STONY CREEK FAN AQUIFER PERFORMANCE TEST
GLENN COUNTY, CALIFORNIA

Township 22 North, Range 3 West, Section 24

Prepared by the California Department of Water Resources
Northern District Groundwater Section
in Cooperation with
Glenn County Department of Agriculture

March 2005

STONY CREEK FAN AQUIFER PERFORMANCE TEST
GLENN COUNTY, CALIFORNIA
Township 22 North, Range 3 West, Section 24

This summary report was prepared by the Department of Water Resources, Northern District, Groundwater Section, on behalf of the Glenn County Department of Agriculture. It was prepared under the direct supervision of Toccoy Dudley, Chief of the Northern District Groundwater Section, Registered Geologist No. 3732, and was written by Kelly Staton, Registered Geologist No. 7501, in accordance with the provisions of the Geologist and Geophysicists Act of the State of California.

Kelly Staton
Engineering Geologist
CA Registered Geologist No. 7501
CA Certified Engineering Geologist No. 2337

TABLE OF CONTENTS

List of Figures

List of Photos

List of Tables

Introduction

Glenn County was awarded an AB303 grant in 2003 to perform two aquifer performance tests of the Stony Creek Fan aquifer system. The first test was performed in the spring of 2004 in the eastern part of the Stony Creek Fan alluvium. The current report summarizes the findings of the second aquifer test, which was performed in February 2005. Figure 1 shows the location of the second aquifer performance test, which is in the western portion of the Stony Creek Fan. This site is about 500 feet north of Highway 32 and about 300 feet west of the Tehama-Colusa Canal, at the Porter property.

The location of the second aquifer performance test was determined by members of the Glenn County Technical Advisory Committee and the California Department of Water Resources. Factors involving the site selection of the test location were total thickness of the Stony Creek Fan aquifer, location of existing dedicated observation wells, proximity to drainage facilities, and landowner permission.

Scope of Work

Starting on February 23, 2005, an aquifer performance test was performed on the Stony Creek Fan aquifer system to determine the transmissivity, storativity and hydraulic conductivity of the aquifer. Data needed to calculate these hydraulic properties were collected from existing observation wells and a test production well installed specifically for the aquifer performance test.

Prior to the test, groundwater levels were measured manually in eight wells in the study area, as shown on Figure 2. These wells were monitored for one week prior to the test, multiple times daily throughout the step-drawdown and constant-discharge tests, and seven-days following the tests as the groundwater levels recovered. Groundwater level measurements from these wells were used to determine if interference occurred while the test production well was operating. In addition to hand measurements, data loggers were used to continuously record groundwater levels in the test production well and three dedicated observation wells.

A test production well, SCF-AB303-9, was drilled and constructed to a total depth of 161 feet in October 2004, as shown in Photo 1 and Figure 3. A diesel-powered test pump was then installed and discharge pipe was laid to convey the extracted water approximately 75 feet to an existing drainage system. Photos 2 and 3 show the discharge pipe and conveyance system. A McCrometer flow meter was mounted on the discharge pipe to measure the volume of water extracted.

The well was then developed at varying flow rates, ranging from 600 gallons per minute (gpm) to 1,250 gpm. During development, a pre-test check on the drainage facilities was done to ensure that there was no leakage from the drainage pipe and that water flowed away from the test site.

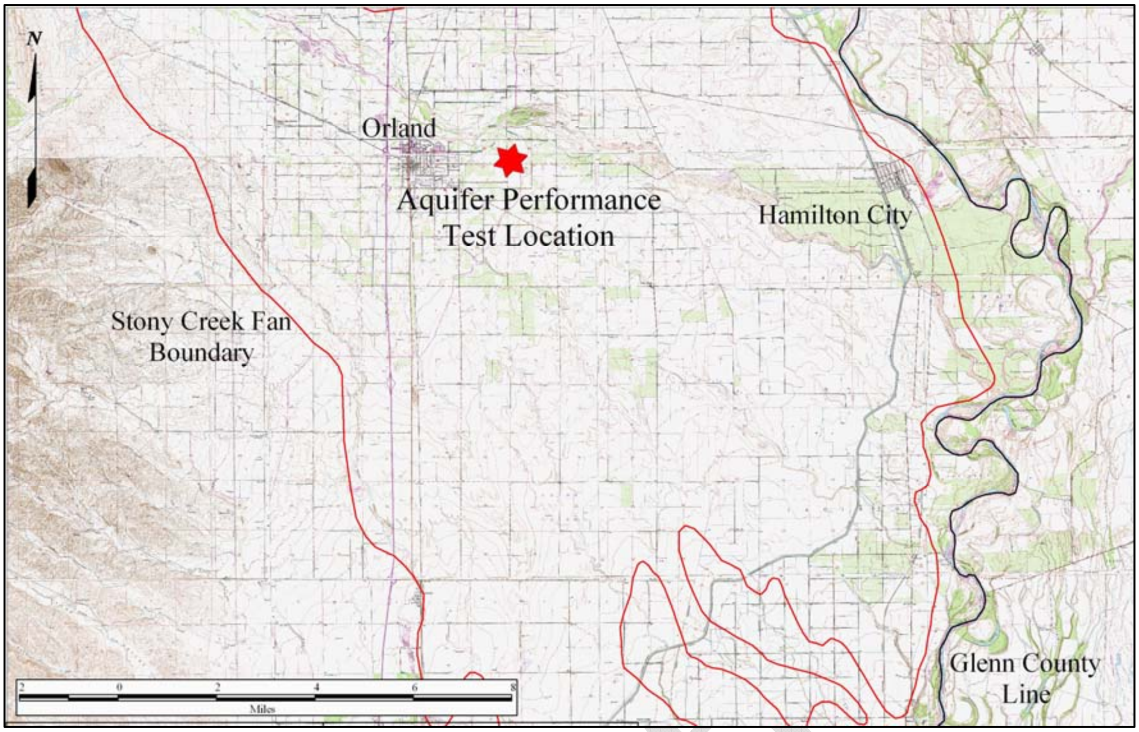


Figure 1. Location Map of Stony Creek Fan Aquifer Performance Test.

