Review of Boise Front Geothermal Monitoring Data for Water Year 2005 (October 1, 2004 – September 30, 2005)

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1. EXECUTIVE SUMMARY

Monitoring results for Water Year 2005 (WY05) showed that net withdrawals from the four downtown Boise geothermal district heating systems was 293.4 million gallons (mgal), which is about 9.5% higher than the net withdrawals in Water Year 2004 (WY04). Overall, water levels[1] in the downtown area of the Boise Front geothermal system declined in 2005 from the previous year. Peak water levels decreased just over one foot in the BLM well, which is the primary monitoring well in the downtown area of the Boise Front geothermal system. The greatest water level change occurred in the Boise Warm Springs Water District West well where the minimum water level decreased 46 feet from 2004 to 2005. Maximum monthly water temperatures continued to decline in the water withdrawn from the State of Idaho Capitol Mall production well.

For Stewart Gulch Ground Water District 63S (WD63S), total ground water withdrawal was 196.4 mgal, which was about 9% higher than in WY04. In general, the minimum water levels were higher in early 2005 than they were in early 2004. However, the maximum water levels in mid 2005 did not recover to the levels of 2004, and the overall status of ground water levels in the District by late 2005 was lower than 2004.

2. DOWNTOWN BOISE/HARRIS RANCH

In WY05, gross and net withdrawals from the four downtown Boise district heating systems were 775.6 and 293.4 mgal, respectively (Table 1). Gross withdrawals were about 4% more in WY05 than in the previous water year, and net withdrawals were about 9.5% higher, with the majority of this increase attributed to the City system (Table 1). About 62 percent of the fluids were re-injected, which is a decrease of approximately 2% from the previous year. After dropping sharply in Water Year 2001 (WY01), net withdrawals have risen from 249.3 mgal (WY01) to 293.5 mgal (WY05), which is about an 18% increase over this time period (Figure 1).

Overall, water levels in the Boise Front geothermal system declined in 2005 from the previous year. The peak water level in the BLM well was 1.1 feet lower in 2005 than in 2004 (Figure 2). Minimum water level patterns in the BLM well have been inconsistent over the last three years.

Water levels in the BWSWD East, West, and #3 wells were all lower in 2005 than in 2004 (Figure 3). The minimum water levels in early 2005 were 33 and 46 feet lower than

[1]For flowing wells, pressure readings were converted to the equivalent feet below measuring points.

in 2004 for the East and West Wells, respectively (the minimum values for these two wells generally occur annually in January – March). For the West Well, this declining trend started in 2003 when the minimum water level dropped 19 feet from 2003 to 2004. The East Well, however, had a higher minimum value in 2004 than in 2003. The maximum values for the East and West wells were 2 feet and 3 feet lower, respectively, in 2005 than in 2004. The peak water level in the BWSWD #3 was only 0.07 feet lower in 2005 than in 2004; however, the minimum value, which occurred in March 2005, was 4.6 feet lower than the minimum value in 2004 (Figure 4).

The minimum water level in the Kanta well declined about 4.4 feet from March 2004 to March 2005 (Figure 5). BGL #1's minimum water level dropped about 7.7 feet from March 2004 to March 2005, but the minimum value was still higher than the minimum value in 2003 (Figure 6). Water levels in the Old Penitentiary well have shown an overall decline of about six feet since late 2002; however the decline was less in 2005 than in previous years (Figure 7). After over two years of steady water level increases (with some seasonal cycling), water levels in the Harris Ranch wells declined about 3.9 feet from January 2005 to August 2005 (Figure 8). This decline is the largest in the recent (2002-2005) water level records for the Harris wells.

The maximum monthly water supply temperatures in the Capitol Mall Production well continued to decline in WY05 (Figure 9). Maximum monthly water temperatures during the water year were all below 154 degrees Fahrenheit (F) for the first time on record. Since December, 1998, the maximum monthly water temperature has dropped 1.54 degrees F which is equates to 0.26 degrees F per year. The trend since 1998 is statistically significant at a greater than 95% confidence level.

Table 1. Production from the four district geothermal heating systems in the downtown Boise area for Water Year 2005 (October 1, 2004 through September 30, 2005).

System	Gross Withdrawals (gallons) and percent change from WY04 to WY05	Net Withdrawals[1] (gallons) and percent change from WY04 to WY05
Boise Warm Springs Water District	248,354,024 (+5%)	248,354,024 (+5%)
Capitol Mall	134,634,190 (-5%)	0 (NC[2])
City of Boise	195,088,046 (+4%)	45,081,820 (+48%)
Veterans Administration	197,552,789 (+11%)	0 (NC)
Total	**775,626,049 (+4%)**	**293,435,844 (+9.5%)**

[1]Net Withdrawals equal Gross Withdrawals minus Injection amounts.
[2]NC = No change.

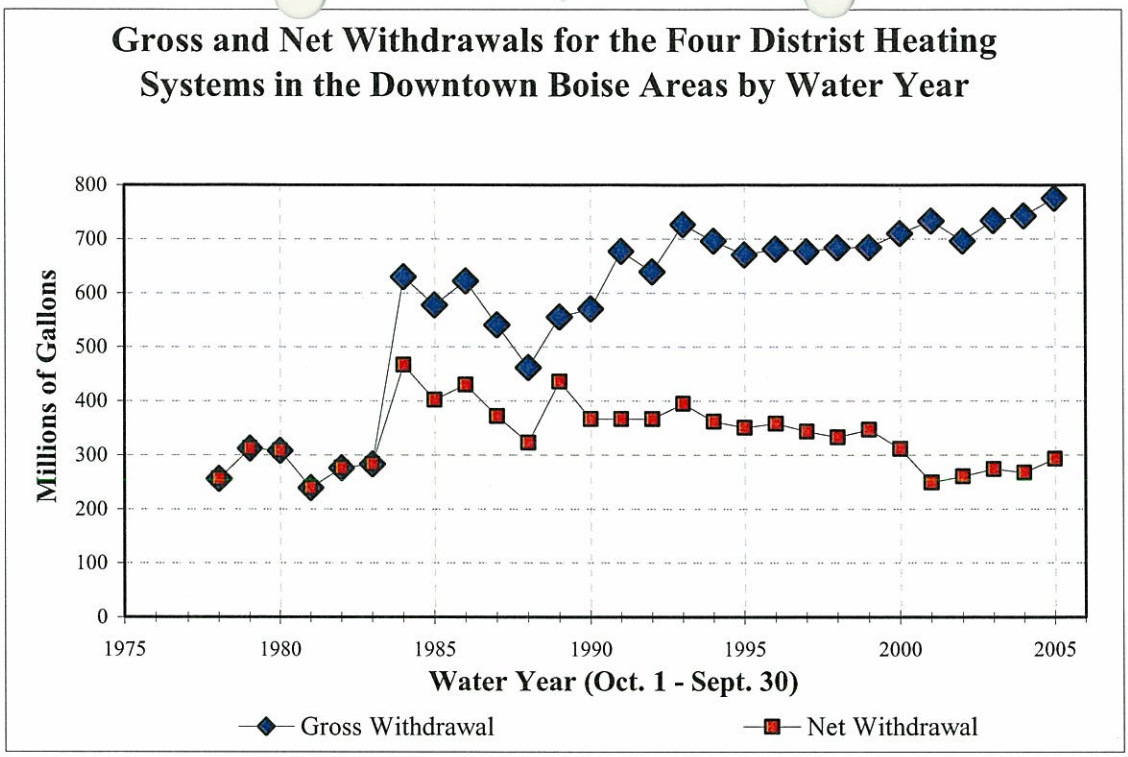

Figure 1. Gross and net withdrawals for the four district heating systems in the downtown Boise area for water years 1978 through 2005.

