

YUCCA
MOUNTAIN
PROJECT

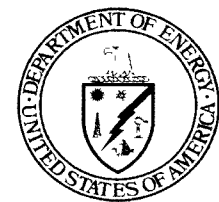
Studies

Saturated Zone Flow and Transport Analyses in Total System Performance Assessment for Yucca Mountain

Presented to:
Nuclear Waste Technical Review Board

Presented by:
Bill W. Arnold
Sandia National Laboratories
Albuquerque, NM

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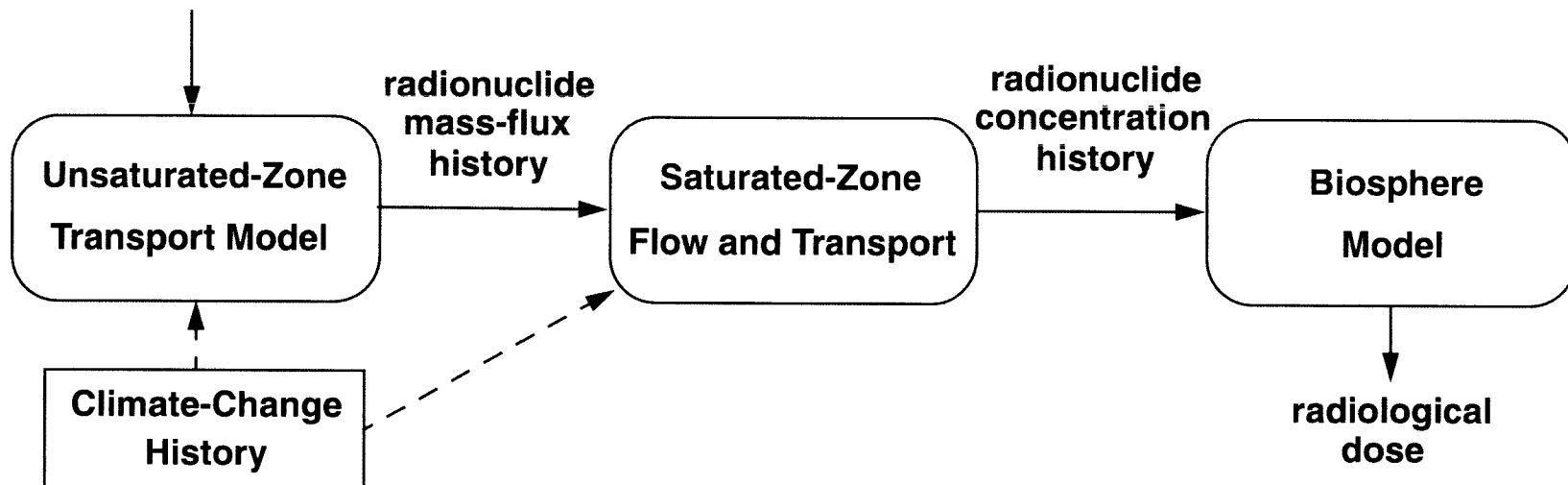
U.S. Department of Energy
Office of Civilian Radioactive
Waste Management

