Analysis of Potential Water-Supply Management Options, 2010–60, and Documentation of Revisions to the Model of the Irwin Basin Aquifer System, Fort Irwin National Training Center, California

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Abstract

The Fort Irwin National Training Center is considering several alternatives to manage their limited water-supply sources in the Irwin Basin. An existing three-dimensional, finite-difference groundwater-flow model—the U.S. Geological Survey's MODFLOW—of the aquifer system in the basin was updated and the initial input dataset was supplemented with groundwater withdrawal data for the period 2000–10. The updated model was then used to simulate four combinations, or scenarios, of groundwater withdrawal and recharge over the next 50 years (January 2011 through December 2060). The scenarios included combinations of continuing withdrawals from currently active production wells, supplementing any increases in demand with withdrawals from an inactive production well, reducing withdrawal amounts and rates, and reducing the discharge of treated wastewater to infiltration ponds that provide a recharge source to the underlying aquifer. Results of the simulations indicated that, depending on the scenario implemented, groundwater levels would rise (over the next 50 years) from 40 feet to as much as 65 feet in the northwestern part of the Irwin Basin, and from 5 feet to 10 feet in the southeastern part.

Introduction

Fort Irwin National Training Center (Fort Irwin NTC) in the Mojave Desert of California has been used as a military training facility almost continuously since August 1940. The training center currently (2012) obtains its potable water supply by pumping from wells in the Irwin, Bicycle, and Langford Basins. Groundwater development began in the Irwin Basin in 1941. From 1941 to 1996, most of the groundwater pumpage was from the Irwin Basin which resulted in water-level declines of about 30 ft in the basin during this period. Pumping from the Bicycle and Langford Basins began in 1967 and 1992, respectively, and pumping from these basins has resulted in a decrease in the groundwater demand from the Irwin Basin. Since 1991, the combined pumping from the adjacent Bicycle and the Langford Basins has exceeded that in the Irwin Basin. Since the 1990's, reduced pumping and artificial recharge of wastewater and irrigation in the Irwin Basin has caused water levels to stabilize or rise throughout the basin. Although water levels are currently rising in the Irwin Basin, treated wastewater that percolates through evaporate deposits underlying the wastewater-treatment facility and infiltration/holding ponds has resulted in high concentrations of dissolved solids in groundwater that is migrating toward the pumping-caused depression in water levels near the center of the basin (Densmore and Londquist, 1997). Water-quality concerns have led to the abandonment or destruction of several production wells in the Irwin Basin.

To effectively manage the water resources and plan for future water needs at the Fort Irwin NTC, it is important to have a complete understanding of the hydrogeologic and geochemical framework of the Irwin, Langford, and Bicycle Basins. To provide the information needed to develop that understanding, the U.S. Geological Survey (USGS), in cooperation with the Fort Irwin NTC, conducted a series of studies to evaluate the hydrogeologic system and conditions at the training center. This report describes the results of one of those studies.

Purpose and Scope

This report describes the results of the simulation of groundwater flow in the aquifer system in the Irwin Basin at the Fort Irwin NTC, California, using an existing groundwater-flow model developed by Densmore (2003) that was updated to run with MODFLOW 2005, the most current version of the USGS three-dimensional, finite-difference groundwater model, and to use groundwater withdrawal data for the period 2000–10. The original model simulated the hydrologic conditions of the Irwin Basin for the period 1941–99. This report describes the hydrogeology of the Irwin Basin, the