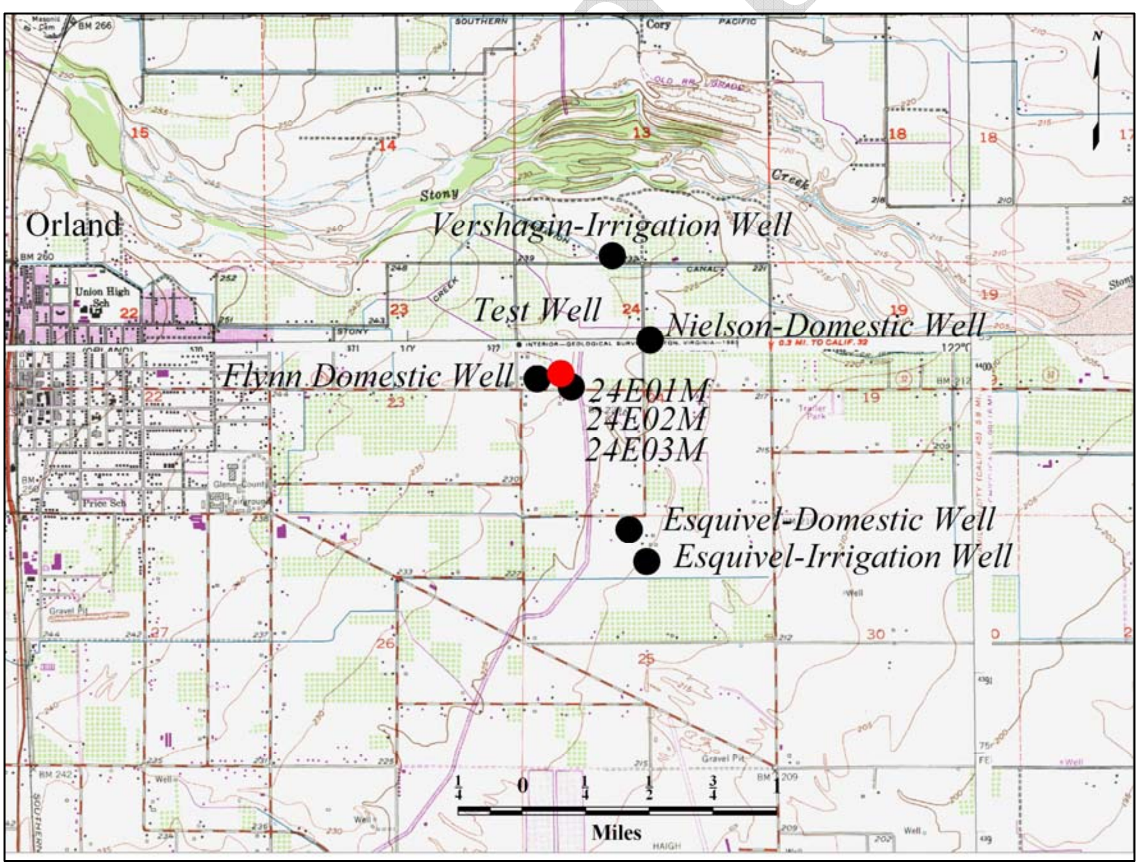


Figure 2. Location of Test Production Well, Observation Wells and Background Wells.

Following well development, a step-drawdown test was performed on the test production well. The purpose of the step-drawdown test was to determine the highest flow rate at which the well would operate efficiently during the constant discharge test. After evaluating the step-drawdown test data, a flow rate of 800 gpm was determined to be the optimal flow rate at which to stress the aquifer while still ensuring laminar flow through the well screen.

The aquifer performance test began February 28, 2005 at 9:15 am. and continued until March 3, 2005 at 9:04 am. Drawdown in the test production well, flow rate, and discharge volumes were recorded throughout the 72-hour constant discharge test. Water quality parameters were taken daily throughout development and testing to measure temperature, electrical conductivity and pH.

Photo 1. Test Production Well and Test Pump with Conveyance Pipe.

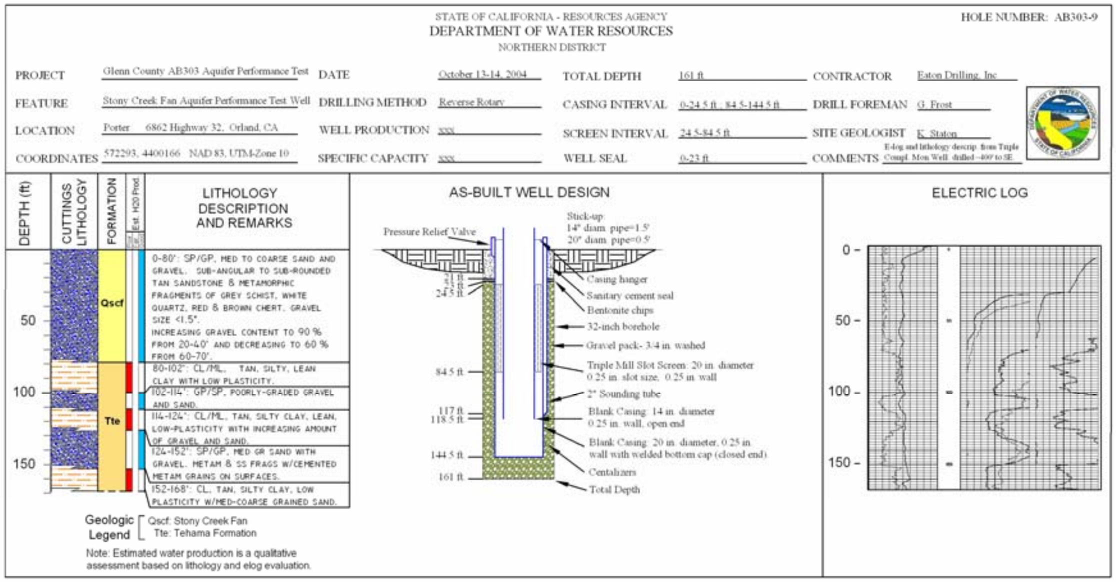


Figure 3. Lithology, Well Construction and Electric Resistivity Log.

Photo 2. Conveyance Pipe to Existing Drainage System.

Photo 3. OUWUA Drainage System.

Results

Step-Drawdown Test.

A step-drawdown test was performed to determine the highest flow rate at which the test production well could operate efficiently during the constant discharge test. The step-drawdown test is evaluated by calculating the specific capacity of the well while operating the pump at varying discharge rates. The specific capacity is calculated by dividing the flow rate by the measured drawdown in a well. The data from the step-drawdown test are used to determine the extraction rate at which groundwater entering the well changes from laminar to turbulent flow.

During this test, the pump was operated at 600, 800, 1000 and 1200 gpm for two hours at each rate. Figure 4 is a graph of the step-drawdown test showing the rate, drawdown and specific capacity for each two-hour interval. The specific capacity ranged from a high of 63 gallons per minute per foot of drawdown (gpm/ft dd) at 600 gpm to a low of 21 gpm/ft dd at 1200 gpm which is summarized in Table 1.

By plotting the specific capacity at each discharge rate, a break in slope of the data was determined, as shown in Figure 5. This is the point above which turbulent flow occurs in the well. At this location, a flow rate of 800 gpm was determined to be the best flow rate at which to stress the aquifer while still ensuring laminar flow into the well.