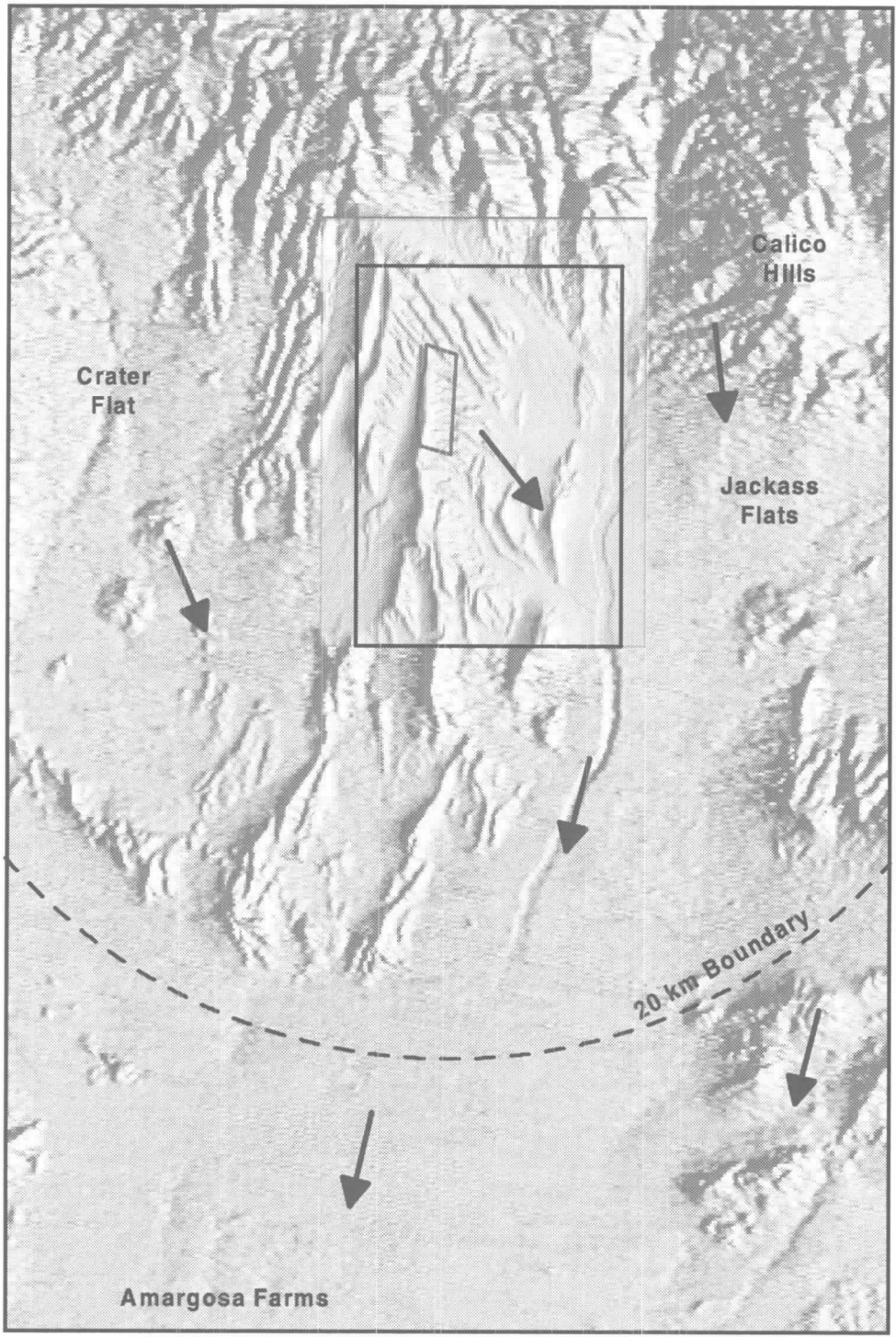


SZ Flow and Transport in TSPA

- **SZ flow and transport processes important to performance:**
 - **Groundwater advection.**
 - **Diffusion of dissolved radionuclides into rock matrix.**
 - **Mechanical dispersion of dissolved radionuclides.**
 - **Geochemical retardation by sorption on mineral grains.**
 - **Dilution at a pumping well.**

