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Effects of Well and Piezometer Design on Water-Level Monitoring

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Aquifer test analyses and groundwater development monitoring depend on reliable measurements of water-level change in observation wells or grouted piezometers. Observation wells communicate with aquifers through screened intervals that typically penetrate thicknesses between 5 and 500 ft. Grouted piezometers reflect point measurements in an aquifer because pressure transducers or equivalent devices are emplaced with low-permeability grout as a borehole is backfilled. Similar water-level changes are observed within collocated long-screen, observation wells and grouted piezometers where aquifers are relatively homogeneous. However, differences between collocated long-screen, observation wells and grouted piezometers become pronounced where transmissivity varies markedly with depth such as in fractured rocks and basin fill with thick clay sequences. Water-level changes from pumping can be attenuated greatly where observation wells with short screens and grouted piezometers do not penetrate permeable intervals in an aquifer. For example, maximum drawdown in a piezometer will be attenuated to 30 percent of the response above a thin, transmissive horizontal fracture, where the hydraulic conductivity of the fracture is 100,000 times greater than the 100-ft of unfractured rock. Results such as these suggest that drawdowns from distant pumping are detected better with long-screen wells.

What Drought? Water Levels on the Rise in Southern Nevada

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Water levels in areas distant from pumping have been rising since the 1970s in the Death Valley regional flow system (DVRFS), southern Nevada. The rising water-level trends are attributed to precipitation-derived groundwater recharge resulting from a series of above-average winter precipitation events between 1970 and present-day. The observed short-term (30-year) rising trend is part of a longer-term (century-scale) steady-state condition.

Steady-state groundwater conditions in southern Nevada can be thought of as occurring over a scale of about a century. Winter precipitation in southern Nevada was considerably below average from 1900-1970 compared to 1970-present. Above-average winter precipitation is assumed to recharge the groundwater system. A simple recharge model of this precipitation pattern indicates that regional water levels are expected generally to decline during the dry period prior to 1970 and rise during the wet period after 1970. Because water levels in the DVRFS area are steady state over a period of about a century, no net change in regional water levels between 1900 and present-day is assumed.

Water-level models are used to show groundwater recharge is the dominant stress affecting steady-state water levels. The justification for attributing rising trends to steady-state conditions will be discussed.