Technical Memorandum

Windsor Well Equipment Evaluation and Aquifer Testing
National Aeronautics and Space Administration,
Jet Propulsion Laboratory, Pasadena, California

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This technical memorandum provides results from the evaluation of the pump equipment, sand content of production water, and aquifer testing associated with the City of Pasadena Windsor Well. These data were collected during the Windsor Well experiment that was conducted between July 12 and July 14, 2005 by the City of Pasadena. The objectives of the experiment were to evaluate the nitrate levels in the Windsor Well and to evaluate the pump equipment for future operations. The activities documented in this technical memorandum were conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program at the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL).

Equipment Evaluation

On July 11, prior to the initiation of pumping, and July 12, during pump operation, a representative from General Pump Company of San Dimas, California, conducted a general inspection of the Windsor well pump equipment. This inspection included testing of the pump motor and pipeline connections, and manually turning the motor and pump shaft. With the exception of the electrical starting system, all other equipment was observed to be in good working order. Electrical issues associated with starting the pump were resolved by City of Pasadena staff and a successful test start of the pump was completed on July 11.

On July 12, prior to the initiation of pumping and during the pump operation, a representative from Pump Check of Riverside, California, collected data from the pump equipment as part of an overall hydraulic evaluation. Pump Check also conducted testing to evaluate the sand content of the production water using a Rossum sand tester. Results of these evaluations are provided as attachments A and B. During the experiment (28 hour duration), approximately 2.2 million gallons (6.79 acre feet) of water were produced at an average rate of 1,317 gallons per minute (gpm). Pump equipment performed with an overall pump efficiency in the 60 to 62% range.

Results of the sand test indicate that approximately 7 minutes after the pumping was started, the discharge water contained an average sand content of 3.65 ppm. Similar results were observed during the restart test that was performed on July 14 (average of 3.08 ppm after 8 minutes). Based on information provided by Pump Check, these sand concentrations are within the acceptable ranges for this type of production system (i.e., a well that discharges into a reservoir). Sand content of less than 5 ppm is usually considered desirable to minimize wear on pump equipment.

Windsor Well Aquifer Testing

On July 12, prior to the initiation of pumping, the static groundwater level in the Windsor well was measured at approximately 134 feet below the centerline of the pump discharge piping. Following the initiation of pumping and throughout the experiment, additional groundwater level-

measurements were collected from this well using the existing airline pressure gauge located at the base of the motor mount. During the experiment, groundwater levels also were collected from nearby NASA-JPL monitoring well MW-19, which is located approximately 400 feet southwest of the Windsor well within the Windsor Reservoir property boundary. Monitoring well MW-19 is completed with five screened intervals that are isolated from each other using the Westbay multi-port monitoring well system. Groundwater levels were collected from the first (shallowest) and third screened intervals using a pressure transducer and pressure meter, respectively. Four sets of groundwater-level data were collected during the Windsor well experiment, consisting of drawdown and recovery data from the initial aquifer test and the restart test.

Drawdown data from the Windsor well are somewhat difficult to interpret and analyze because of inherent well effects (in the pumping well) and the absence of very frequent readings during the initial portion of the test when drawdown occurs very quickly. A datalogger (pressure transducer) is typically required to collect a solid dataset in a pumping well during the first few minutes of an aquifer test; however, access to the well for the placement of a datalogger was not available with the existing configuration. Hydraulic conductivity measurements estimated from the drawdown data collected in the Windsor well were quite low, ranging from 2.2-3.0 feet per day (ft/d). Because of the limited reliability and inherent well effects, the drawdown data collected in this well are more useful in evaluating well efficiency than in estimating hydraulic conductivity.

Drawdown in monitoring well MW-19 was observed shortly after (within minutes) the start of pumping in the Windsor well. The maximum drawdown observed in screens 1 and 3 was approximately 1.5 and 7.5 ft, respectively. For purposes of aquifer parameter estimation, the most accurate groundwater level data were collected during the initial aquifer test (drawdown and recovery data) as opposed to the restart test. Hydraulic conductivity values estimated from these tests ranged from 34 to 40 ft/d. These values are similar to those estimated during the OU-1 aquifer test (~65 ft/d) and the large scale pumping test (~25 ft/d) conducted as part of the initial groundwater modeling effort.

Recommendations

The 60-62% pump efficiency estimated during the conservative hydraulic evaluation is within acceptable limits; however, a more detailed evaluation will be performed as part of the system design. The aquifer test performed during the investigation yielded hydraulic conductivity values similar to those previously estimated. As a result of these similar estimates, modification of existing groundwater model input parameters is not necessary.