

Review of Boise Front Geothermal Monitoring Data for Water Year 2004 (October 1, 2003 – September 30, 2004)

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December 8, 2004**

1. EXECUTIVE SUMMARY

Monitoring results for Water Year 2004 (WY04) showed that net withdrawals from the four downtown Boise geothermal district heating systems decreased about 2% from the previous water year despite an increase in gross withdrawals of about 1.2%. Water levels increased over four feet in the Kanta well, and slightly in the BLM and Boise Warm Spring Water District (BWSWD) East and West wells, but decreased slightly in the BWSWD #3, and Old Penitentiary wells. Water levels have climbed in the Harris Ranch wells since 2003. Maximum monthly water temperatures continued to decline in the water withdrawn from the Capitol Mall production well.

Total ground water withdrawal was 28% lower in Ground Water District 63S (WD63S) in WY04 than in Water Year 2003 (WY03). Water levels were higher in WD63S in 2004 than in the previous year. Recent wellhead modifications on the Stralow well will provide additional monitoring data for WD63S. A new casing liner was installed in the Terteling Ranch Windsock well in order to remediate the casing corrosion problem that was discovered in 2004.

2. DOWNTOWN BOISE/HARRIS RANCH

In WY04, gross and net withdrawals from the four downtown Boise district heating systems were 743.3 and 267.8 million gallons, respectively (Table 1). Gross withdrawals were about 1.2% more in WY04 than in the previous water year. About 64 percent of the fluids were re-injected, which is a slight increase from the previous year. Overall, net withdrawals decreased about 2%. Since Water Year 1999, when the City of Boise's re-injection well went online, total gross withdrawals for the four systems have increased 59 million gallons, while total net withdrawals have decreased 80 million gallons (Figure 1).

The peak water level in the BLM well was 1.11 feet higher in 2004 than in 2003 (Figure 2). Some large daily swings in water levels and unusually low values observed in the BLM well over the last year are currently without explanation. Peak water levels in the BWSWD East and West wells were also about one foot higher in 2004 than in 2003; however, water levels declined slightly in the BWSWD #3 well which is used for monitoring only (Figure 3). The low value in the East well was up 13 feet from 2003, but the low value in the West well was down one foot. The peak water level in the Kanta well was about 4.2 feet higher in 2004 than in 2003 (Figure 4). BGL #1's peak water levels have climbed over 4.5 feet since 2002. However, the maximum peak for 2004 was not available from the data logger because the City of Boise was not expecting as much recovery as has been seen in this well, and the cable holding the pressure transducer is too long. Manual water level recordings in the City of Boise's BGL #1, #2, and #4 wells

showed increases of about 2.5 to 4 feet over the last two years (Figure 5). BGL #3 is unmeasurable at this time. The Old Penitentiary well dropped a few feet in 2004 (Figure 6). Water levels in the Harris Ranch wells have climbed about five feet in the East well and about six feet in the West well since 2003 (Figure 7). Equipment problems with the data logger in the Harris West well became evident to ERO Resources in the third quarter of WY04. ERO will be submitting any useable data from this time period to IDWR after the data logger manufacturer has examined the device.

The maximum monthly water temperatures in the Capitol Mall Production well continued to decline in WY04 (Figure 8). Eight of the nine months that met the qualification for selecting a maximum monthly supply temperature (i.e., the highest water temperature in a given month that was preceded by at least eight hours of production greater than 300 gallons per minute) had lower values in WY04 than in WY03. Bill Hudson (Idaho Department of Administration) ruled out the likelihood of an equipment problem by switching the supply and return thermometers, and finding that they read essentially the same values. Although not large in magnitude, the declining water temperature trend from late 1998 until September 2004 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 2004 (October 1, 2003 through September 30, 2004).

