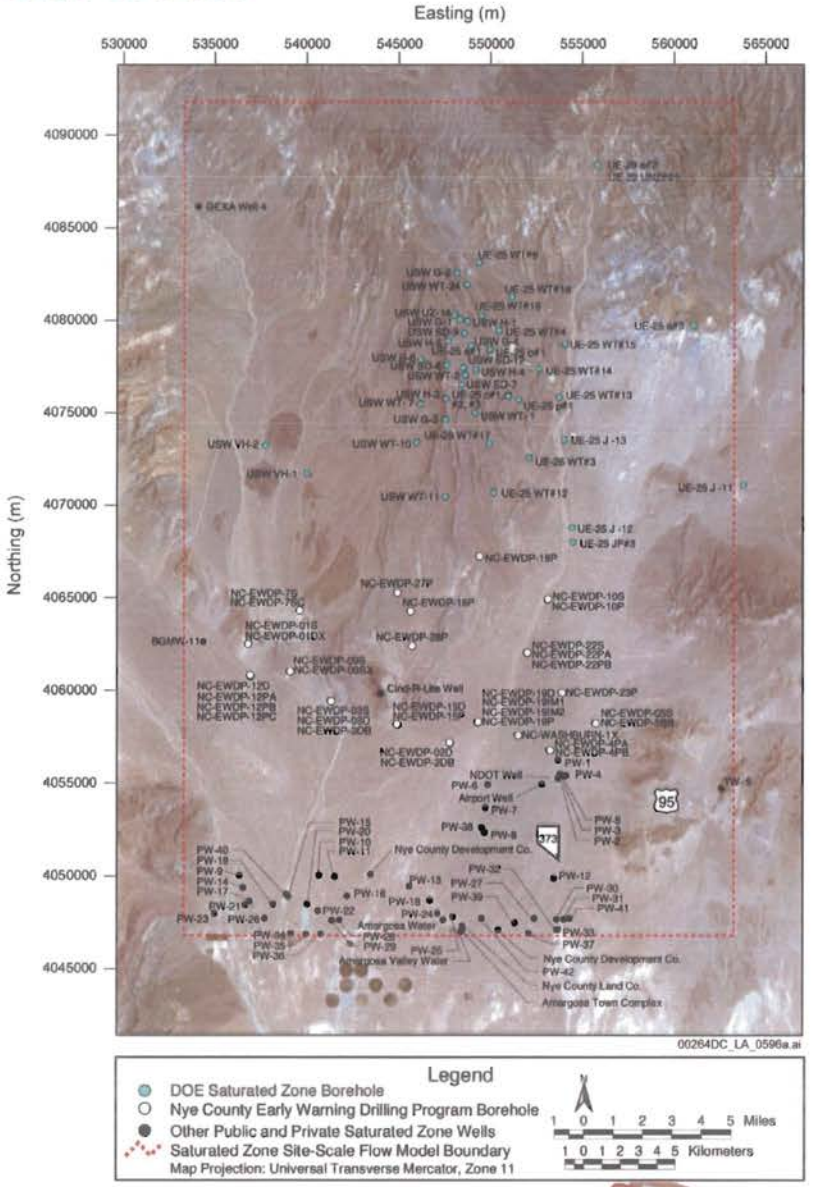
- New HFM incorporates the regional model HFM and New Nye County Lithology
- Top of the 250-m computational grid, coincident with the domain topology.
- The different colors show the material units as defined by hydrogeologic surfaces