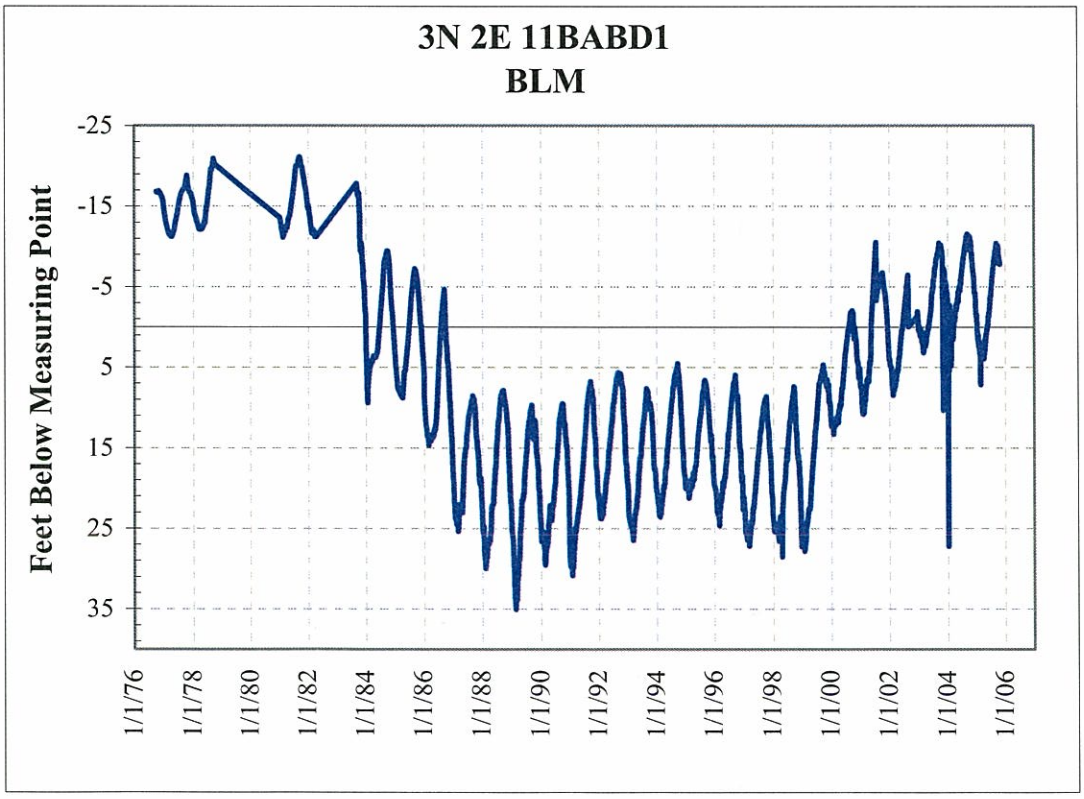

Figure 2. Water level hydrograph for the BLM well.

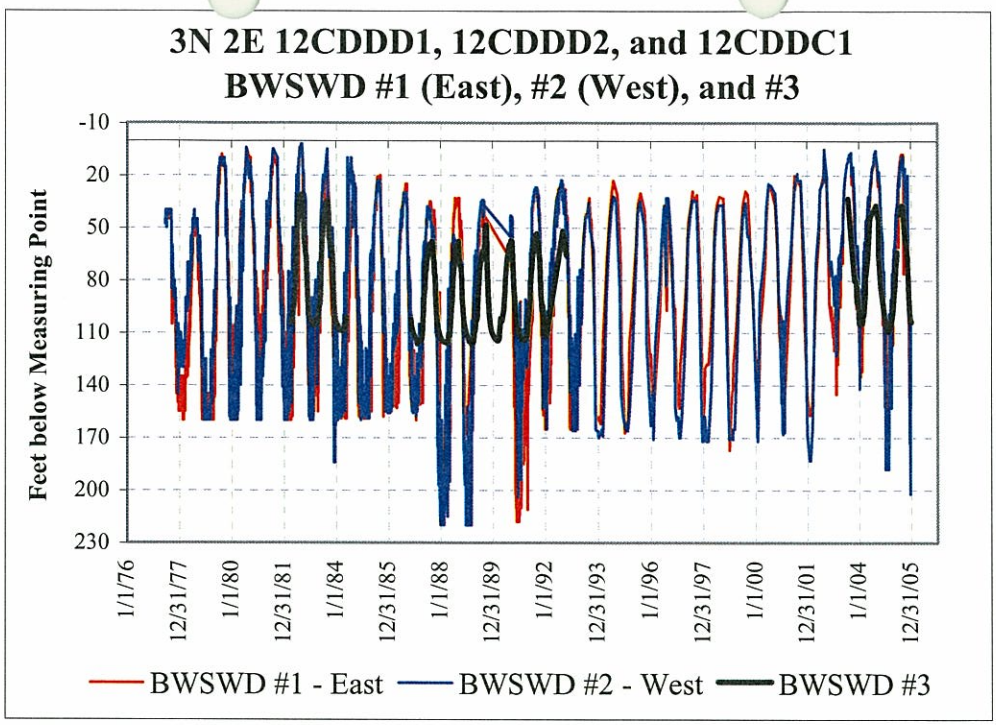

Figure 3. Water level hydrographs for the Boise Warm Springs Water District (BWSWD) wells.

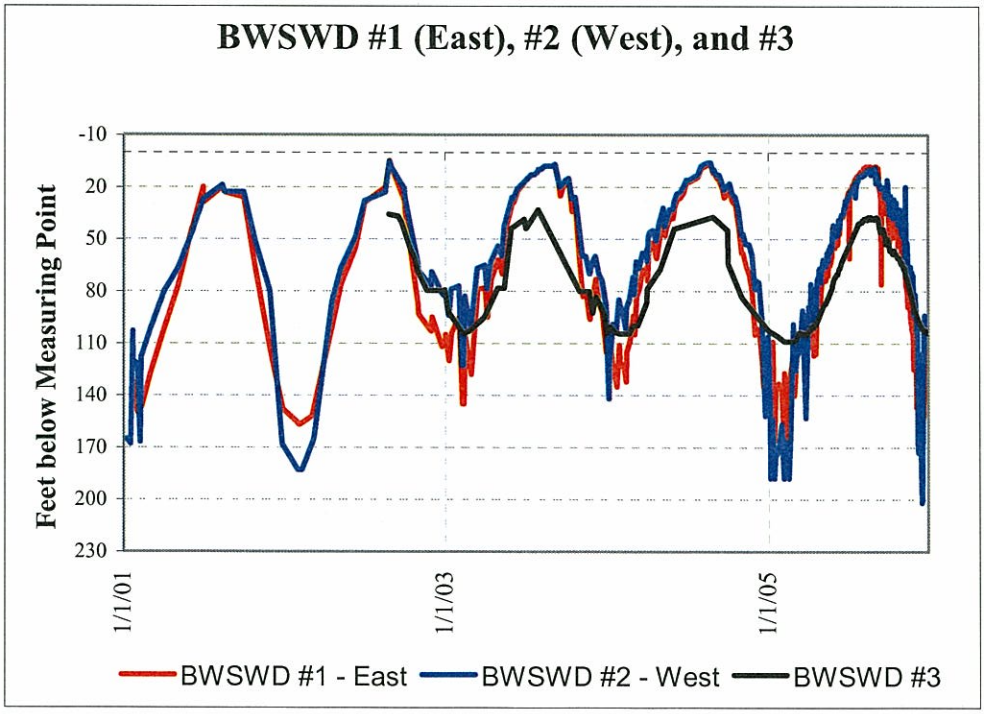

Figure 4. Water level hydrographs for the Boise Warm Springs Water District (BWSWD) wells, January 2001 to December 2005.