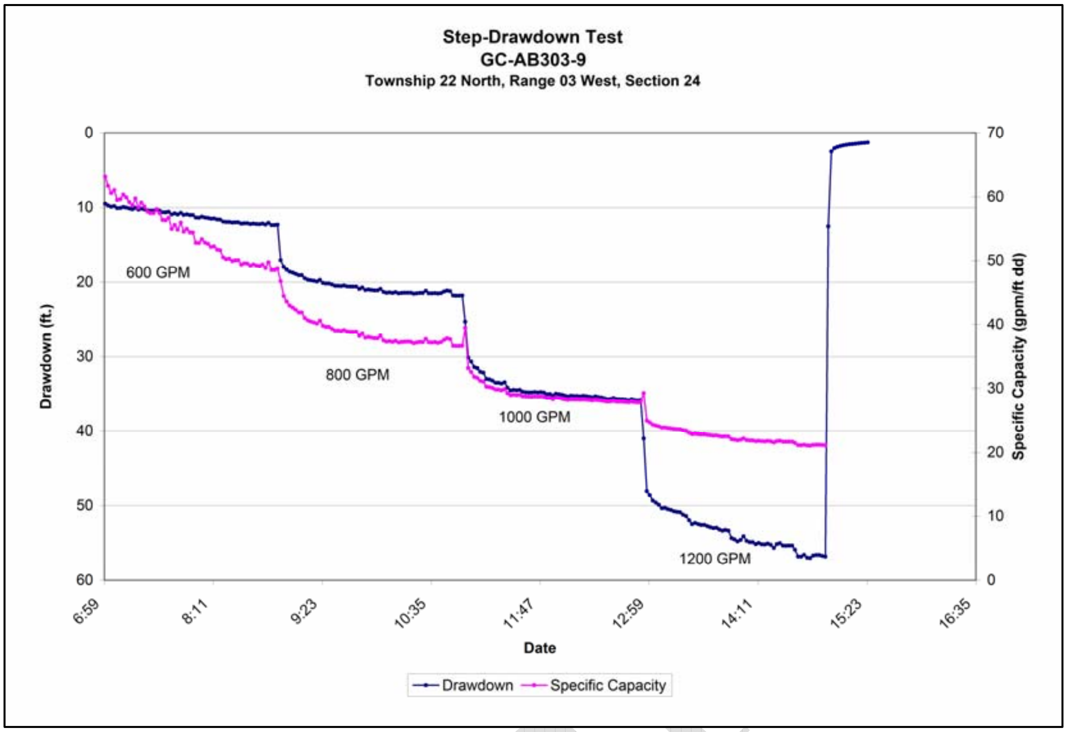


Figure 4. Step-Drawdown Test.

	Specific Capacity (gpm/ft dd)		
GPM	High	Low	Average
600	63	49	54
800	47	37	39
1000	39	28	29
1200	29	21	23

Table 1. Specific Capacity during Step-Drawdown Test

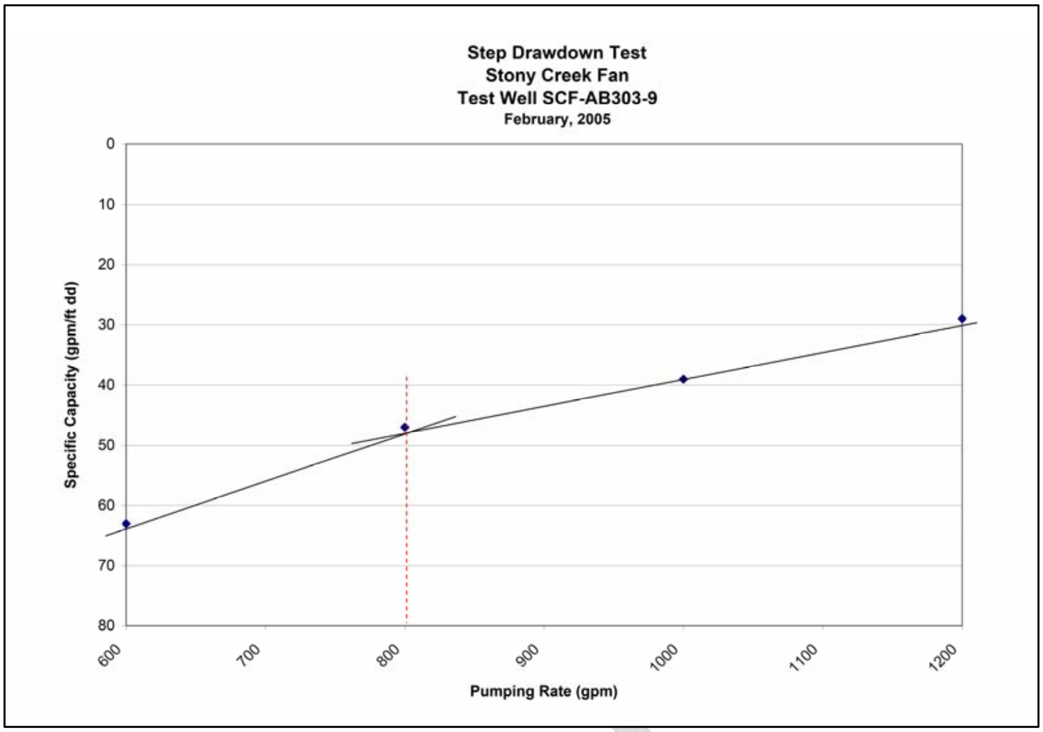


Figure 5. Specific Capacity vs. Discharge (gpm)

Aquifer Performance Test.

A constant discharge aquifer performance test was performed to determine the hydrogeologic properties of an aquifer. The three main aquifer parameters calculated were transmissivity, storativity and hydraulic conductivity. Transmissivity and storativity values were calculated using the Jacob Straight-Line method for time-drawdown series data; hydraulic conductivity is determined from the transmissivity.

Transmissivity is defined as the ability of an aquifer to transmit water through a saturated thickness, and is often expressed in gallons per day per foot (gpd/ft). For perspective, transmissivity values less than 1,000 gpd/ft will usually supply only enough water for domestic wells or other low-yield purposes. In wells with transmissivity values higher than 10,000 gpd/ft., well yields should be sufficient for industrial, municipal or irrigation purposes.

Transmissivity for the Stony Creek Fan alluvium was calculated to be about 390,000 gpd/ft. in observation well 24E03M. The calculated transmissivity in the test production well SCF-AB303-9 is about 53,000 gpd/ft. The transmissivity in a pumping well is usually lower than in an observation well due to minor changes in well discharge caused by variations in pump speed, and from inexact groundwater level measurements due to turbulence in the well casing caused by the pump. For these reasons, the calculated transmissivity in the observation well is considered more accurate.

The calculated aquifer storativity, or storage coefficient, is defined as the volume of water taken into or released from storage per unit change in head per unit area. The aquifer storage coefficient is reported in dimensionless units. In an unconfined aquifer, the storativity is equal to the specific yield. The storativity for observation well 24E03M is about 0.0073 suggesting that the aquifer is semi-confined. However, geologic information suggests that the aquifer system is unconfined. Storativity values cannot be calculated for a pumping well.