upstream components



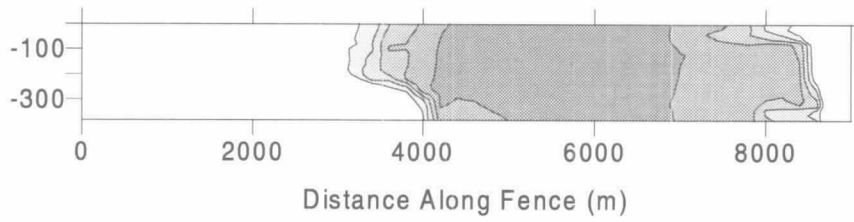
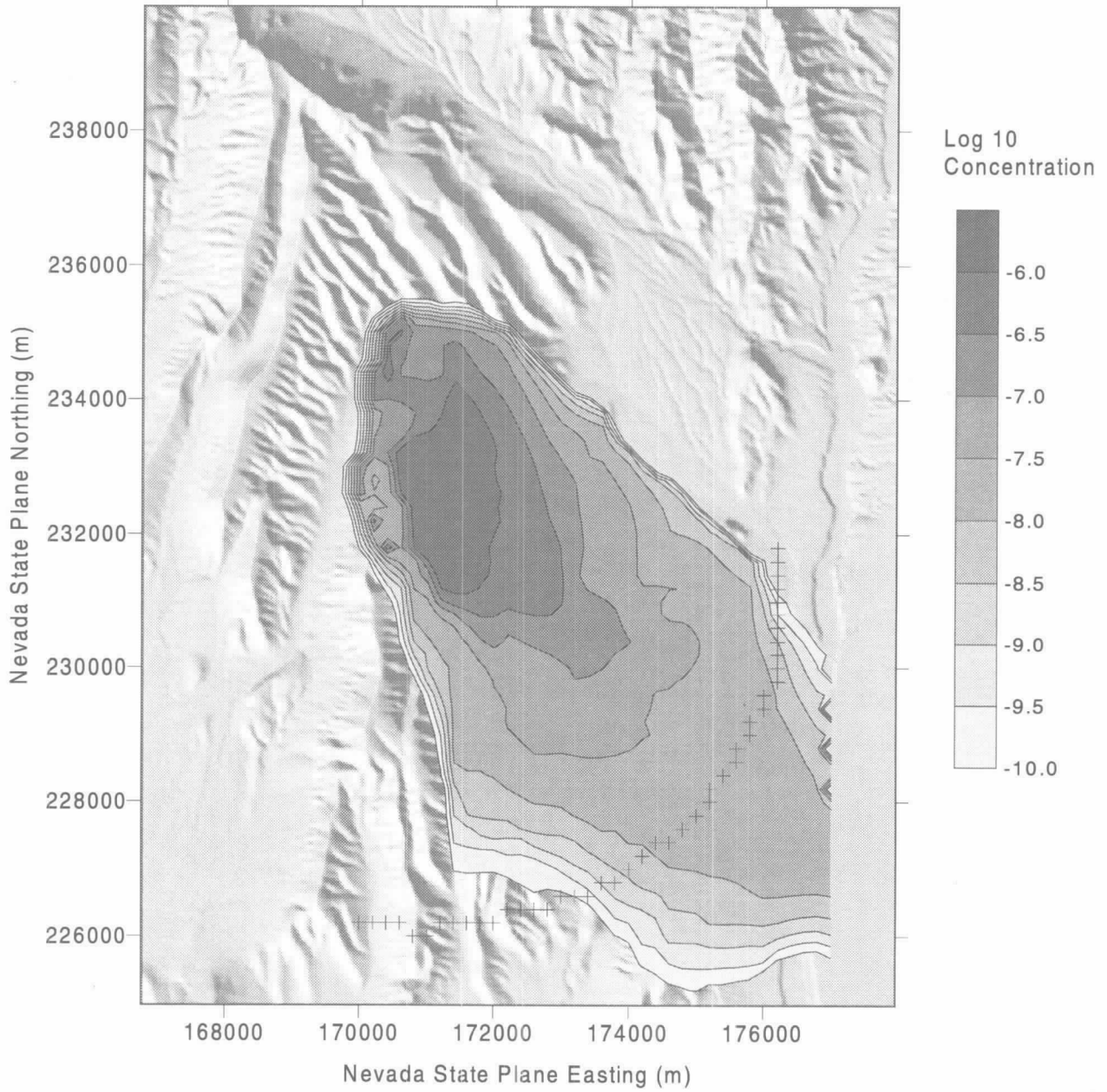