System	Gross Withdrawals (gallons)	Net Withdrawals ¹ (gallons)
Boise Warm Springs Water District	237,256,536	237,256,536
Capitol Mall (State of Idaho)	141,051,750	0
City of Boise	187,000,690	30,509,349
Veterans Administration	177,984,233	0
Total	743,293,209	267,765,885

¹Net Withdrawals equal Gross Withdrawals minus Injection amounts.

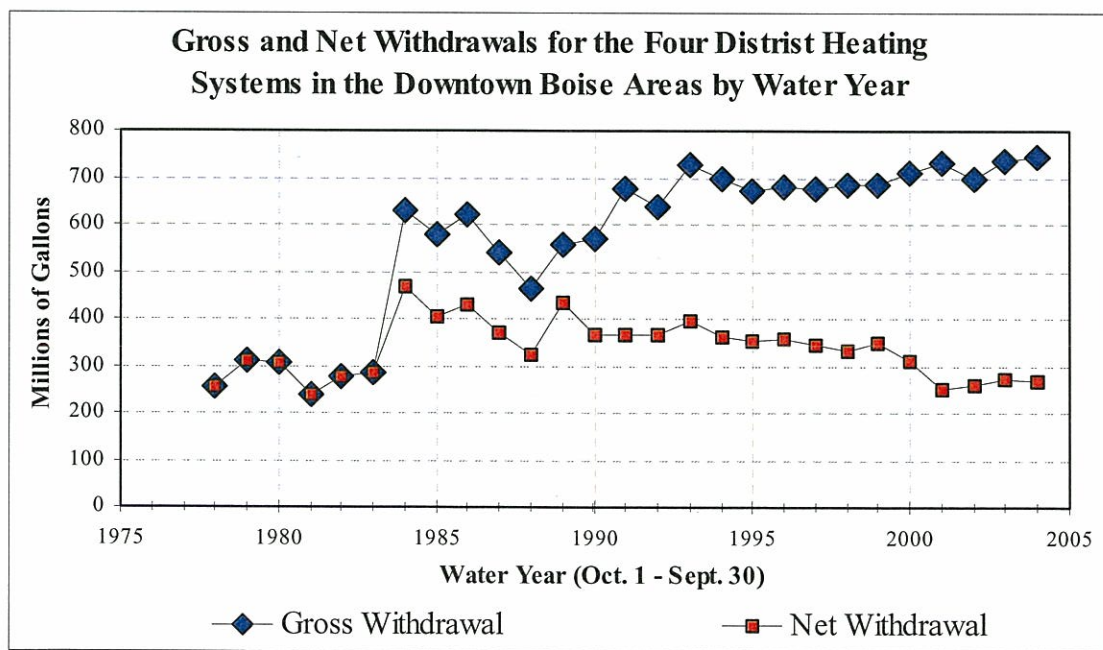


Figure 1. Gross and net withdrawals for the four district heating systems in the downtown Boise area for water years 1978 through 2004.

