Characterization and Modeling of the Alluvium Beneath Fortymile Wash, Nevada

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Yucca Mountain, Nevada, is being investigated by the U.S. Department of Energy (DOE) for a potential high-level radioactive waste repository. Natural geologic barriers are evaluated for their effectiveness in isolating radioactive waste from the accessible environment. The valley-fill alluvial aquifer beneath Fortymile Wash constitutes an important component of the natural barrier system. The alluvium is currently modeled as a homogenous hydrogeologic unit in the DOE saturated zone site-scale model. Geological and geophysical surveys conducted in the area, however, have indicated strong spatial variability in the alluvium resulting in a significant amount of model uncertainty.

Facies distributions, when modeled under a probabilistic framework, can be used to generate images of subsurface heterogeneity and to link geology to hydraulic parameters, which in turn can be used for stochastic flow and transport simulations. Driller lithology logs and previous studies of outcrop exposures were analyzed to define quantitative models for the proportions, geometry, and spatial distribution of geologic materials that have distinctive hydraulic properties (i.e., hydrofacies). A transition probability/Markov chain geostatistical approach was taken to represent the geometry and juxtapositioning tendencies of facies and to generate conditional realizations of facies distributions. The results show that interconnected facies form preferential flow paths and large variability exists in the flow path pattens. The effect of flow path variability on potential radionuclide transport can then be evaluated via stochastic simulations. This work provides an approach for representing uncertainty in the alluvial architecture within the site-scale, saturated zone models.