Top of the 250-m SZ Site-Scale Computational Grid

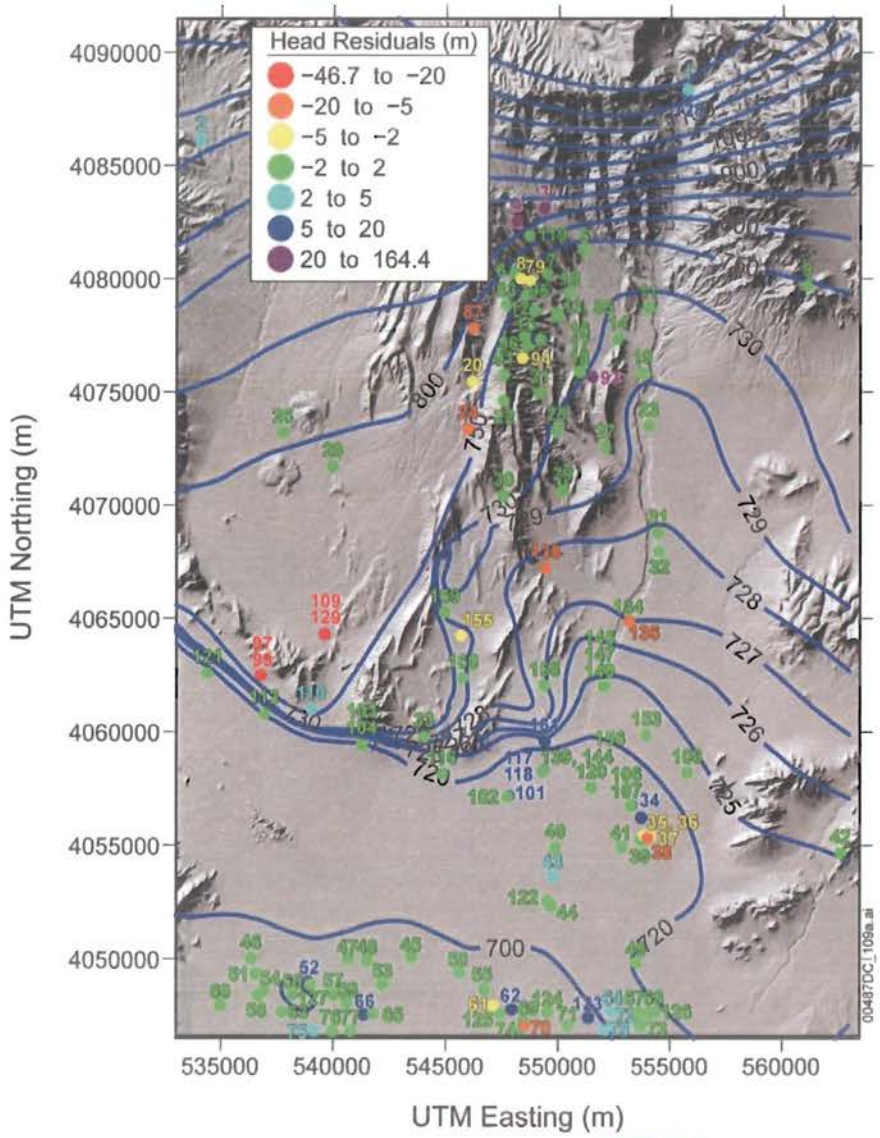
Well Locations

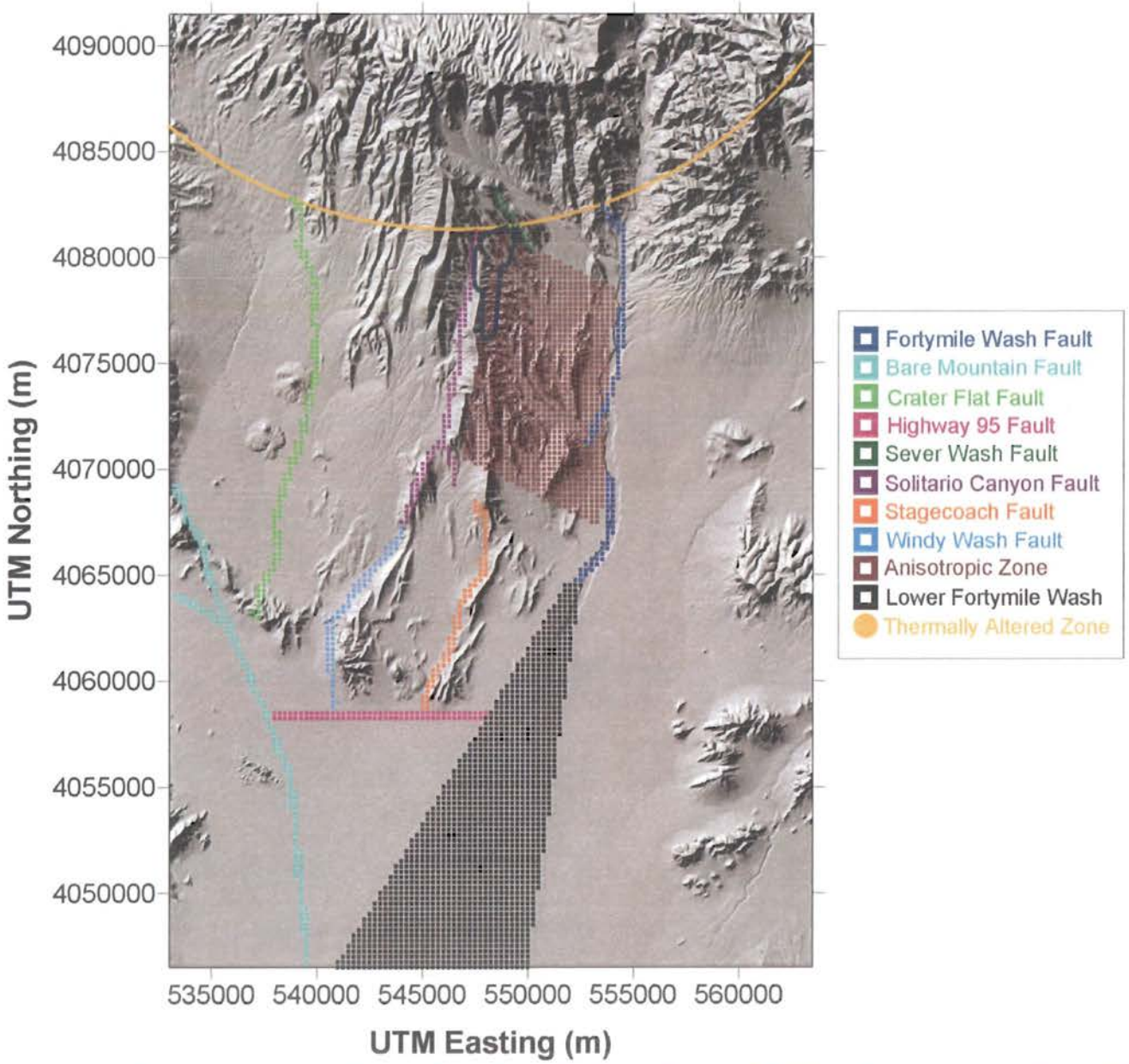
- New Data
  - Hydraulic head and water level elevations
  - Lithology of Nye County wells
  - Hydrologic testing
- Current Model Activities and Analyses
  - New Regional Flow Model 2004 DVRGFS