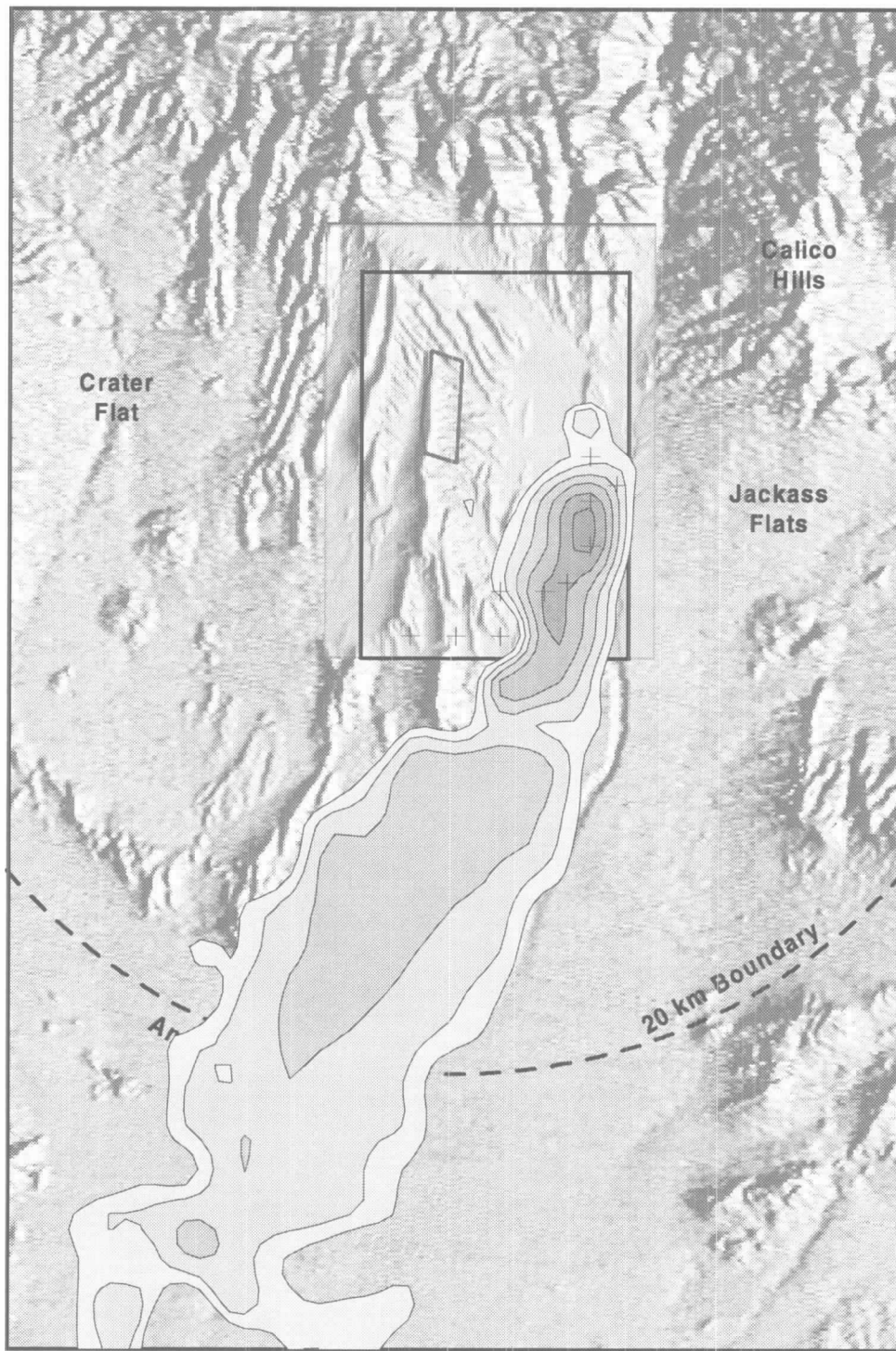
0 5 10 kilometers



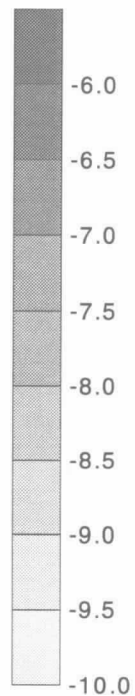
SZ Flow and Transport Modeling

- **Sub-site-scale model for transport to 5 km.**
 - **Incorporates YMP site geologic framework model.**
 - **Higher resolution grid and hydrostratigraphic definitions.**
- **Site-scale model for transport to 20 km.**
 - **Described in previous talk by John Czarnecki.**
- **Coupling between models occurs at the 5 km fence with radionuclide concentration term.**
- **For Monte Carlo TSPA runs, the convolution integral method is used to approximate radionuclide transport in the SZ.**



