

## 4.2 **Aspects of Groundwater Modeling In Oil Shale Basins**

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Beneath the drainage basins of Northwest Colorado and Northeast Utah lie the Uinta and Green River Formations of Eocene age and older rocks. The Uinta and Green River Formations consist of marlstone, sandstone, and siltstone and include large reserves of oil shale. Extensive fracturing and leaching of the formations has increased their permeability and resulted in aquifers that lie within, above and below the oil-shale deposits. The hydrologic system of the basins consist of natural recharge from precipitation, circulation through fractured aquifers and confining beds, and discharge to stream valleys or seepage faces. A new preliminary three-dimensional multilayer simulation model using GIS, Autocad, and Modflow was prepared using available data from the 1980's. A steady-state error analysis assessed the degree of error in the hydrologic parameters used in the past ground water model. This analysis indicated that simulated hydrologic characteristics are plausible, but that all layers exhibited impaired vertical hydraulic conductivity. The new groundwater models indicate that the impaired vertical hydraulic conductivity of the layers of oil shale was changed to a functioning vertical hydraulic conductivity in the fractured oil shale layers after drilling for tight gas, ex-situ and in-situ oil development processes had occurred. The Mahogany Unit appears to be more of a leaky confining layer after the extensive drilling of wells and many years of recent drilling for tight gas into the geologic formations below the Garden Gulch member. Also a review of the regulations is presented to demonstrate the need for 3-D and groundwater modeling for the respective regulatory agency's understanding of the aquifer system.