Hydraulic conductivity is the capability of a porous medium to transmit water, and is calculated by dividing the transmissivity by the saturated thickness of the aquifer. In observation well 24E03M, the hydraulic conductivity is about 2,800 gallons per day per foot squared (gpd/ft^2) which is typical for fine to coarse sand and gravel. In the test production well, the hydraulic conductivity is about 440 gpd/ft^2. Because the hydraulic conductivity uses transmissivity in the calculations, it is lower for the same reasons as mentioned above. The time-drawdown graphs for the observation well and the test production well are shown in Figures 6 and 7.

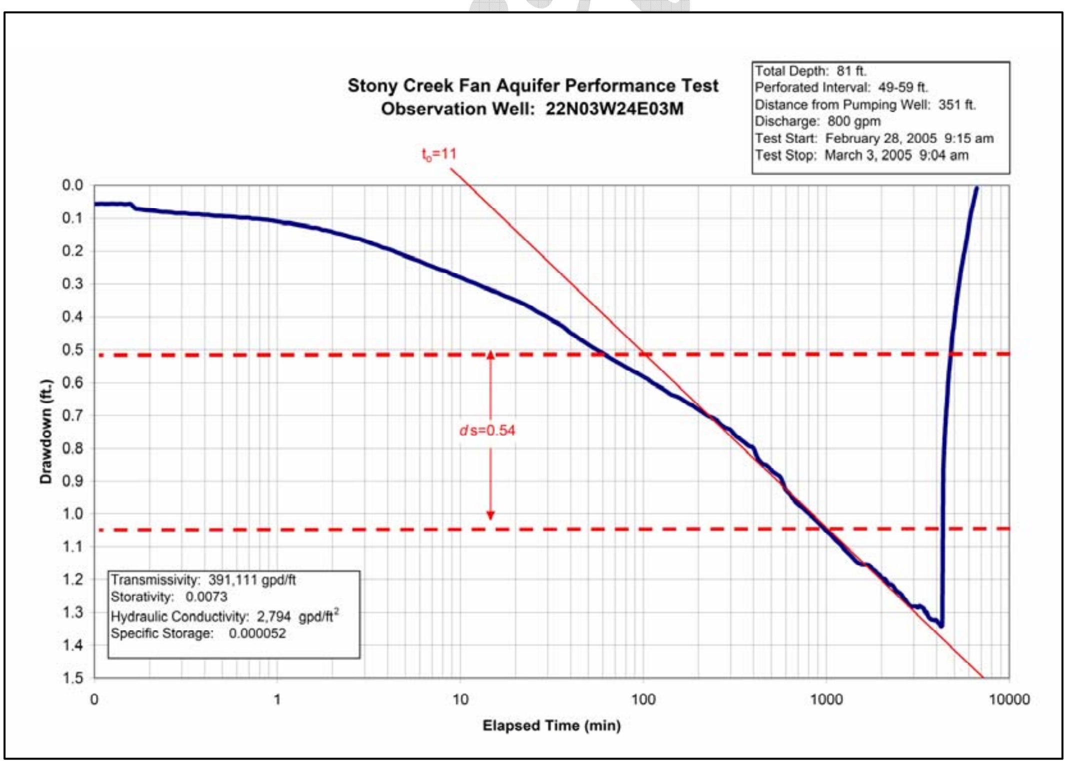


Figure 6. Observation Well 22N03W24E03M: Drawdown vs. Time

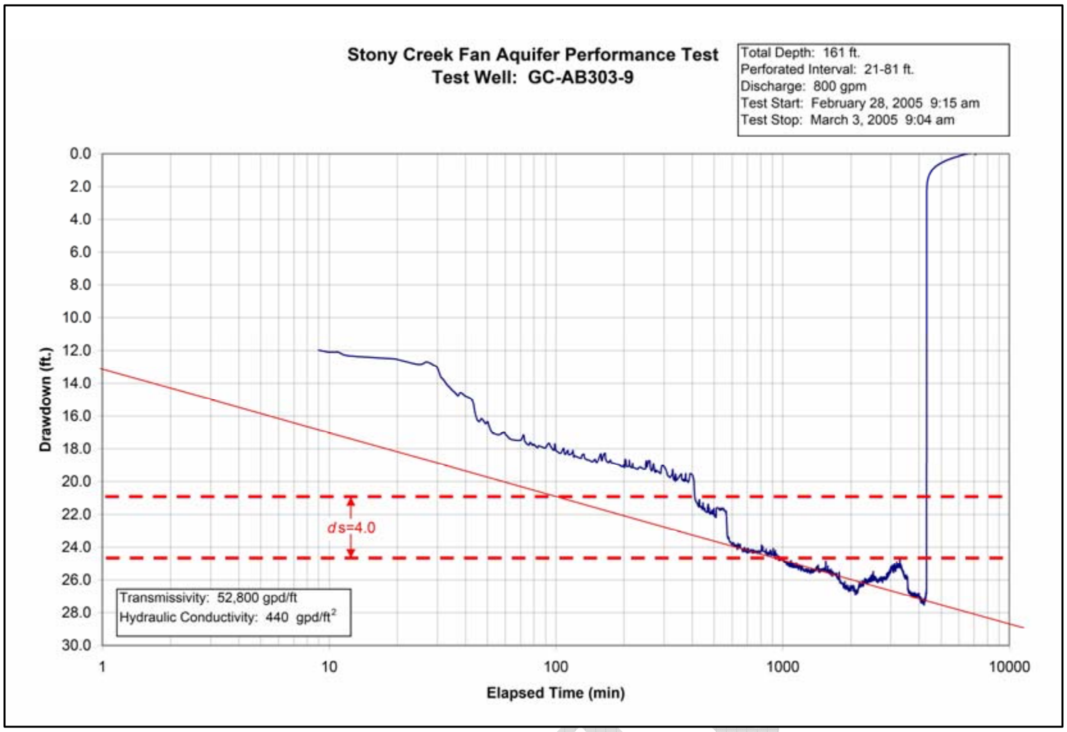


Figure 7. Test Production Well SCF-AB303-9: Drawdown vs. Time

Groundwater Levels.

Groundwater level data collected suggest that wells within about a mile radius of the test production well were influenced by the test well. Groundwater level recovery in most of the measured wells was plus or minus three-tenths of a foot from pre-test groundwater levels. However, two of the three domestic wells that were in use intermittently before, during and after the constant discharge test did not recover fully, returning only to within one and a half feet of the pre-test groundwater levels.

Observation well 24E02M showed the most drawdown at 4.4 feet and the Nielson domestic well showed the least at 0.5 feet although it pumped intermittently throughout testing. Maximum drawdown in the test production well was 27.7 feet over the test period. After a seven-day recovery period, five wells, including the test production well, surpassed the pre-test groundwater levels with an increase in groundwater level of up to +0.3 feet. Recovery of groundwater levels ranged from a low of 1.3 feet in the Esquivel domestic well to a high of +0.3 ft. in observation well 24E03M and the test production well. The relative locations of the wells used during the test are shown on Figure 2.

Table 2 shows the maximum drawdown during the test, groundwater levels after seven days of recovery, distance from the test production well to the monitored wells and available well construction information. Hydrographs are presented at the end of this report depicting groundwater levels before, during, and after the aquifer performance test.