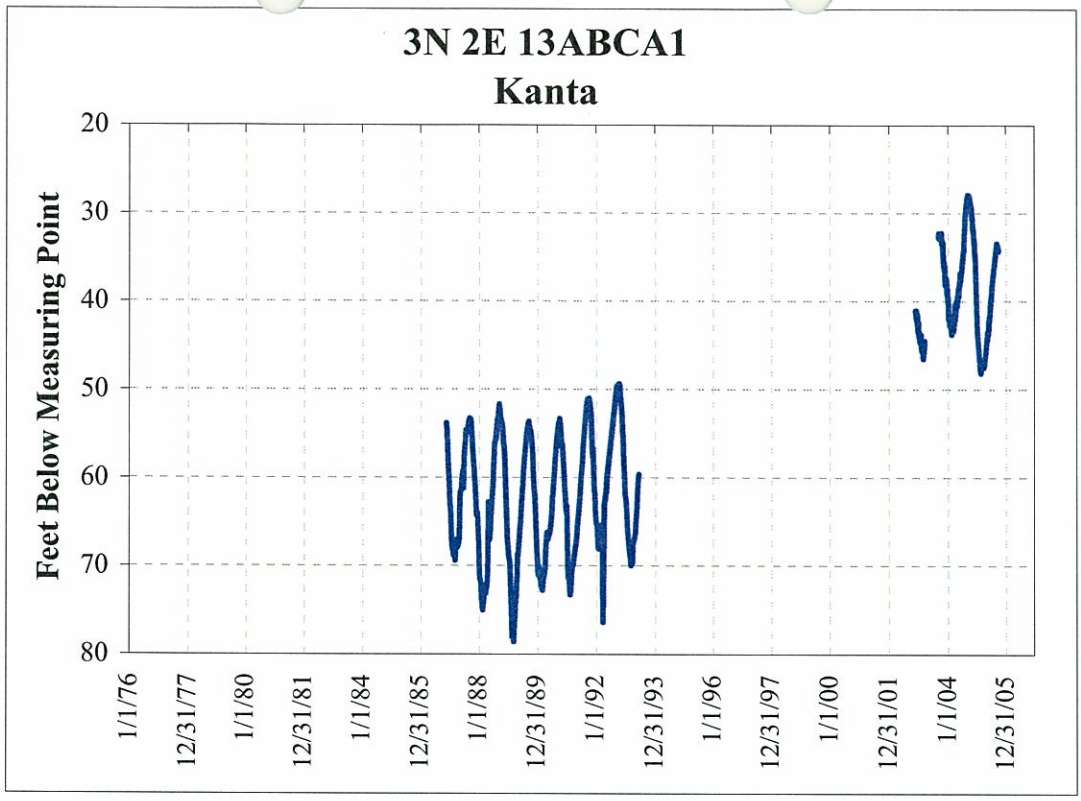

Figure 5. Water level hydrograph for the Kanta well.

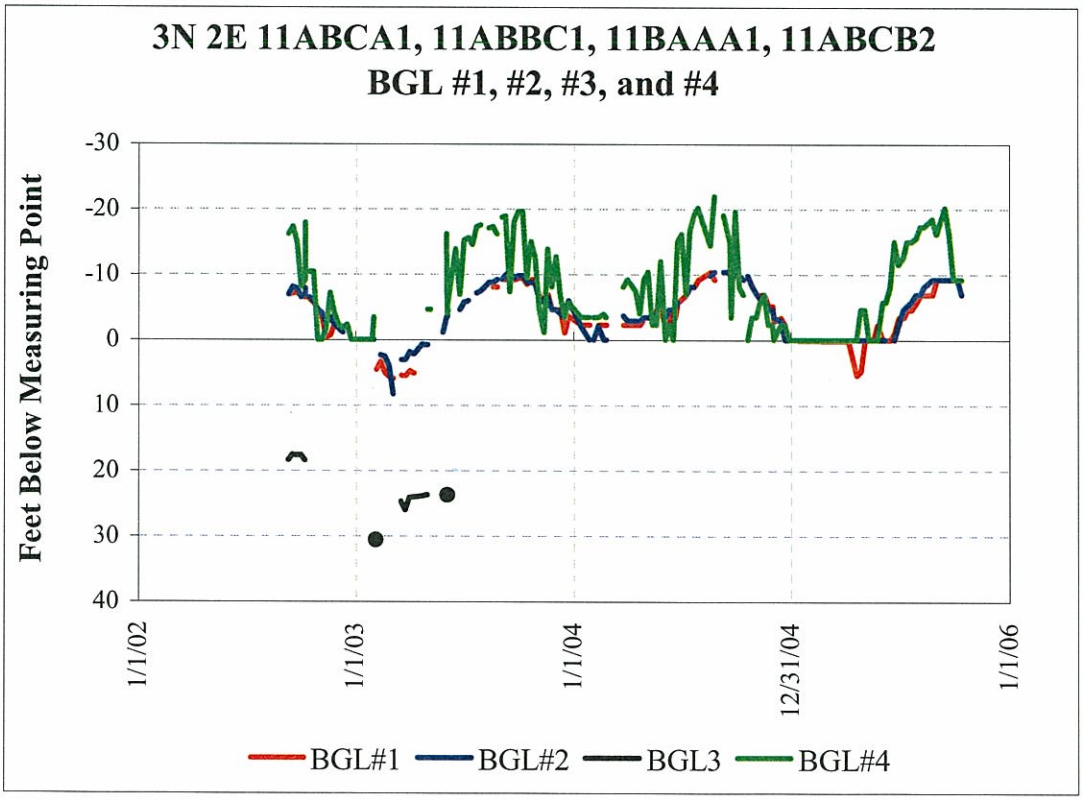

Figure 6. Water level hydrograph for the BGL #1, #2, #3, and #4 wells.

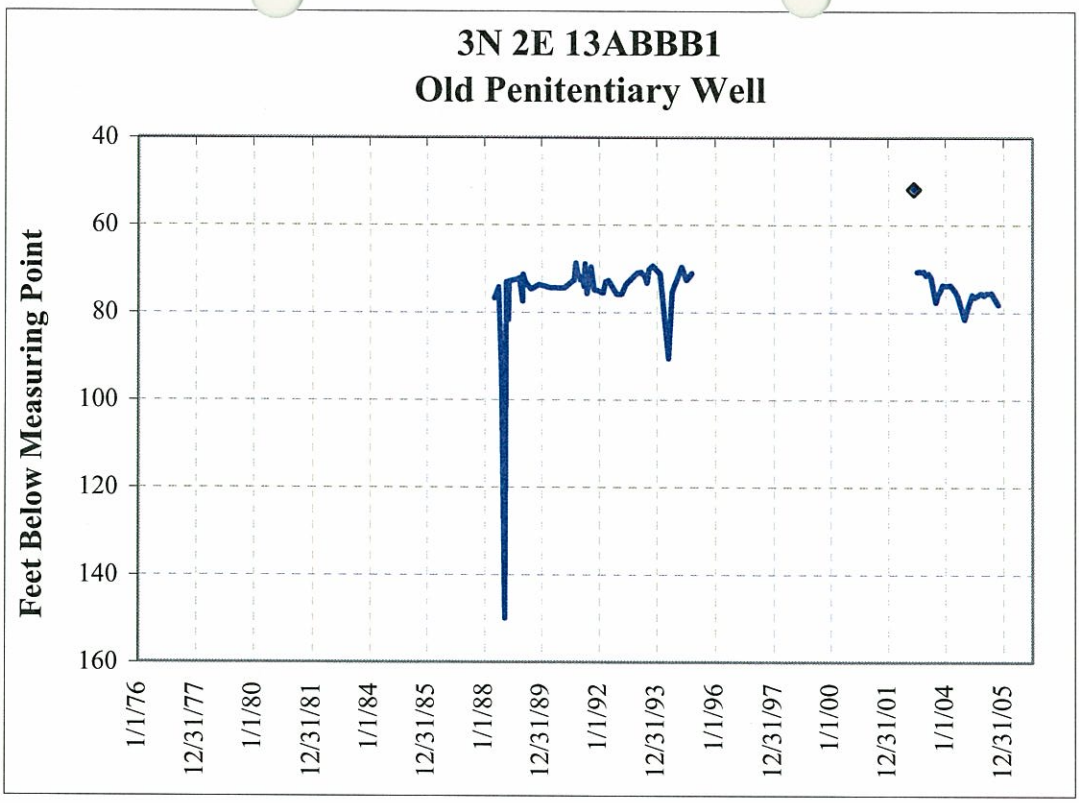

Figure 7. Water level hydrographs for the Old Penitentiary well.