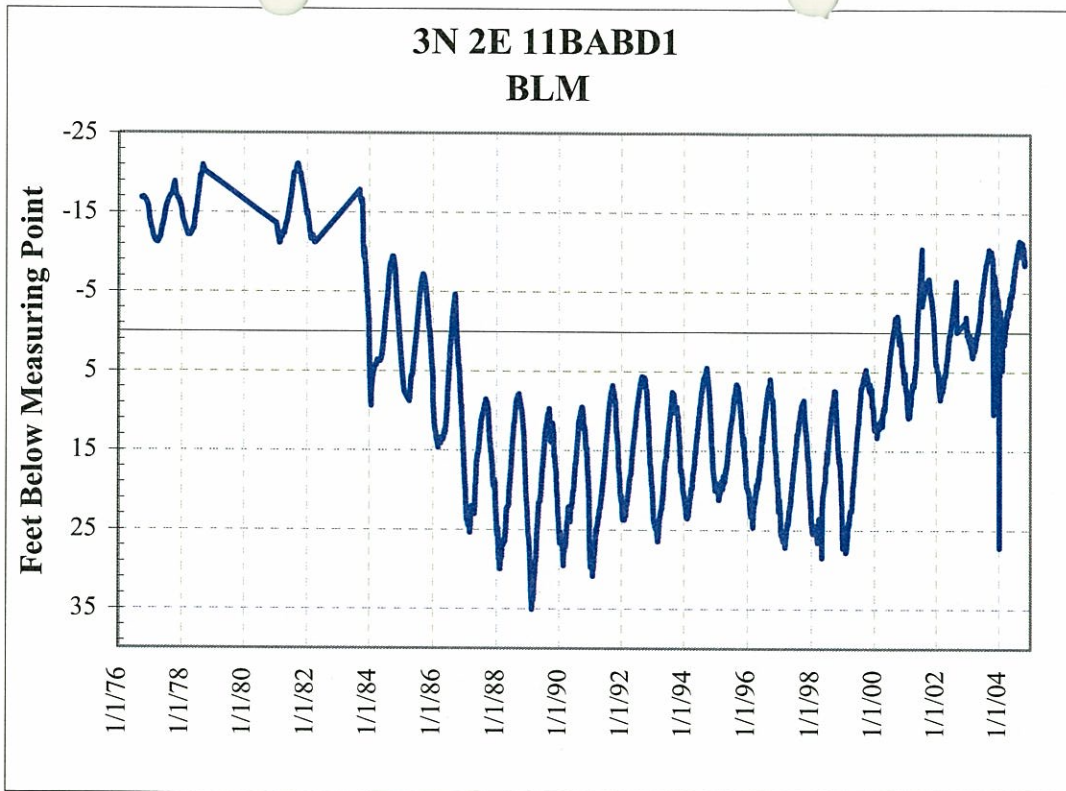


Figure 2. Water level hydrograph for the BLM well.