Well ID	Distance from Test Production Well (ft)	Maximum Drawdown (ft)	Seven-Day Recovery (ft)	Top Perf. (ft)	Bottom Perf. (ft)	Total Depth (ft)
24E03M Observation	351	1.2	+0.3	49	59	81
24E02M Observation	351	4.4	+0.1	128	178	225
Flynn Domestic*	502	4	+0.3	100	120	120
Vershagin Irrigation	2687	2.1	+0.1	149	251	295
Nielsen Domestic*	1988	0.5	0.8	unknown	unknown	no log
Esquivel Domestic*	3563	3.2	1.3	unknown	unknown	no log
Esquivel Irrigation	4318	1.3	0.3	110	200	200
Test Production Well	0	27.7	+0.3	161	25	85
*Well pumped intermittently throughout test.						

Table 2. Distance from Pumping Well, Drawdown, and Well Construction Data.

Water Quality.

Water quality samples were taken in the field using a portable water quality unit. Temperature, pH and electrical conductivity were measured prior to throughout the constant discharge test, as shown on Table 3. Water temperature remained steady, alternating between 64°F and 65°F, indicating a consistent recharge source. The pH varied between 7.1 and 7.2 over the three-day test, which is within the normal range for groundwater. The electrical conductivity dropped from 391 micromhos to 364 micromhos over the course of the sampling, typical for groundwater being extracted over time.

Date/Time	Temperature °F	pH	Electrical Conductivity (micromhos)
2/23/05	66	7.2	391
2/28/05	65	7.1	373
3/1/05	64	7.2	379
3/2/05	65	7.2	376
3/3/05	64	7.1	364

Table 3. Water Quality Parameters Taken During Testing.

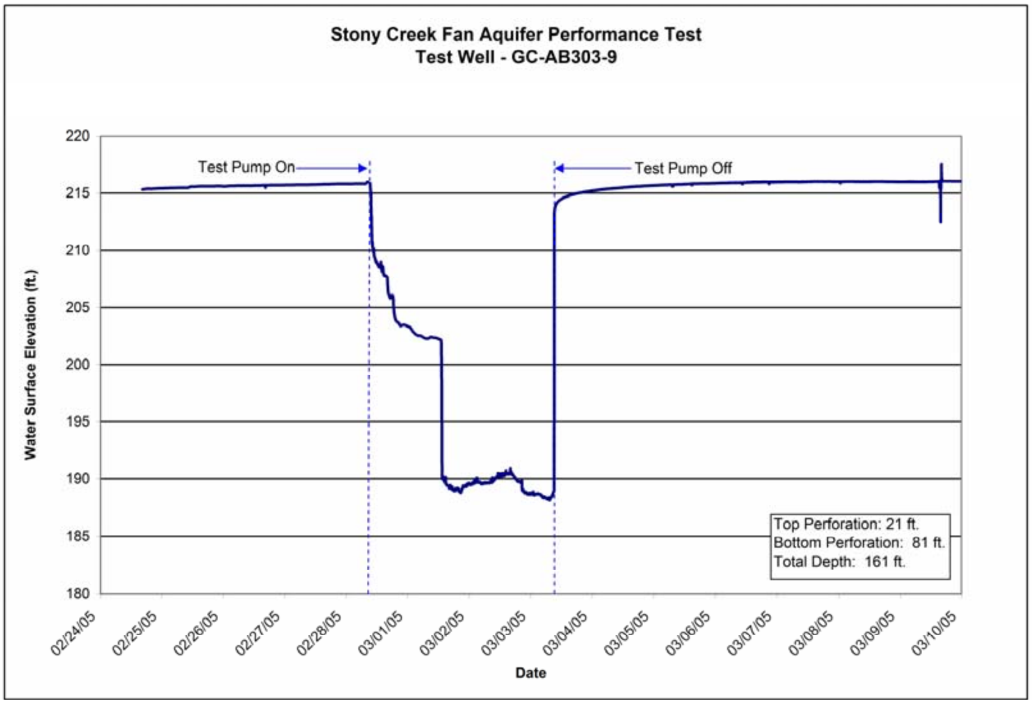
Summary

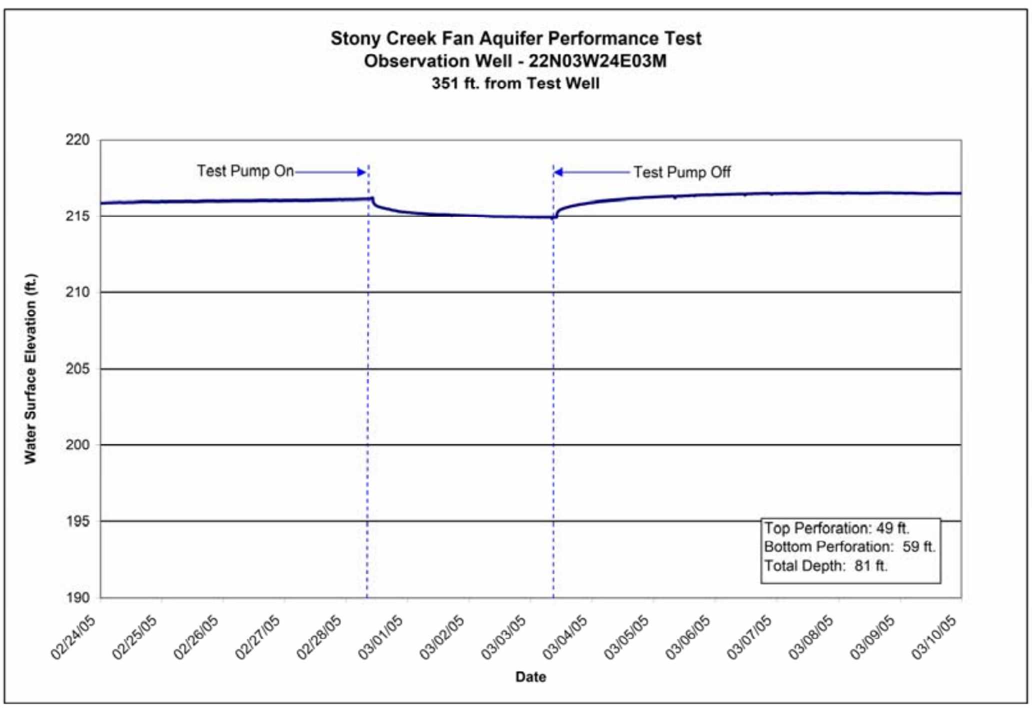
An aquifer performance/constant discharge test was performed on the Stony Creek Fan aquifer system from February 28 to March 3, 2005 to determine the transmissivity, storativity and hydraulic conductivity of the aquifer. The transmissivity of the Stony Creek Fan aquifer was about 390,000 gpd/ft, with a storativity value of around 0.0073. The hydraulic conductivity was about 2,800 gpd/ft^2 in the Stony Creek Fan alluvium.