  - New Recharge Analysis



Potentiometric Surface

- Well locations
- Head residuals
- potentiometric surface used to derive hydraulic heads for model boundary conditions





Geologic features included in the SZ site-scale flow model.

Recharge

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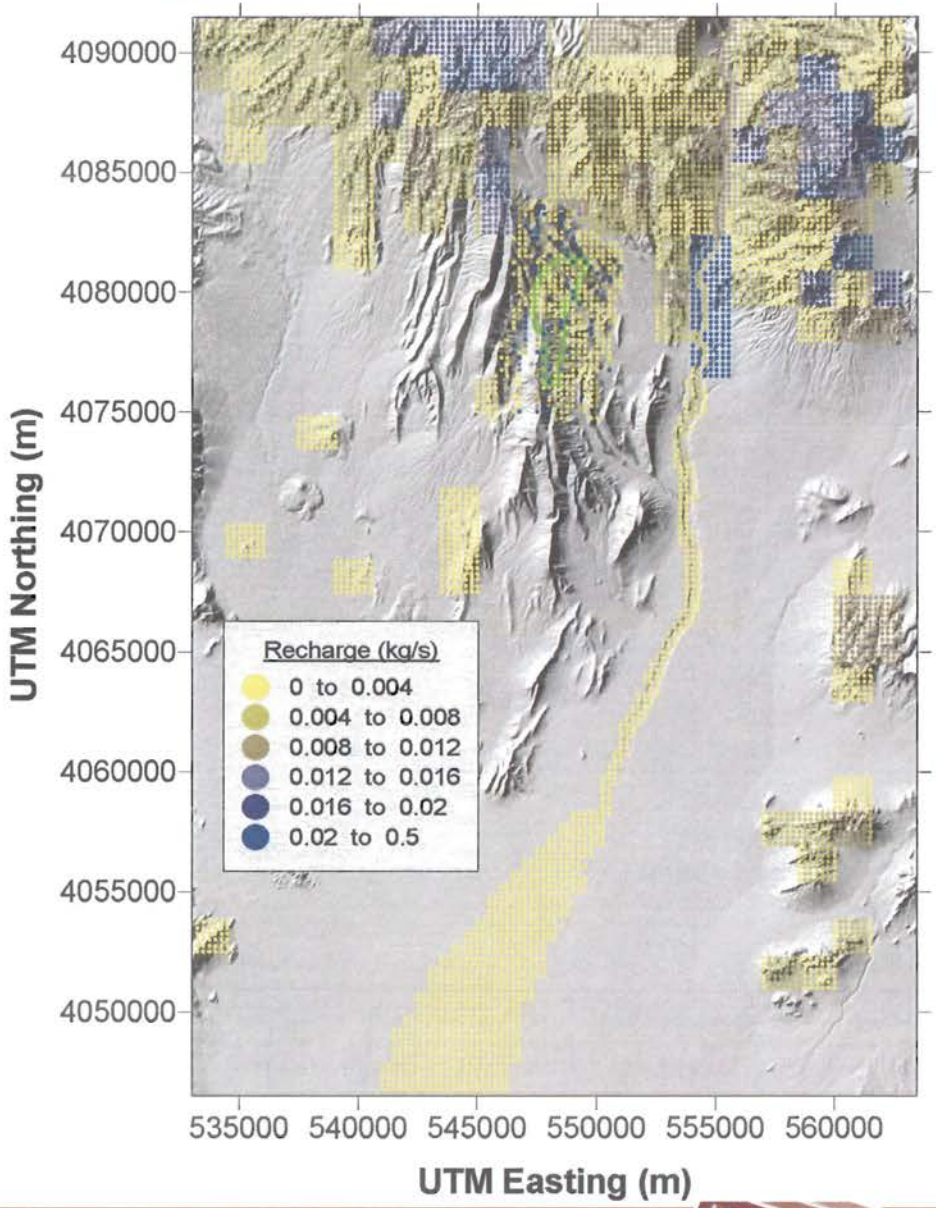
Recharge obtained from:

