A Three-Dimensional Numerical Model of Predevelopment Conditions in the Death Valley Regional Ground-Water Flow System, Nevada and California

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Table 13. Recharge parameter descriptions, values, and composite scaled sensitivities

Parameter name	Description	Parameter value	Composite scaled sensitivity
RCH_zone1	Basin-fill units	0.0	3.68×10^{-2}
RCH_zone2a	Volcanic units–Timber Mountain and Pahute Mesa area	1.0	2.31
RCH_zone2b	Volcanic units–All other	1.0	2.15
RCH_zone3a	Crystalline units–Upper 300 meters of TJi & pCgm	0.005	2.74×10^{-3}
RCH_zone3b	Clastic units–Upper 300 meters of UCCU	0.05	1.06×10^{-3}
RCH_zone3c	Clastic units–Upper 300 meters of LCCU & Mvs	0.01	2.91
RCH_zone3d	Clastic units–LCCU thrusts	0.05	6.02×10^{-2}
RCH_zone4a	Crystalline units–TJi & pCgm deeper than 300 meters	0.001	6.75×10^{-2}
RCH_zone4b	Clastic units–UCCU deeper than 300 meters	0.01	16.8
RCH_zone4c	Clastic units–LCCU deeper than 300 meters	0.00003	1.21
RCH_zone5a	Carbonate units in central/western area	0.12	0.174
RCH_zone5b	Carbonate units in Spring Mountains area	0.55	2.01
RCH_zone5c	Carbonate units in northeastern area	0.25	1.66

than reasonable. This may result from infiltrating water moving past the root zone but being diverted before reaching the water table by smaller K rock units. Bedinger and others (1989) account for a similar situation in metamorphic and crystalline rocks in the Death Valley region. They suggest that the hydraulic conductivity of metamorphic and crystalline rocks at depths less than 300 m below land surface is significantly larger than rocks at depths greater than 300 m. To test this interpretation in the DVRFS flow model, the HFM was modified to represent confining units that occur within 300 m of land surface ("upper" units) and those that occur at depths more than 300 m below land surface ("lower" units). Then, recharge parameters were defined by grouping recharge rates occurring on "upper" and "lower'" confining units. Recharge parameters with this configuration allowed net infiltration to be reduced slightly more on smaller K "lower" confining units. However, the effective recharge on all of the clastic and crystalline rocks was nearly zero (table 13). Only slight amounts of recharge were required to maintain the ground-water mounds occurring in these areas.

Variations in Interpretation of Hydrogeologic Framework

Four general types of changes were made to the hydrogeologic conceptual model during calibration. These include: (1) splitting major rock types into more detailed and complex hydrogeologic units, (2) subdividing hydrogeologic units into spatial regions or zones, (3) adding vertical anisotropy parameters, and (4) differentiating hydrogeologic-unit parameters based on depth. Initially, the hydrogeologic conceptual model used in the DVRFS flow model was simplified to represent four major rock types including confining units (K1), carbonate rocks (K2), volcanic rocks (K3), and basin-fill units (K4). These rock types were considered homogeneous and isotropic and were represented by K parameters. Then, the hydrogeologic framework representation was evaluated by calculating hydraulic heads and ground-water discharges using MODFLOW-2000. Sensitivities were calculated for parameters in each conceptual model representation. Parameters with high CSS values were further divided. For example, the carbonate rock K parameter was subdivided first because of its high sensitivity. This logic was followed for all K parameters that had high enough sensitivities. Model fit generally improved as K parameters were subdivided into more specific hydrogeologic units. Some parameters created during this process had low CSS values. The assigned value for these parameters did not influence calculated heads and flows significantly; however, defining these parameters helped in the overall understanding of how the ground-water flow system functions.