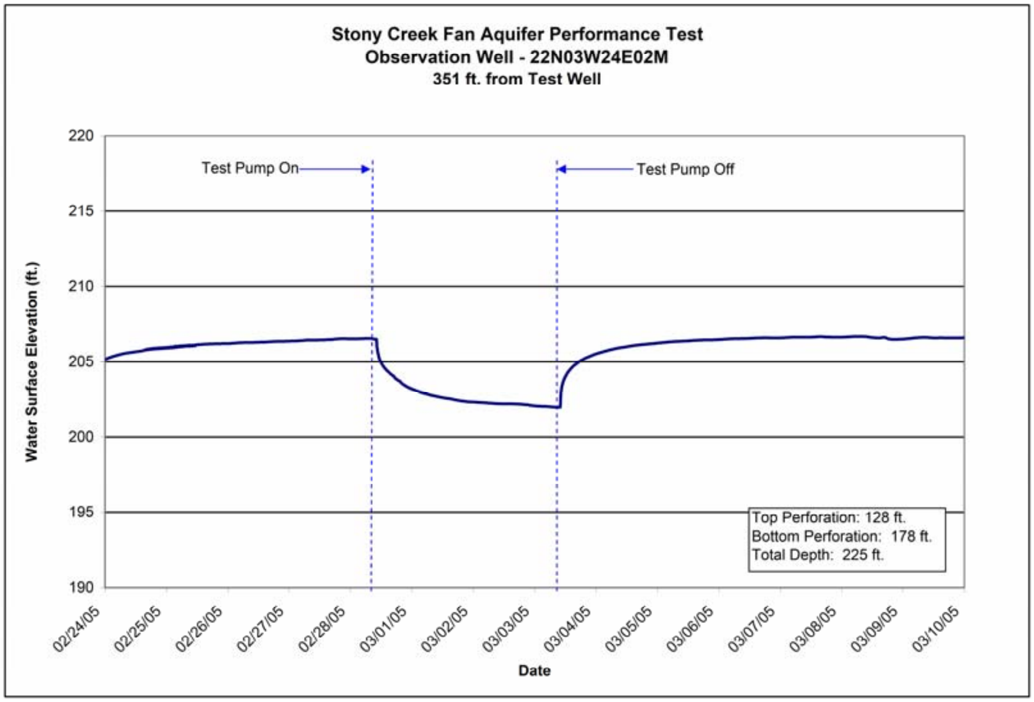
Groundwater levels were influenced by the test production well in wells that were measured within about a mile radius of the test well. Drawdown in the wells ranged from 0.5 ft. to 4.4 ft. Water levels returned to pre-test conditions within about 7 days, with the exception of two wells that pumped intermittently throughout testing and recovery period.

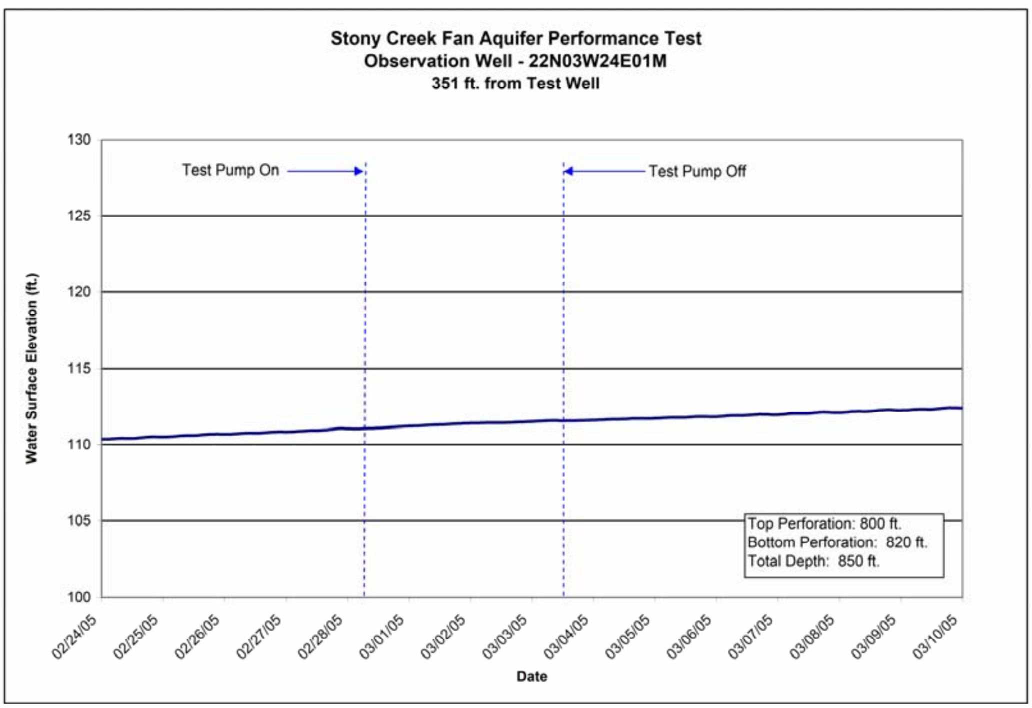
Water quality samples indicate that the water temperature was fairly constant throughout the test, fluctuating between 64 °F and 65 °F. The pH varied slightly, from 71 to 72, and the electrical conductivity dropped from 391 micromhos to 364 micromhos, typical for groundwater being pumped over time.