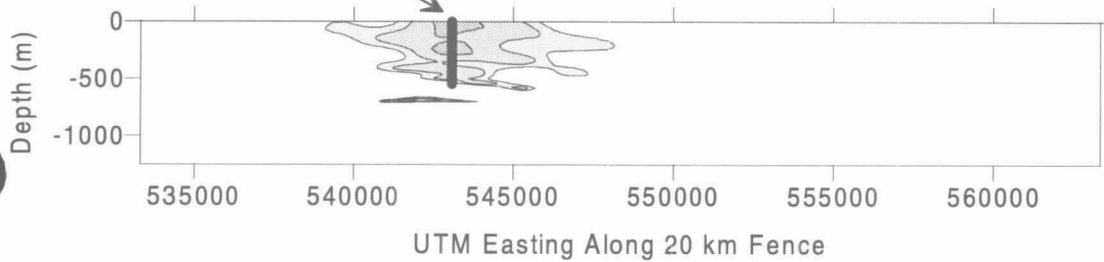


Log 10
Concentration

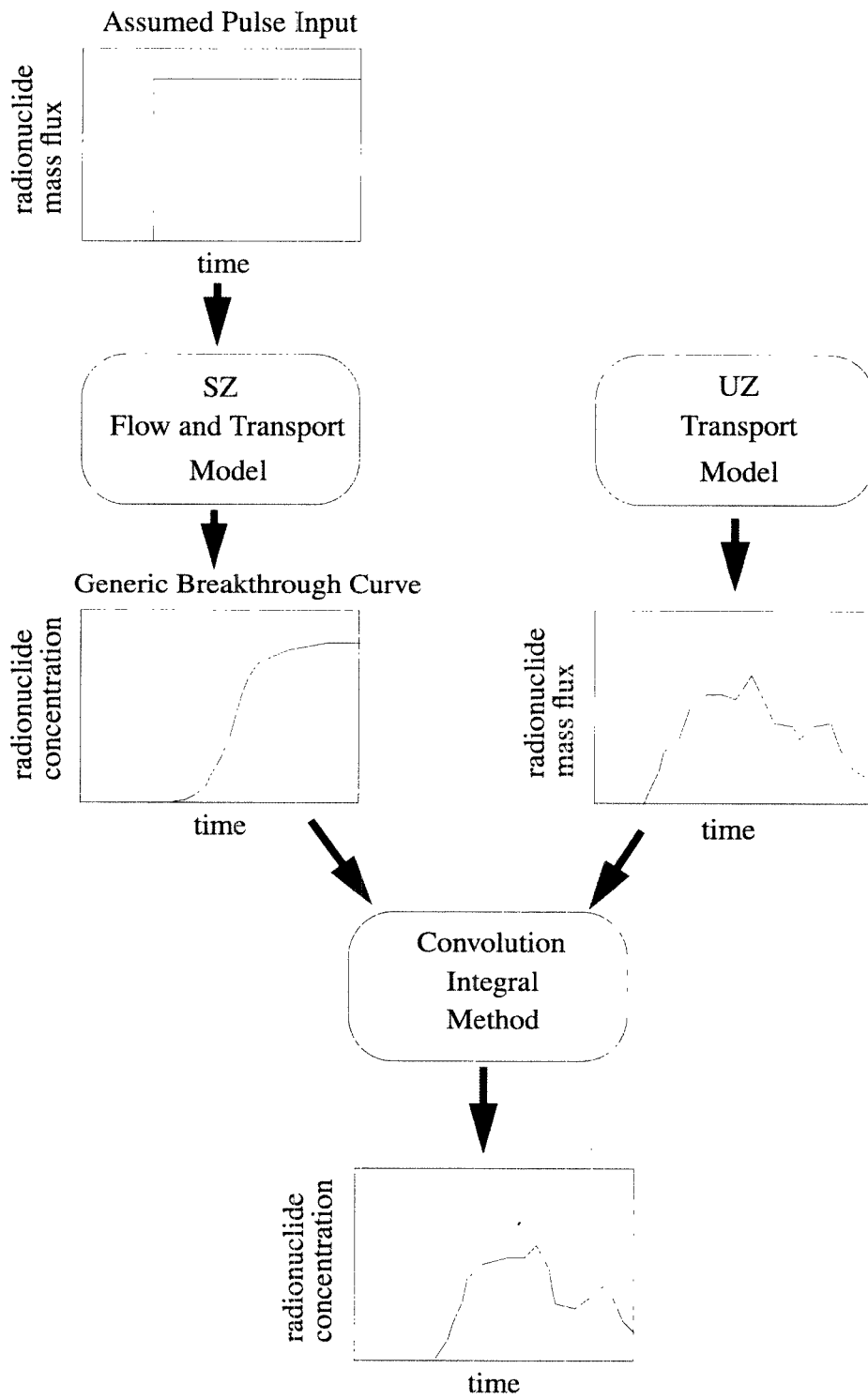


Hypothetical Pumping Well

0 5 10 kilometers



• Convolution integral method for coupling UZ and SZ transport.





Base-Case Analyses for TSPA

- **Focus on uncertainty in transport characteristics of the SZ.**
- **Effective porosity conceptual model.**
 - **Matrix diffusion.**
 - **Heterogeneity / flow channelization.**
 - **Broad distributions encompassing expert elicitation estimates.**
- **Dispersivity.**
 - **Distributions for longitudinal and horizontal transverse dispersivity taken from expert elicitation.**
 - **Low values of vertical transverse dispersivity from expert elicitation to be evaluated in sensitivity studies.**



Base-Case Analyses for TSPA (cont.)

- **Sorption.**
 - **Linear sorption model.**
 - **Distributions of effective K_d values for volcanic units taken from Triay et al. (in draft).**
 - **Distributions of effective K_d values for alluvium and carbonate units taken from expert elicitation and literature (Thibault et al., 1995).**
- **Colloid-facilitated Pu transport.**
 - **Partition coefficient model.**
 - **Broad distribution of K_c values assumed.**



Sensitivity Analyses for TSPA

- **Uncertainty in permeability distribution / groundwater flux.**
 - Evaluate the effects of the uncertainty distributions for permeability and groundwater flux from the expert elicitation.
 - Groundwater flux effects.
 - Flow pathway effects.

- **Influences of heterogeneity / flow channelization.**
 - Geostatistical simulation of permeability including intra-unit heterogeneity and structural zones.

- **Small values of vertical transverse dispersivity.**
 - Evaluate with analytical solution for idealized uniform flow field [e.g., Domenico and Palciauskas (1982), Domenico and Robbins (1985), Domenico (1987)].
 - Will include evaluation of dilution in a pumping well.



Additional Considerations

- **Quantitative comparisons of dilution factors simulated in TSPA with expert elicitation results.**
- **The exclusion of several issues from explicit evaluation in TSPA analyses is generally consistent with expert elicitation results (e.g., uncertainty in the model of the large-hydraulic gradient, and disruptive events).**