- UZ model (UZ model Domain
- Forty Mile Wash Recharge Study
- Regional Flow Model for the rest of the model domain

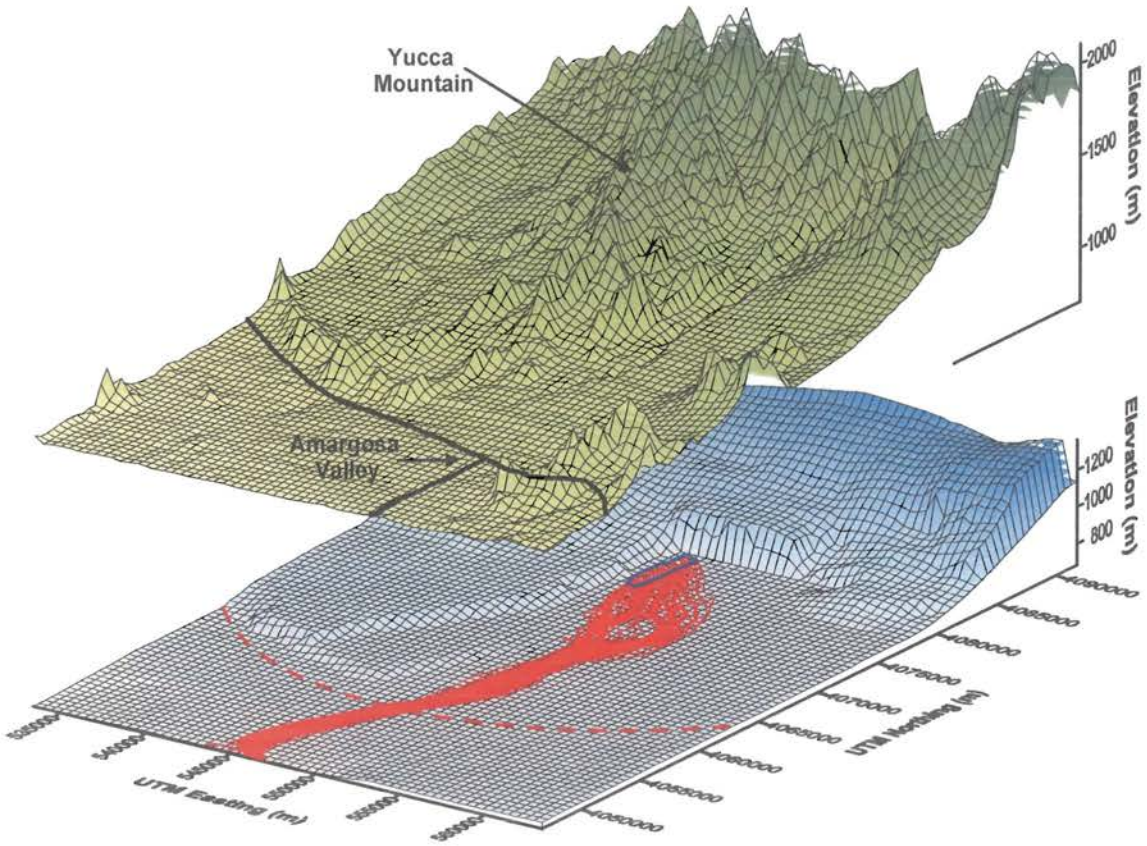


Current SZ Site-Scale Flow Model

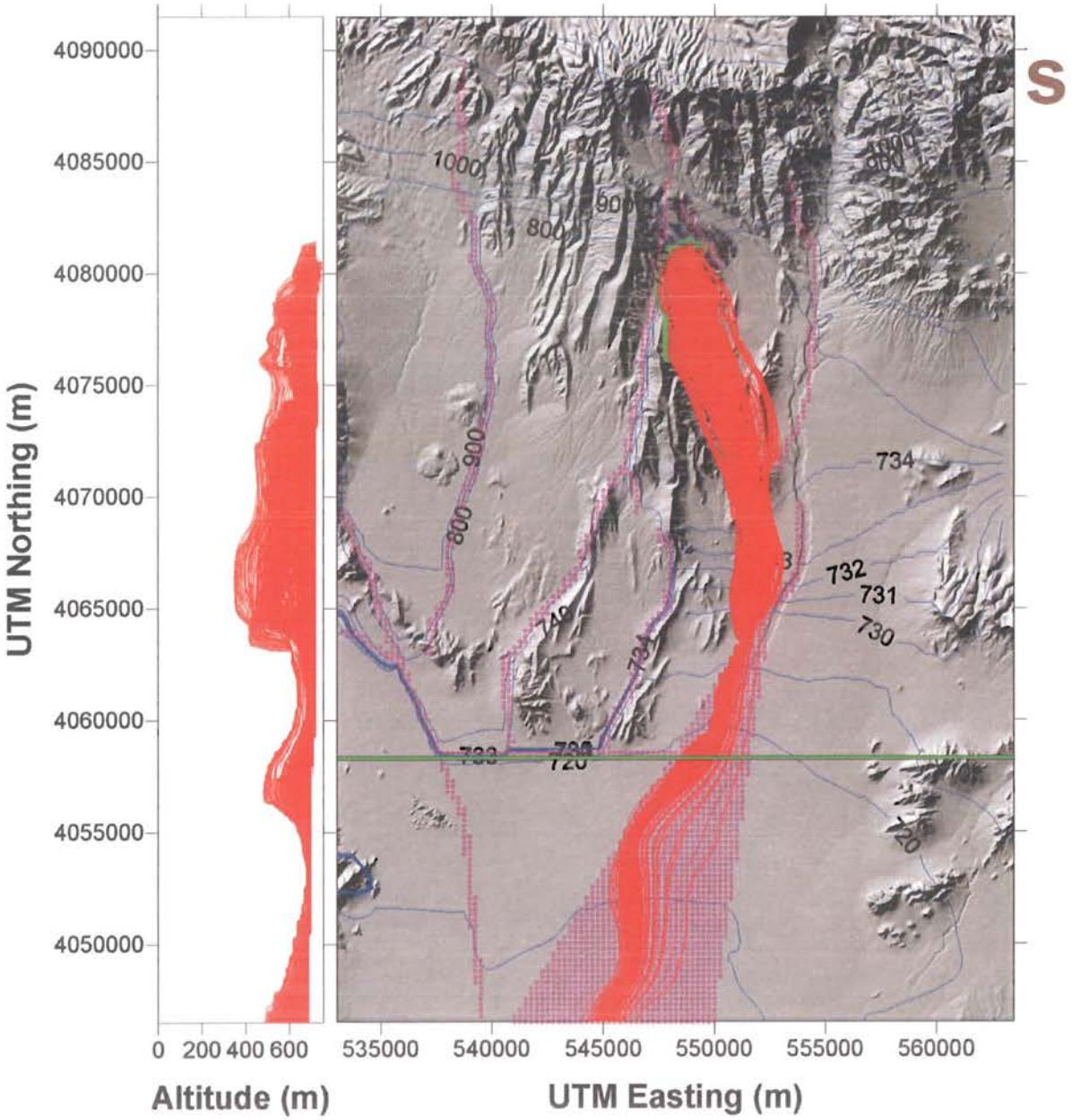
- 3-D model implemented with FEHM software code has domain 30 km x 45 km x 4000 m below water table
- Three Hydrogeologic framework models (containing 27 units)
- Orthogonal grid with 250 m horizontal spacing and variable resolution in the vertical direction
- Flow model calibration used automated inversion (PEST)
- Model calibration (hard data) and validation (soft data) efforts use the following data:
  - Water level measurements in wells
  - Upward hydraulic gradient from carbonate aquifer
  - Ranges of measured permeability
  - Simulated groundwater fluxes at lateral boundaries
  - Inferred flow paths from hydrochemical data
  - Average specific discharge