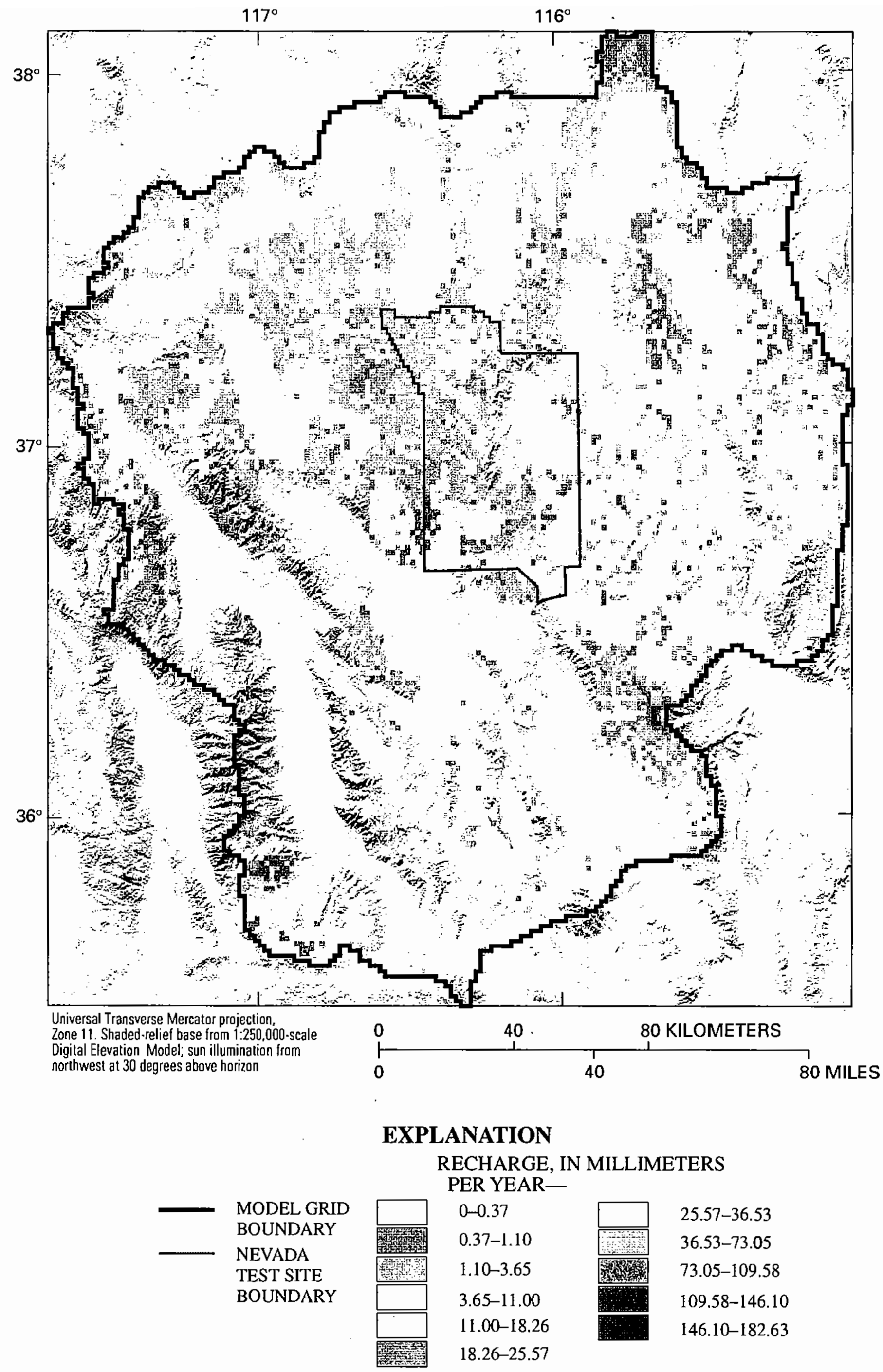
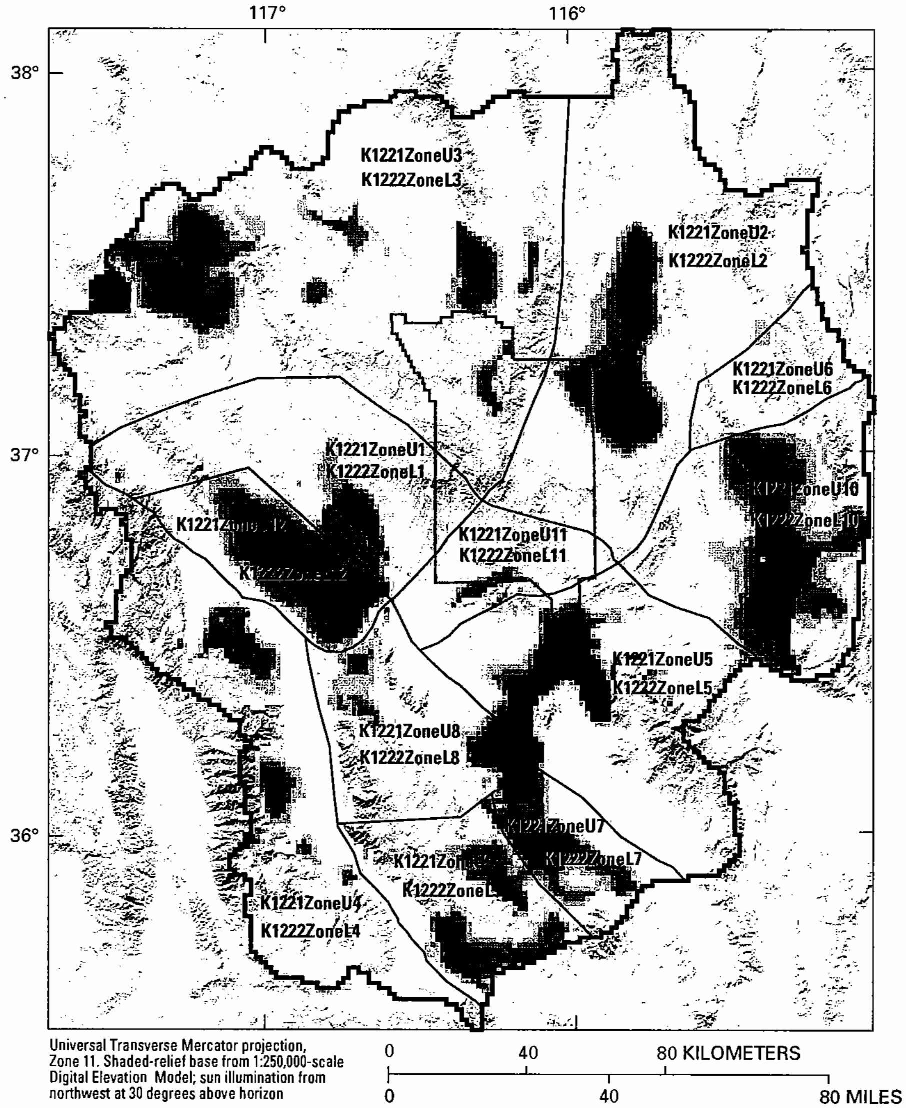


Figure 21. Recharge simulated in the Death Valley regional flow system model.

Confining Units

The confining-unit rock type consists of crystalline and clastic rocks. Crystalline hydrogeologic units include Precambrian granites and metamorphic rocks (pCgm) and Tertiary-Jurassic intrusives (TJi). Clastic hydrogeologic units consist of the upper clastic confining unit (UCCU), lower clastic confining unit (LCCU), and the Mesozoic volcaniclastic and sedimentary rocks (Mvs).

Initially, all rocks interpreted to be confining units were grouped into one K parameter. The sensitivity of this parameter was lower than the three other major rock-type parameters. This may be a result of



EXPLANATION

LCCU THICKNESS, IN METERS

K1221ZoneU7 K1222ZoneL7	LCCU ZONES WITH PARAMETER NAMES
(thick line)	MODEL GRID BOUNDARY
(thin line)	NEVADA TEST SITE BOUNDARY

- 0–250
- 250–500
- 500–750
- 750–1,000
- 1,000–1,250
- 1,250–1,500
- 1,500–1,750
- 1,750–2,000

Figure 22. Definition of lower clastic confining unit (LCCU) hydraulic-conductivity zone parameters and unit thickness.