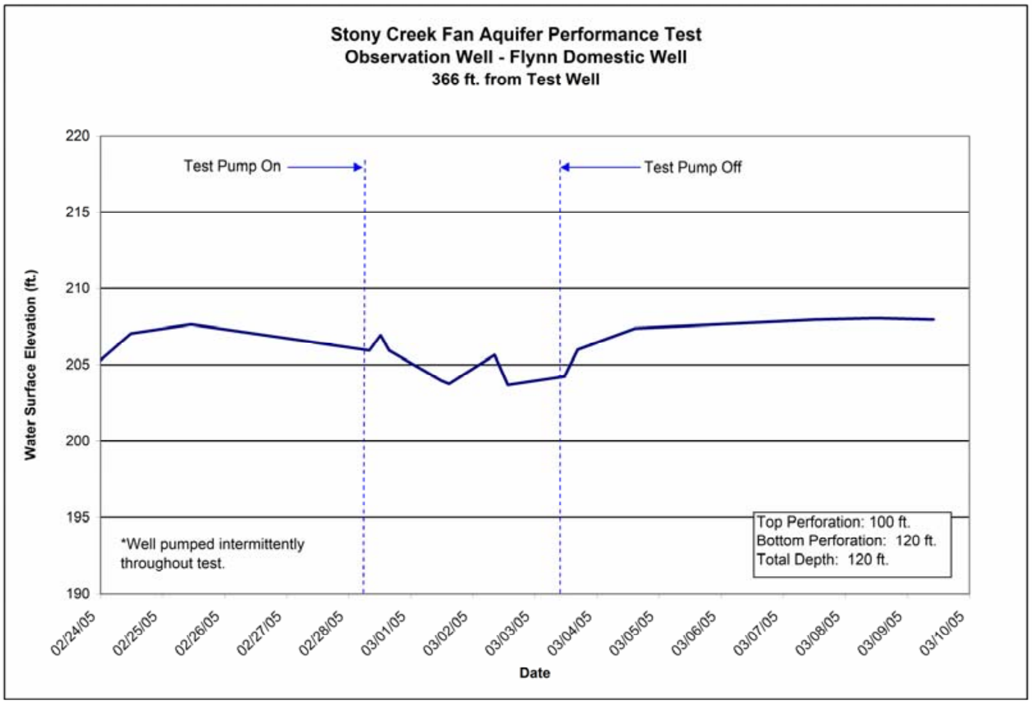
Groundwater Level Hydrographs

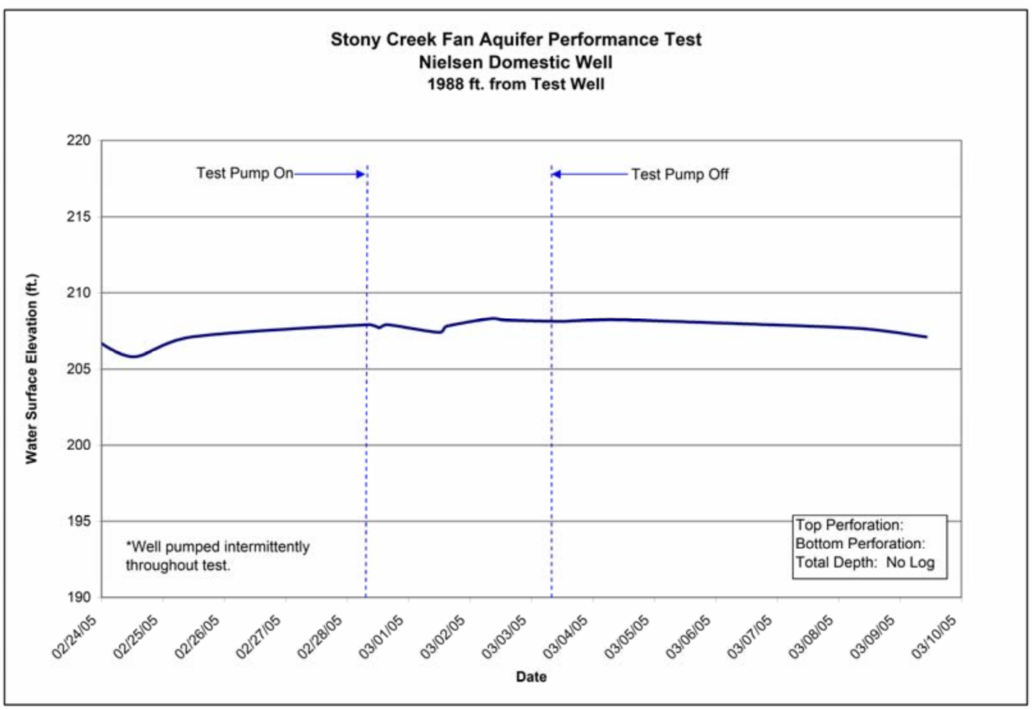


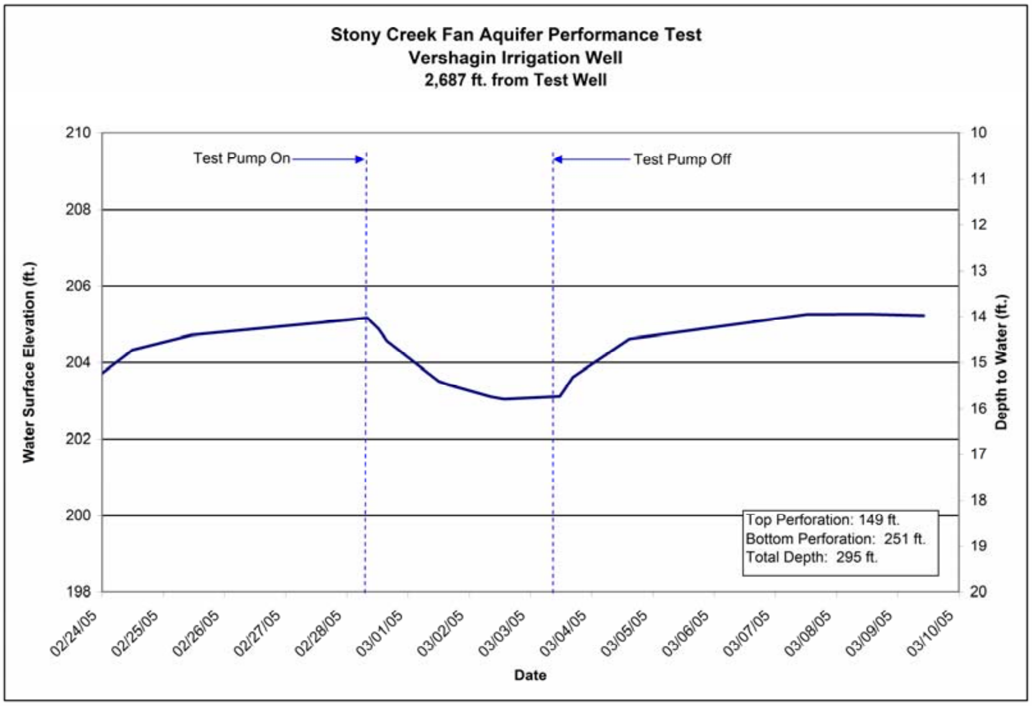


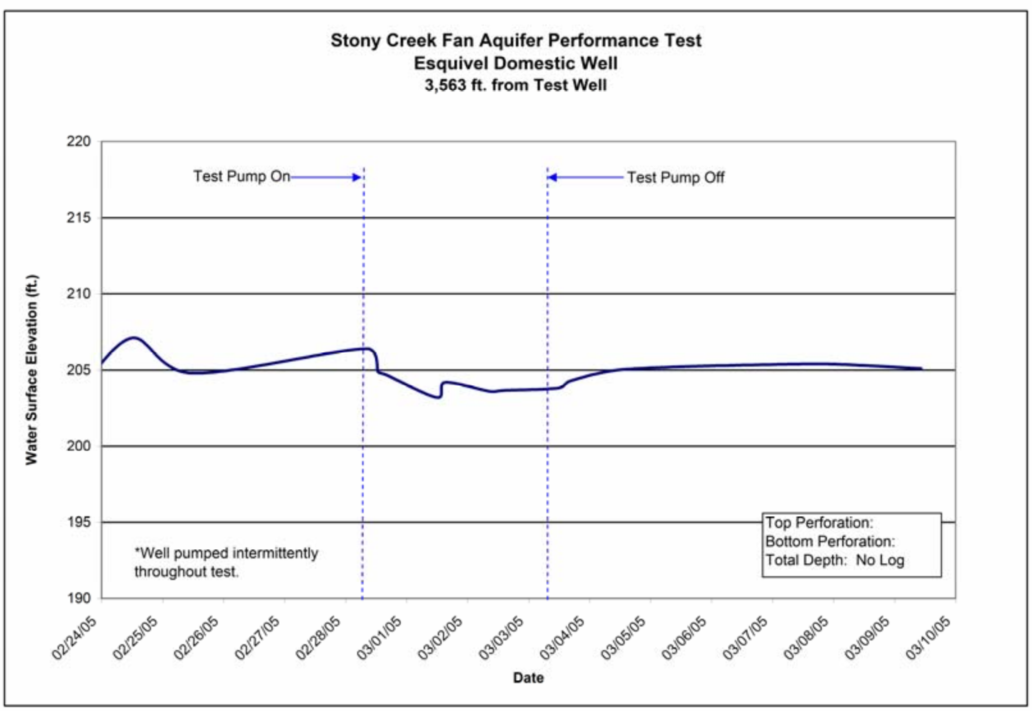

Stony Creek Fan Aquifer Performance Test
Observation Well - 22N03W24E02M
351 ft. from Test Well
Water Surface Elevation (ft.)
Date
Test Pump On
Test Pump Off
Top Perforation: 128 ft.
Bottom Perforation: 178 ft.
Total Depth: 225 ft.
220
215
210
205
200
195
190
02/24/05
02/25/05
02/26/05
02/27/05
02/28/05
03/01/05
03/02/05
03/03/05
03/04/05
03/05/05
03/06/05
03/07/05
03/08/05
03/09/05
03/10/05

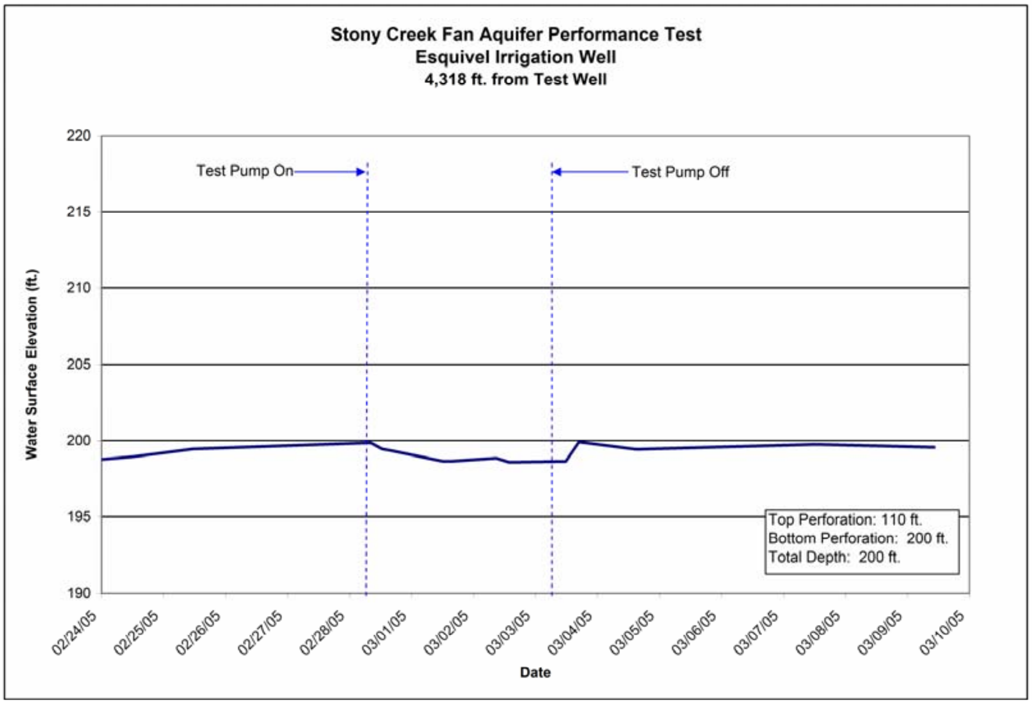

Stony Creek Fan Aquifer Performance Test
Observation Well - 22N03W24E01M
351 ft. from Test Well
Water Surface Elevation (ft.)
Date
Test Pump On
Test Pump Off
Top Perforation: 800 ft.
Bottom Perforation: 820 ft.
Total Depth: 850 ft.
130
125
120
115
110
105
100
02/24/05
02/25/05
02/26/05
02/27/05
02/28/05
03/01/05
03/02/05
03/03/05
03/04/05
03/05/05
03/06/05
03/07/05
03/08/05
03/09/05
03/10/05


Stony Creek Fan Aquifer Performance Test
Observation Well - Flynn Domestic Well
366 ft. from Test Well
Test Pump On
Test Pump Off
*Well pumped intermittently throughout test.
Top Perforation: 100 ft.
Bottom Perforation: 120 ft.
Total Depth: 120 ft.
Water Surface Elevation (ft.)
Date
220
215
210
205
200
195
190
02/24/05
02/25/05
02/26/05
02/27/05
02/28/05
03/01/05