Flow Model Results and Transport Pathways

Flow and Transport Pathways in the Site-Scale Saturated Zone Model Area



- Simulated flow paths from the repository occur in the upper few hundred meters of the SZ
- Simulated flow paths cross the compliance boundary approximately 5 km west of the town of Amargosa Valley
- Specific discharge along the flow path is determined to be within approximately a factor of 3



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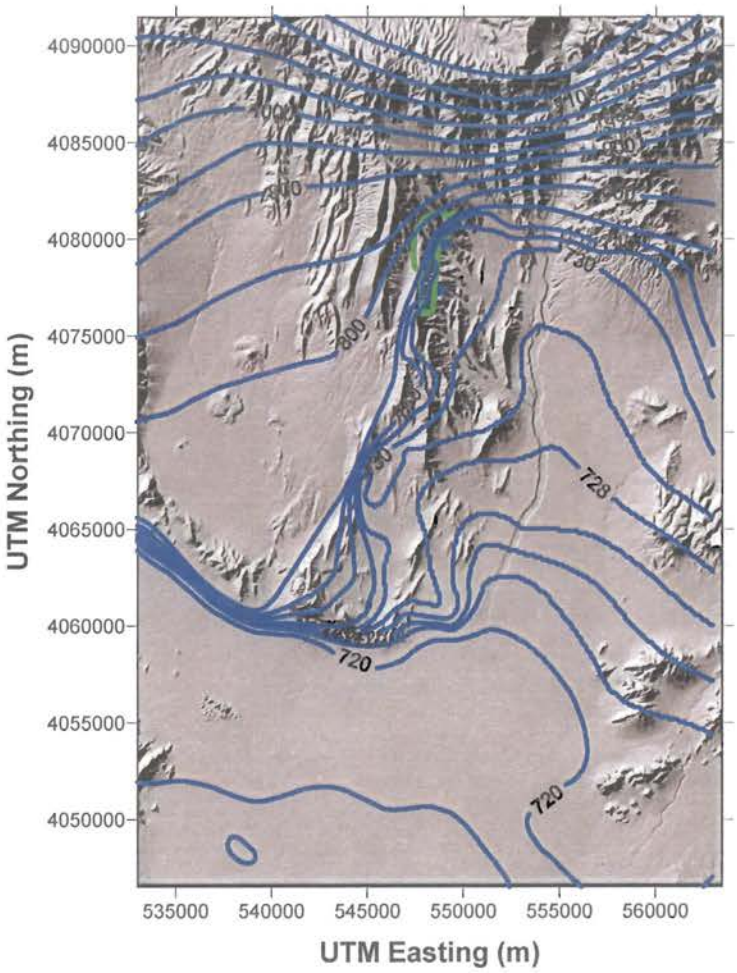
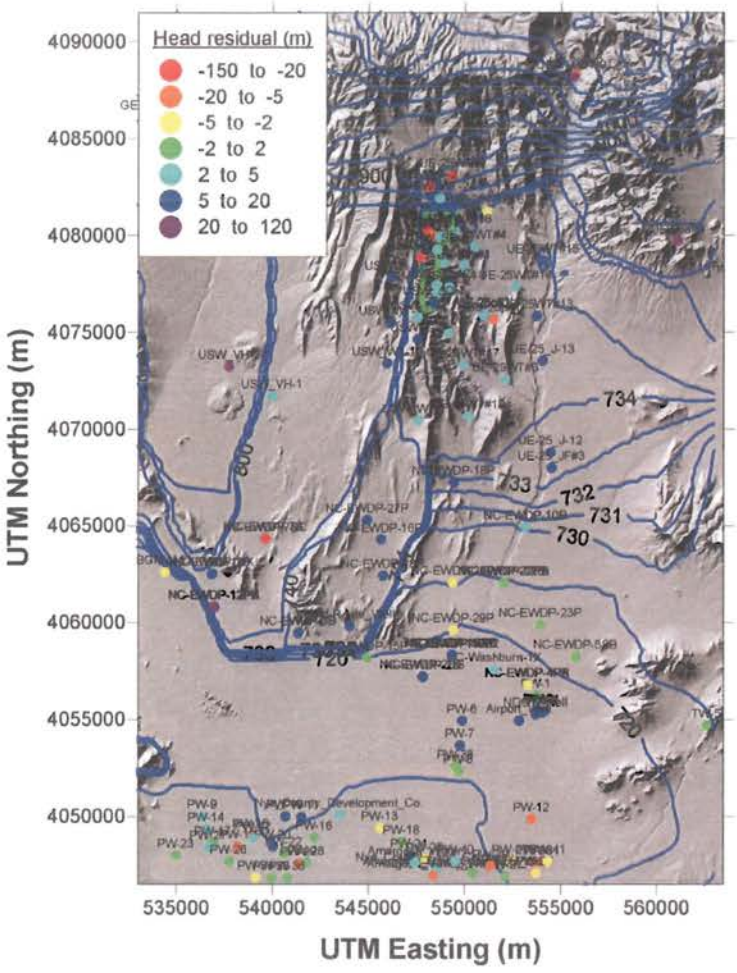
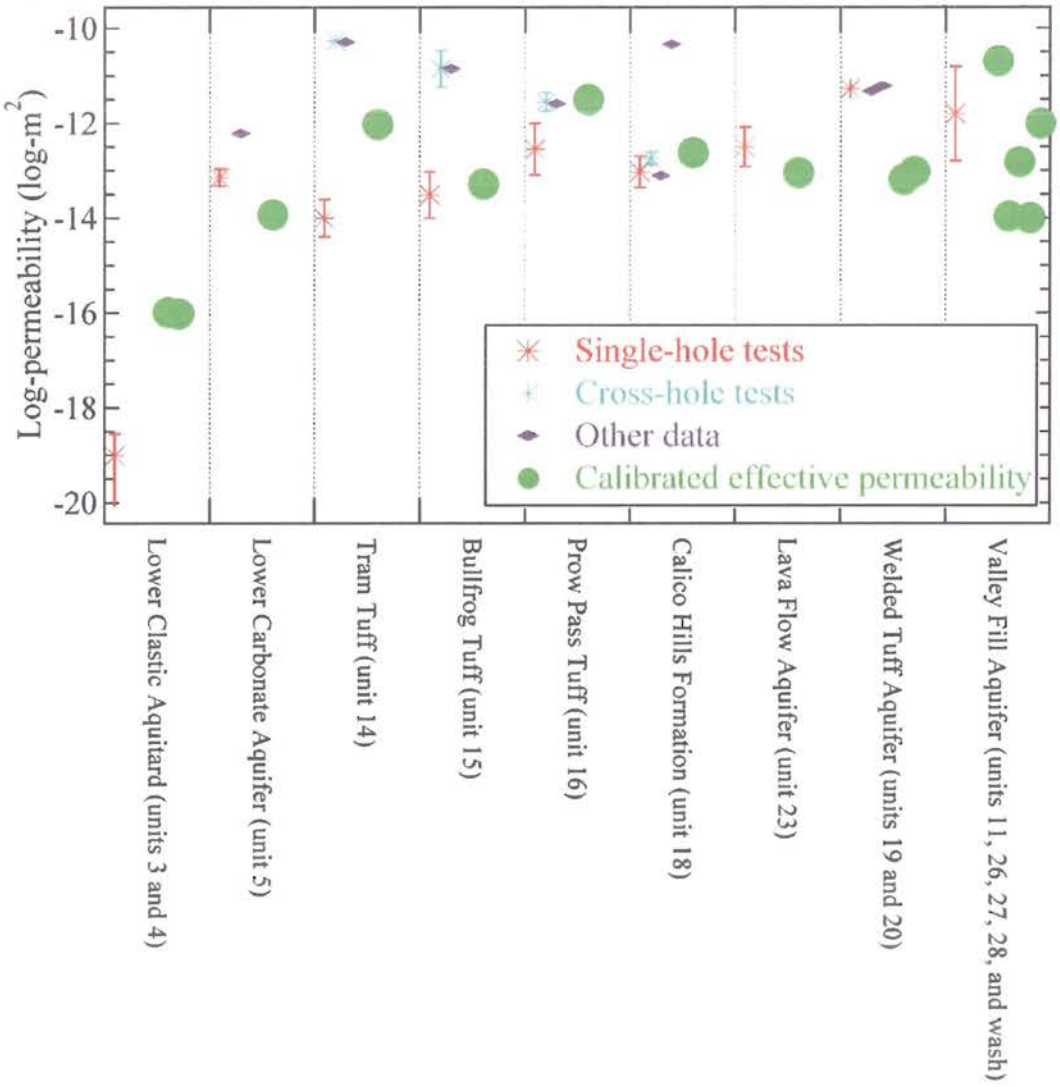
Simulated and Observed Potentiometric Surfaces