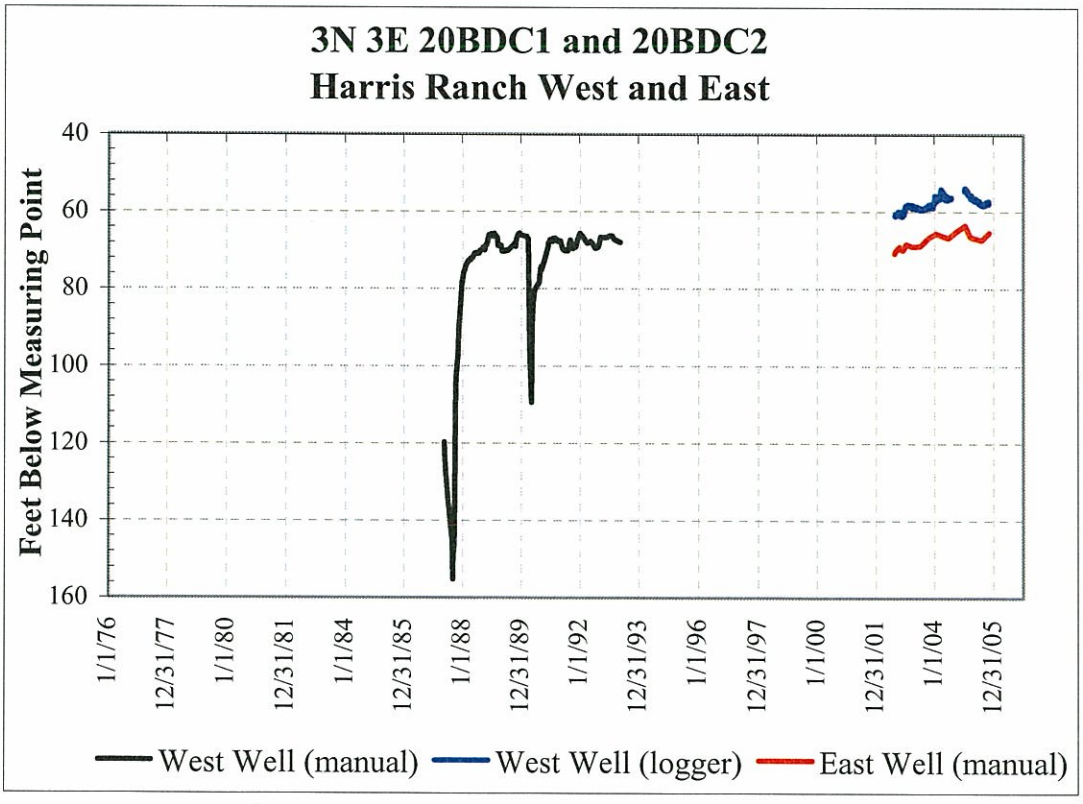

Figure 8. Water level hydrographs for the Harris Ranch wells.

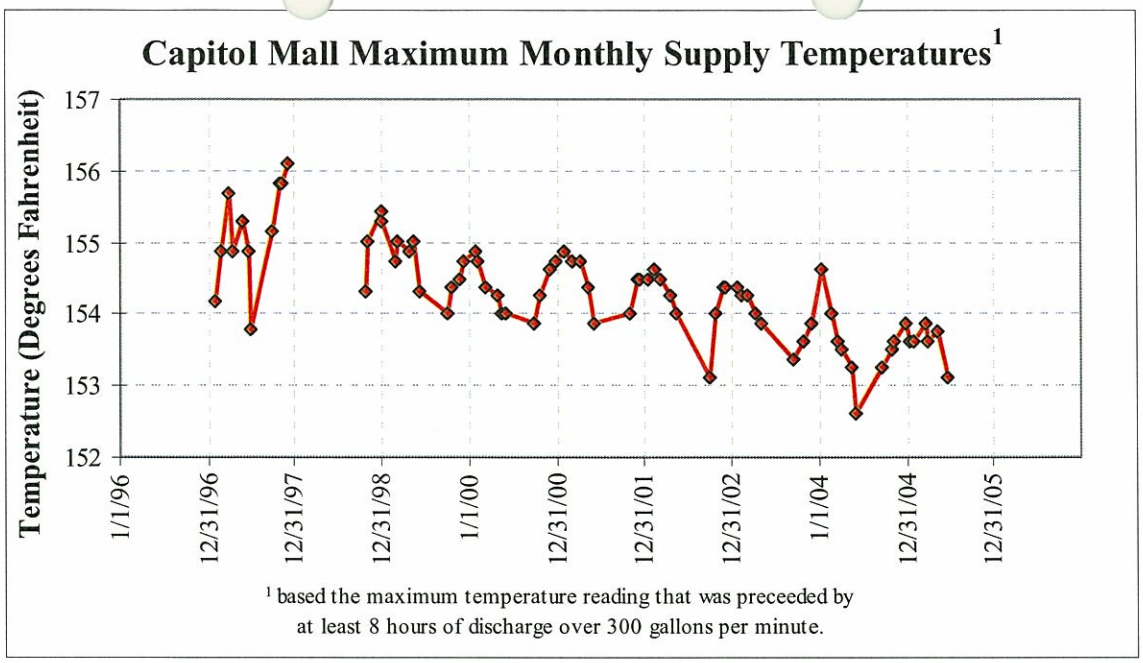

Figure 9. Maximum monthly water supply temperatures for the Capitol Mall geothermal system.

3. STEWART GULCH GROUND WATER DISTRICT 63S

Total withdrawals from WD63S wells for WY05 was 196.40 mgal (Figure 10), which was 16.2 million gallons greater than in WY04 - a change of nine percent[1]. Four of the seven production wells in WD63S (excluding the Whitehead well) had increases in withdrawals (Table 2).

Changes in ground water trends in WD63S were mixed in 2005. Typical of the observed water level patterns in the District, the Edwards Greenhouse well showed an increase in the minimum value from 2004 to 2005, but the latter part of 2005 was characterized by an overall decrease in water levels including a decrease in the maximum value of about 3.7 feet from 2004 to 2005 (Figure 11). The three nearby Flora Company wells exhibited the same pattern as the Edwards well (Figures 12-14). The Whitehead well, which is located between the Edwards and Flora Company wells has only been monitored since late 2004; however, it also showed a decline in water levels in 2005 (Figure 15).

Moving up Stewart Gulch, the two geothermal wells at the Quail Hollow Golf Course also showed similar patterns as the Flora and Edwards well (Figures 16 and 17). At the Terteling Ranch, the Windsock well had the lowest pumping water levels on record in early 2005, and the maximum values dropped 5.8 feet from mid 2004 to mid 2005 (Figure 18). The pumping water levels for the Pool well showed a major increase in the minimum values of about 20 feet, and a slight decrease in the maximum values from 2004 to 2005 (Figure 19). The Motorcycle Club Hot well had minimum values that increased 5.2 feet from early 2004 to early 2005, and maximum values that decreased 5.2 feet from mid 2004 to mid 2005 (Figure 20).

[1]This amount does not include data from the Whitehead well because production records for that well were partial in WY04.