03/02/05
03/03/05
03/04/05
03/05/05
03/06/05
03/07/05
03/08/05
03/09/05
03/10/05


Stony Creek Fan Aquifer Performance Test
Nielsen Domestic Well
1988 ft. from Test Well
Test Pump On
Test Pump Off
*Well pumped intermittently throughout test.
Top Perforation:
Bottom Perforation:
Total Depth: No Log
Water Surface Elevation (ft.)
Date
220
215
210
205
200
195
190
02/24/05
02/25/05
02/26/05
02/27/05
02/28/05
03/01/05
03/02/05
03/03/05
03/04/05
03/05/05
03/06/05
03/07/05
03/08/05
03/09/05
03/10/05


Stony Creek Fan Aquifer Performance Test
Vershagin Irrigation Well
2,687 ft. from Test Well
Water Surface Elevation (ft.)
Depth to Water (ft.)
Test Pump On
Test Pump Off
Top Perforation: 149 ft.
Bottom Perforation: 251 ft.
Total Depth: 295 ft.
Date


Stony Creek Fan Aquifer Performance Test
Esquivel Domestic Well
3,563 ft. from Test Well
Water Surface Elevation (ft.)
Test Pump On
Test Pump Off
*Well pumped intermittently throughout test.
Top Perforation:
Bottom Perforation:
Total Depth: No Log
Date



Stony Creek Fan Aquifer Performance Test
Esquivel Irrigation Well
4,318 ft. from Test Well
Test Pump On
Test Pump Off
Water Surface Elevation (ft.)
220
215
210
205
200
195
190
Top Perforation: 110 ft.
Bottom Perforation: 200 ft.
Total Depth: 200 ft.
02/24/05
02/25/05
02/26/05
02/27/05
02/28/05
03/01/05
03/02/05
03/03/05
03/04/05
03/05/05
03/06/05
03/07/05
03/08/05
03/09/05
03/10/05
Date