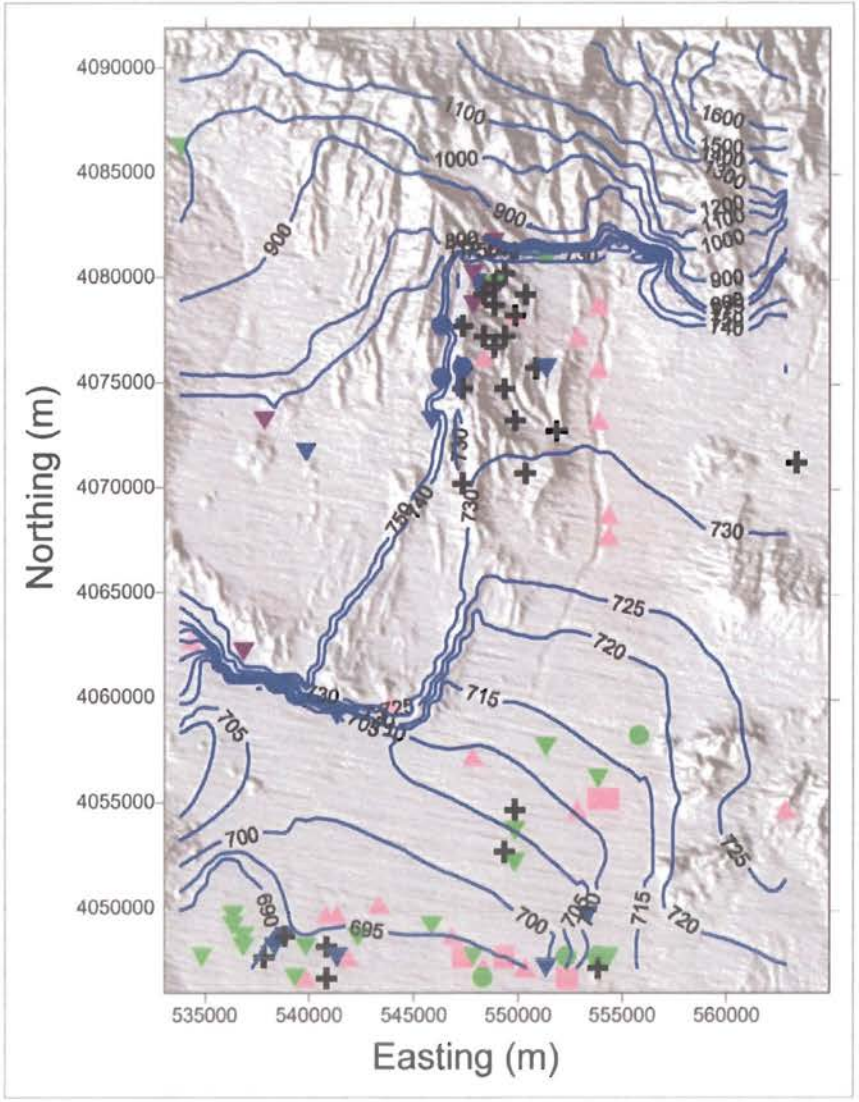




Calibrated and Measured Hydraulic Conductivities



Model Predicted Potentiometric Map



Coordinates are Universal Transverse Mercator.

Validation:

Summary

- A scientifically defensible model of saturated zone flow at Yucca Mountain has been developed
- The model is calibrated to hydrogeologic data using PEST
- Where data are unavailable, conservative assumptions have been applied
- Recent data collection and modeling efforts were designed to:
  - reduce uncertainties
  - relax conservative assumptions
  - further validate conceptual models
- Confidence building activities are carried out to provide evidence that the conceptual and numerical models used are valid for the time and spatial scales of interest (*10,000 years*) for a geologic repository