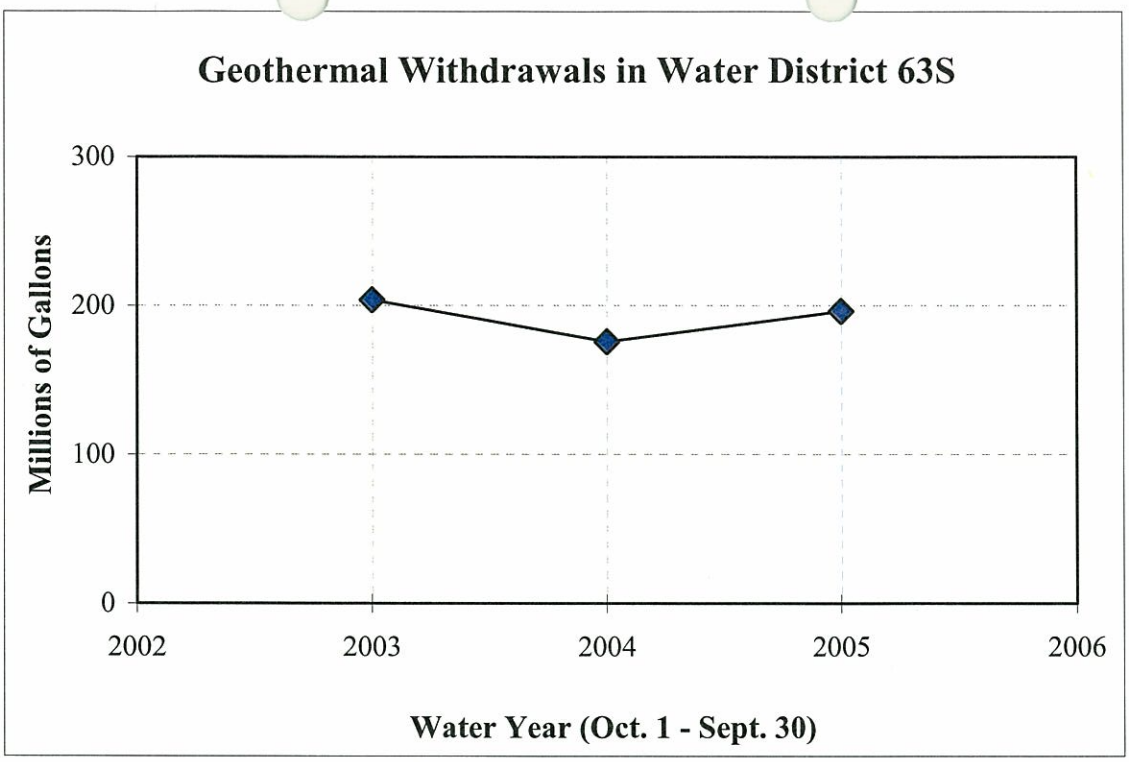

Figure 10. Geothermal withdrawals in Stewart Gulch Water District 63S for Water Years 2003-2005.

Table 2. Withdrawals from Stewart Gulch Water District 63S geothermal wells for Water Year 2005 (October 1, 2004 through September 30, 2005).

Well	Withdrawals in WY05 (gallons)	Change from WY04 (gallons)
Flora Company Tiegs (Triangle)	0	0
Flora Company Silkey (Shed)	33,770,048	-1,497,266
Flora Company House (Office)	5,728,467	-148,953
Edwards Greenhouse	35,677,800	-12,756,000
Terteling Ranch Windsock	85,363,052	+22,296,941
Terteling Ranch Pool	17,256,220	+1,866,809
Quail Hollow Golf Course Upper	13,286,400	+5,759,600
Quail Hollow Golf Course Lower	978,700	+722,000
Whitehead	4,339,274	NA[1]
Total	**196,399,961**	**+16,194,801[2]**

[1]Only partial production data were available in WY04.
[2]Does not include data for Whitehead well.

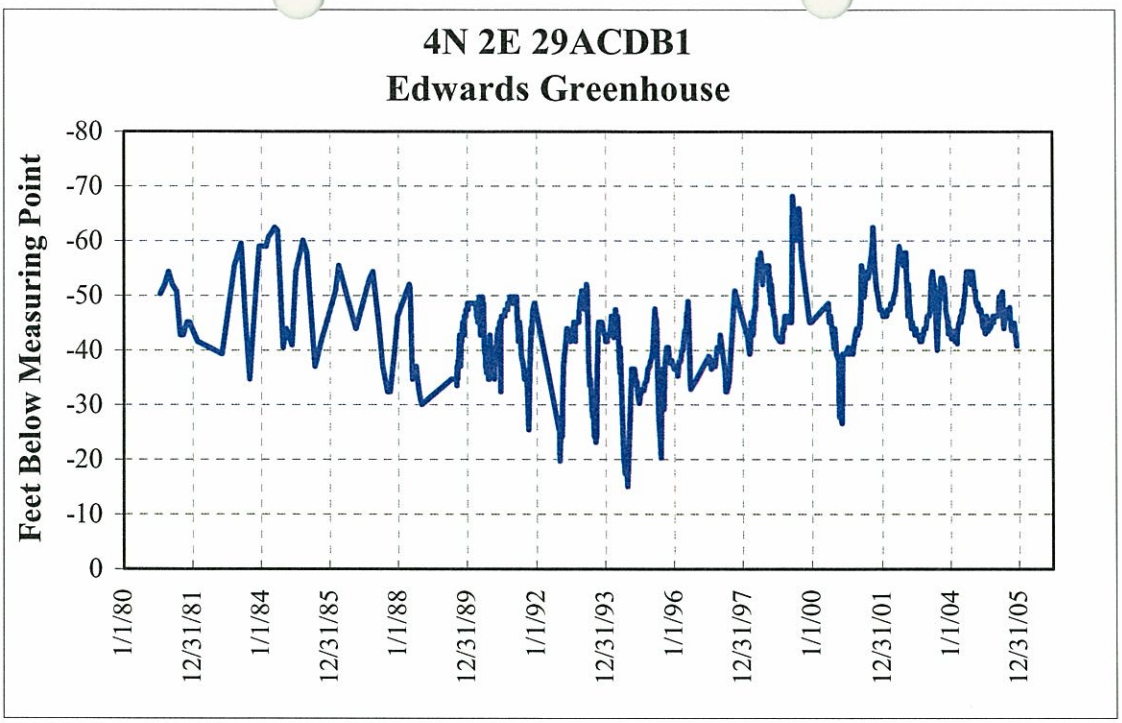

Figure 11. Water level hydrograph for the Edwards Greenhouse well.

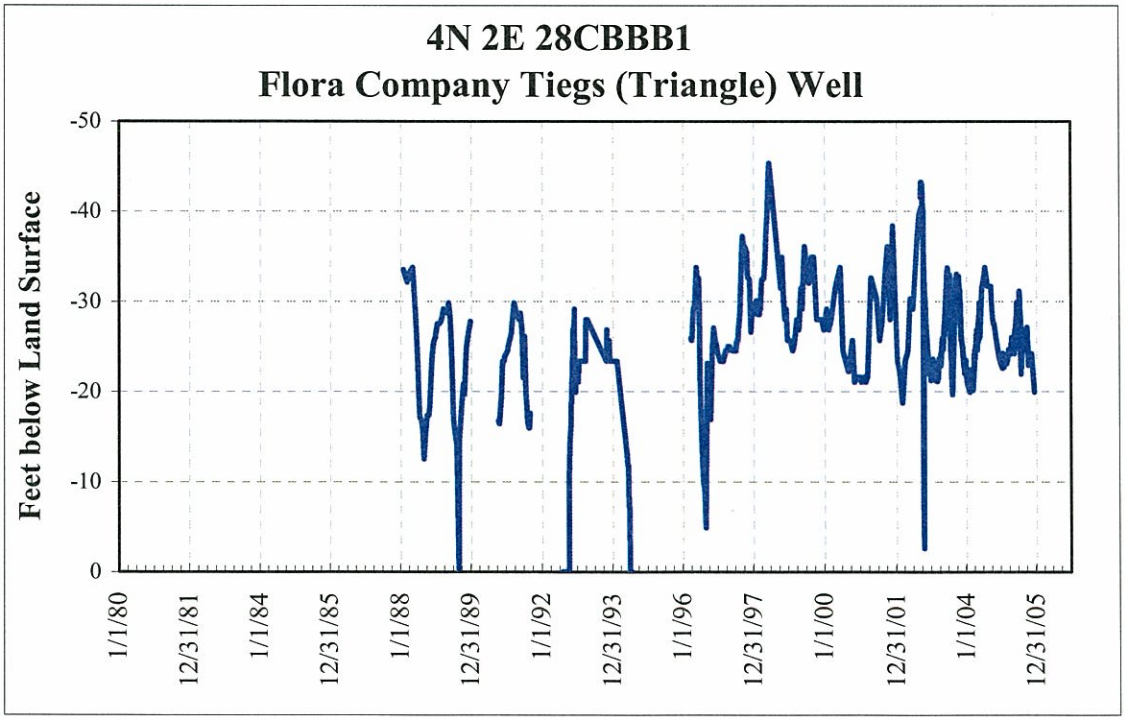

Figure 12. Water level hydrograph for the Flora Company Tiegs (Triangle) well.

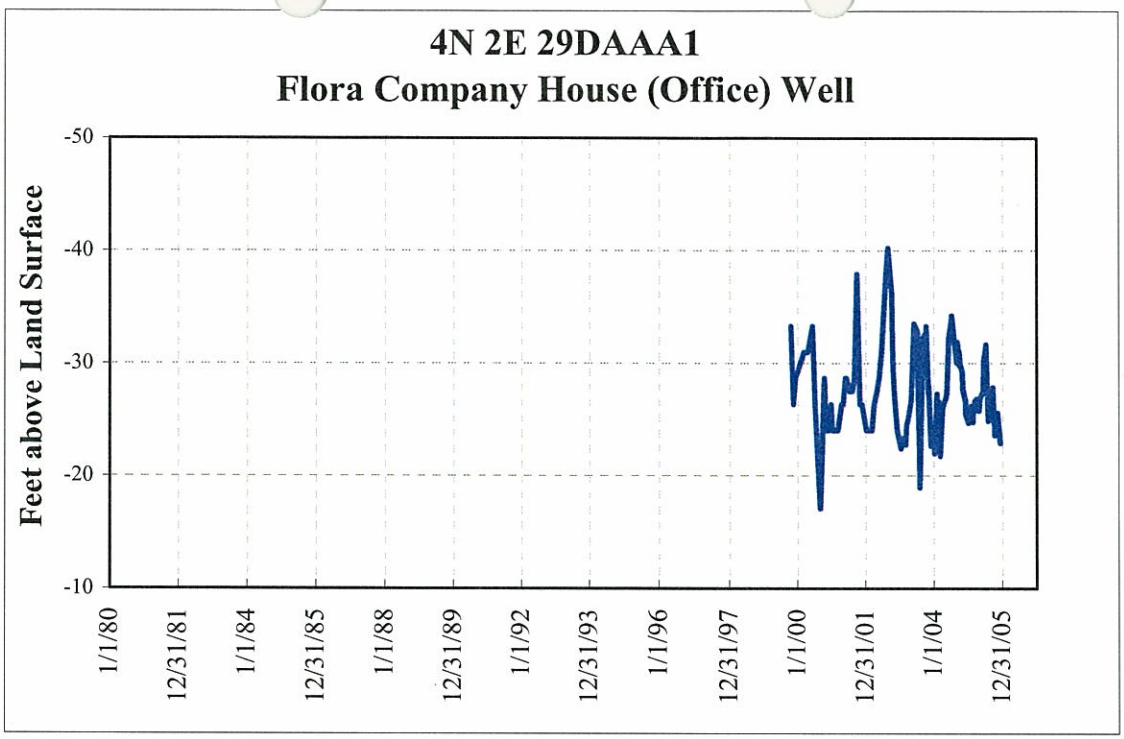

Figure 13. Water level hydrograph for the Flora Company House (Office) well.

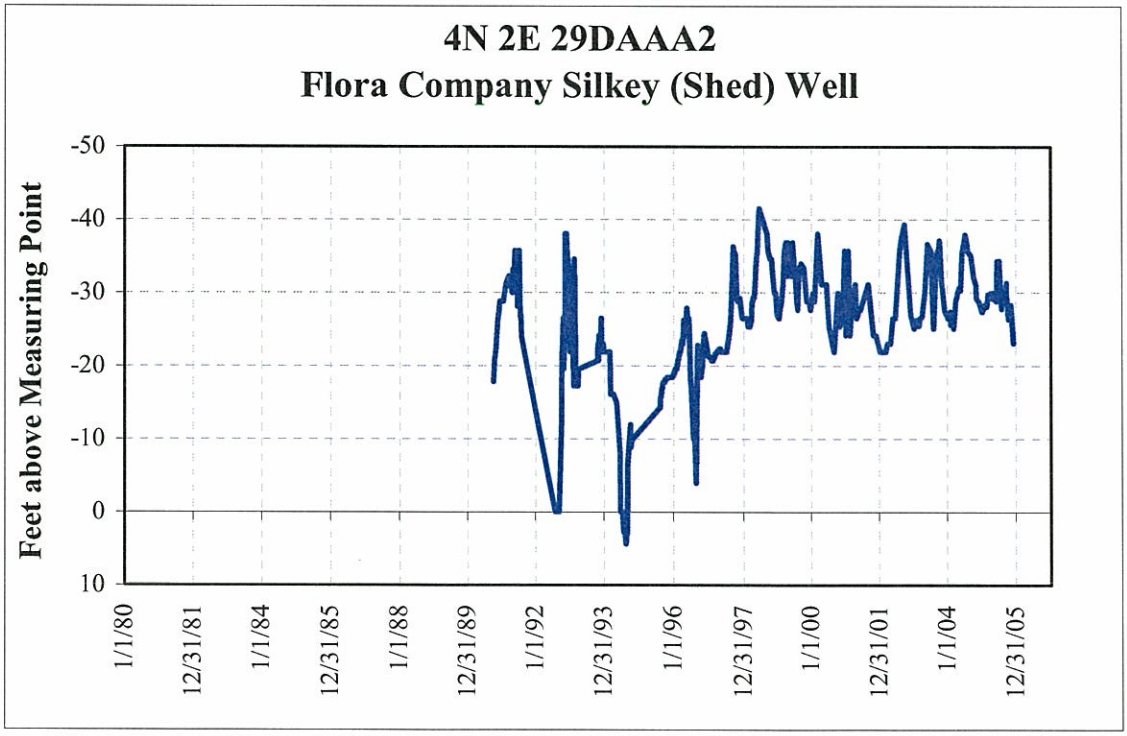

Figure 14. Water level hydrograph for the Flora Company Silkey (Shed) well.

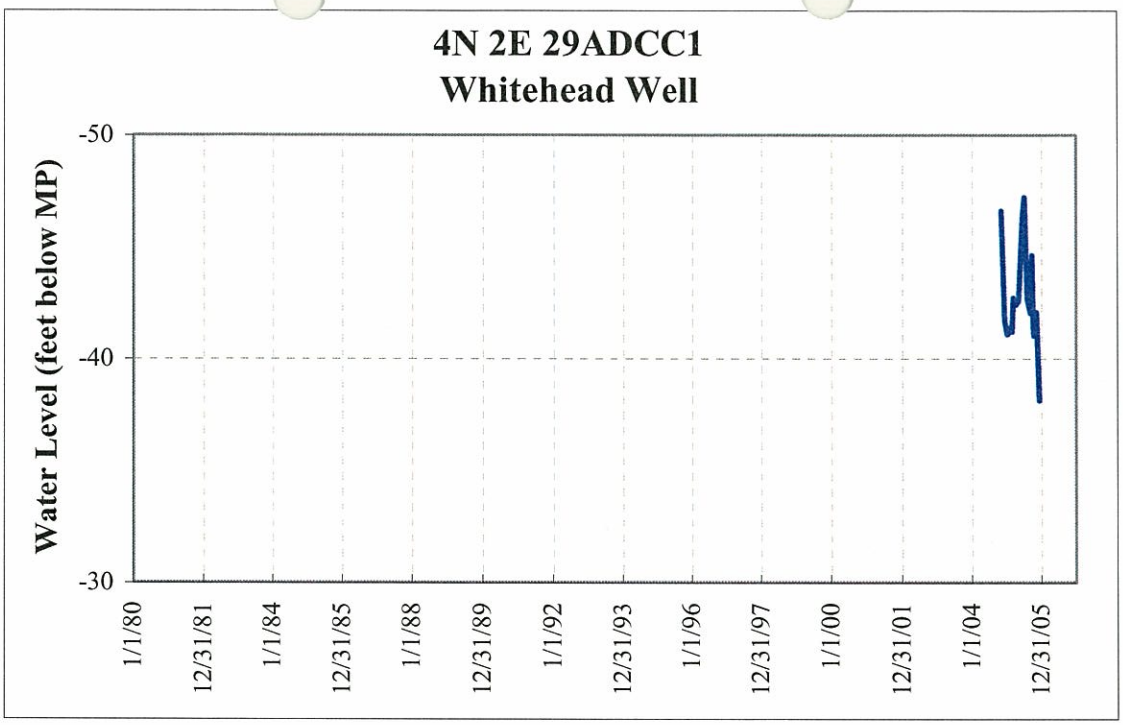

Figure 15. Water level hydrograph for the Whitehead well.

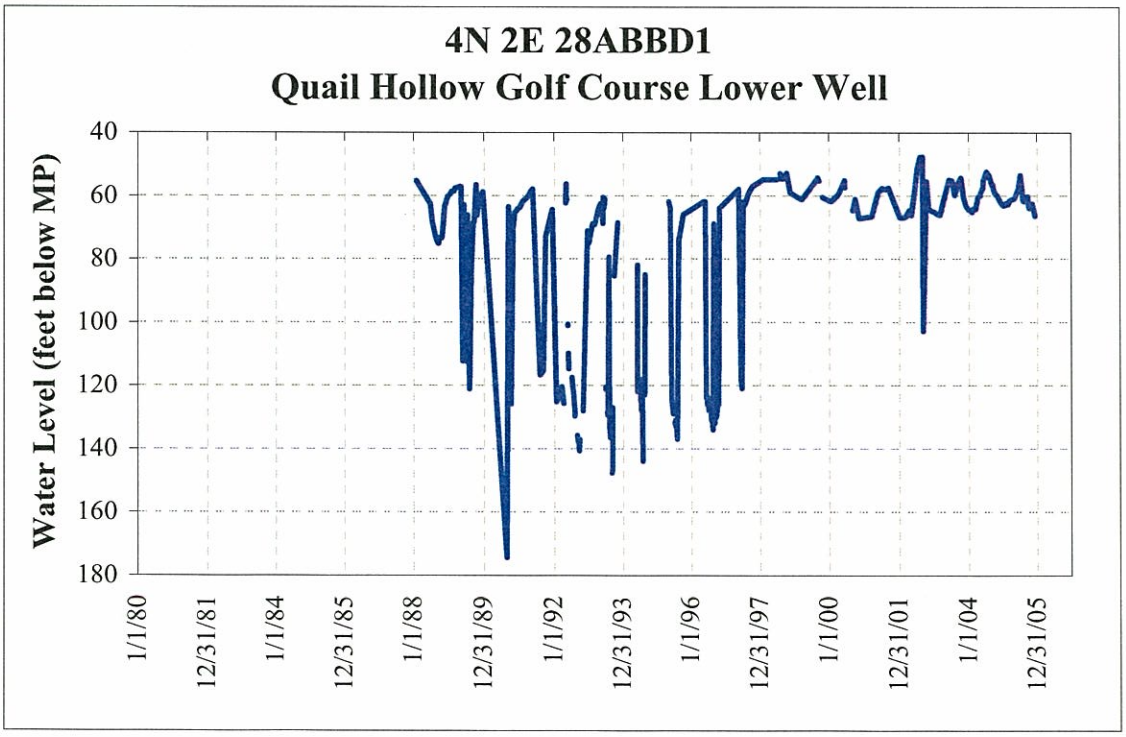

Figure 16. Water level hydrograph for the Quail Hollow Lower well.

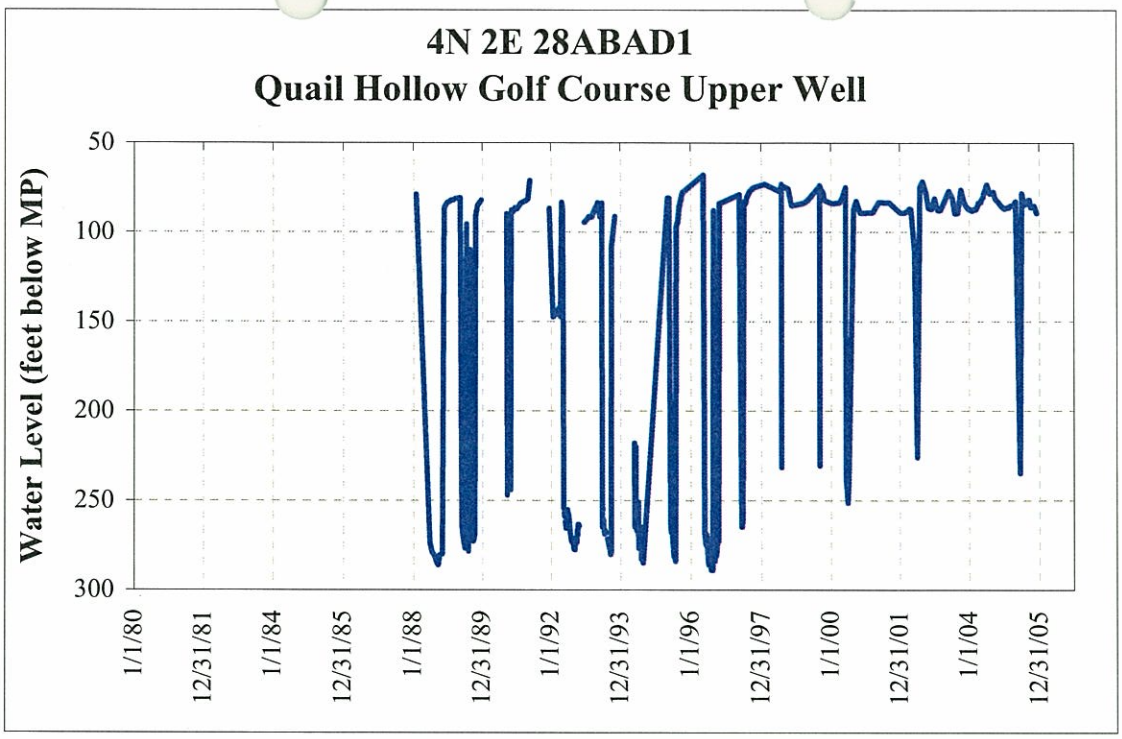

Figure 17. Water level hydrograph for the Quail Hollow Upper well.

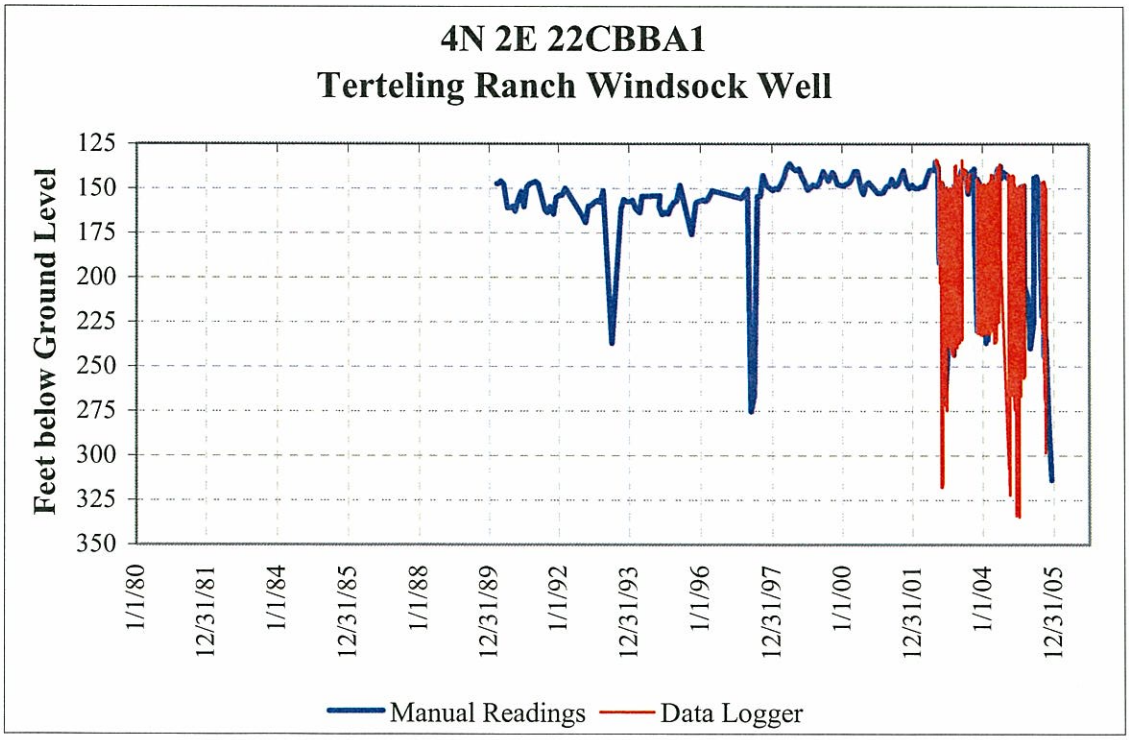

Figure 18. Water level hydrograph for the Terteling Ranch Windsock well.

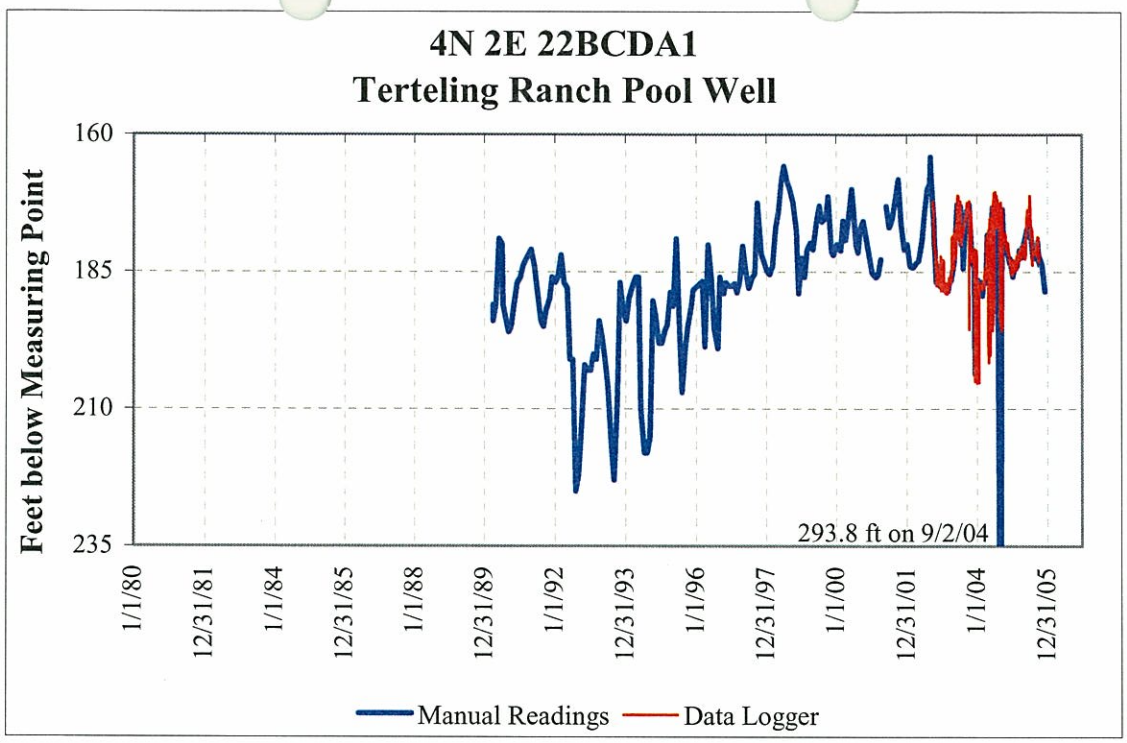

Figure 19. Water level hydrograph for the Terteling Ranch Pool well.

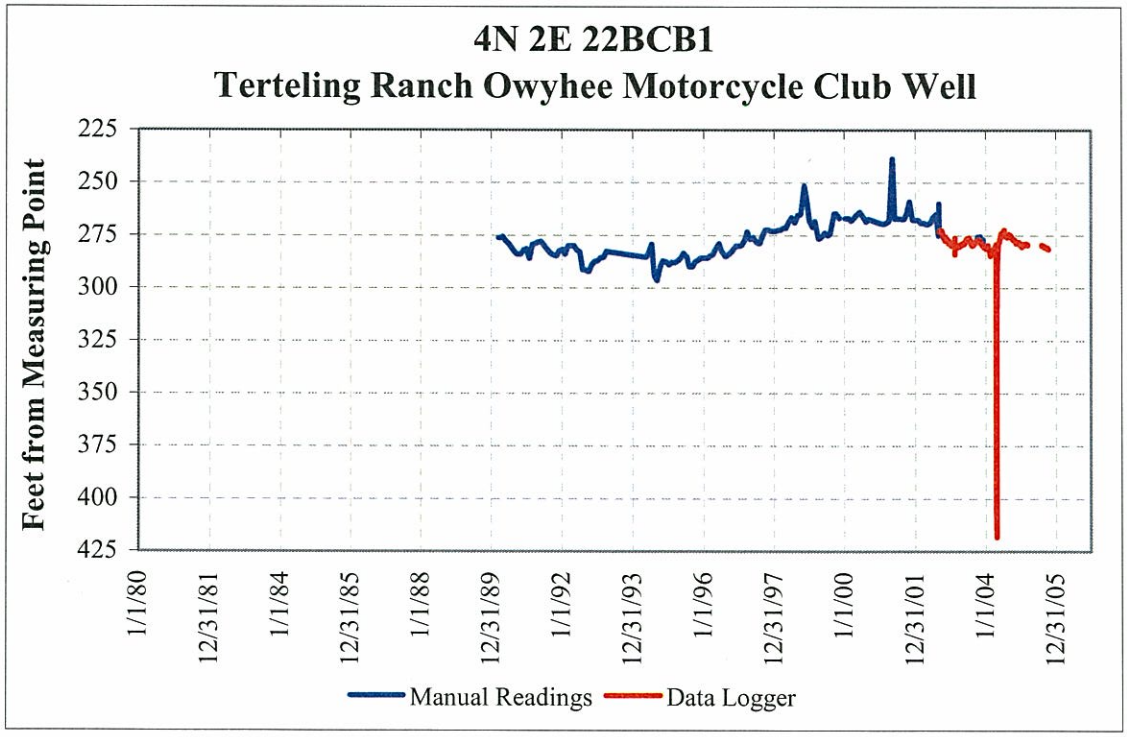

Figure 20. Water level hydrograph for the Terteling Ranch Motorcycle Club Hot well.