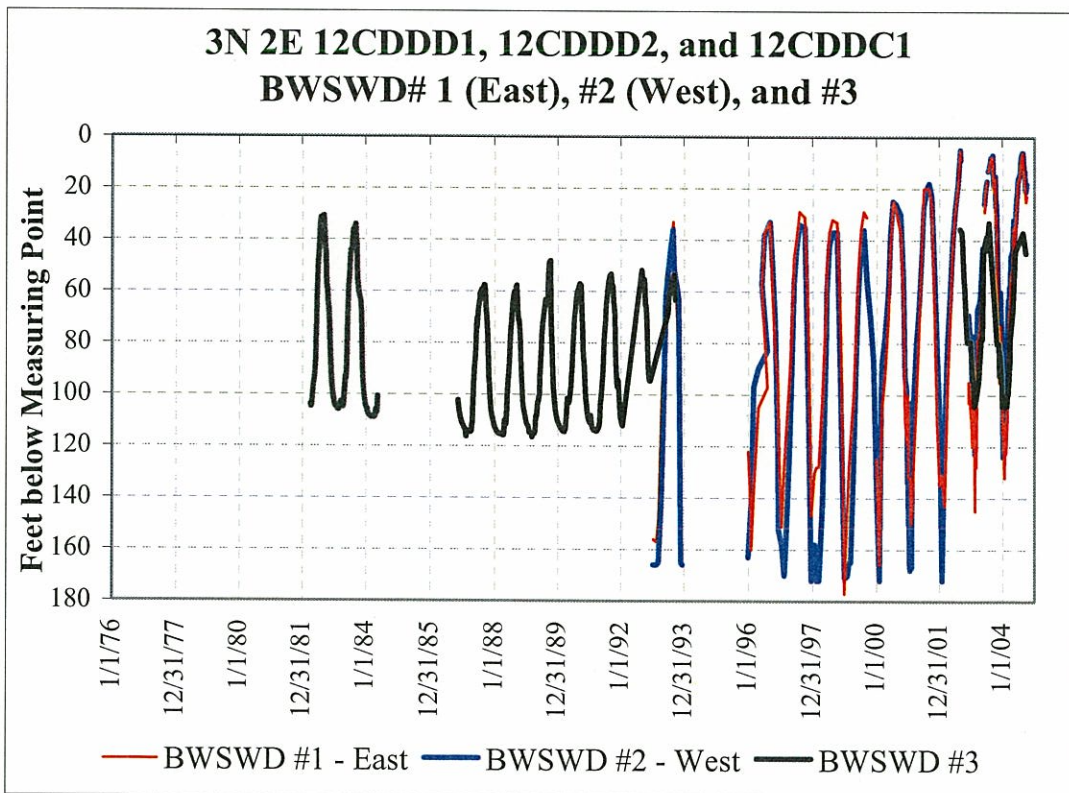


Figure 3. Water level hydrographs for the Boise Warm Springs Water District (BWSWD) wells.

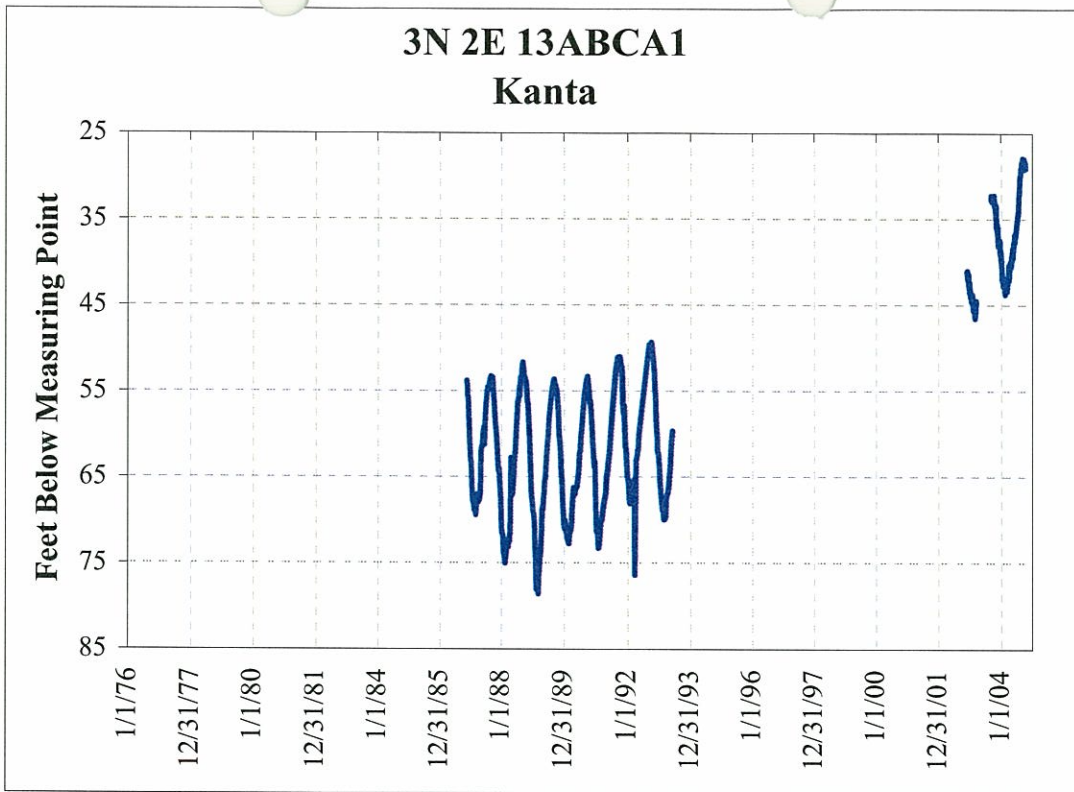


Figure 4. Water level hydrograph for the Kanta well.

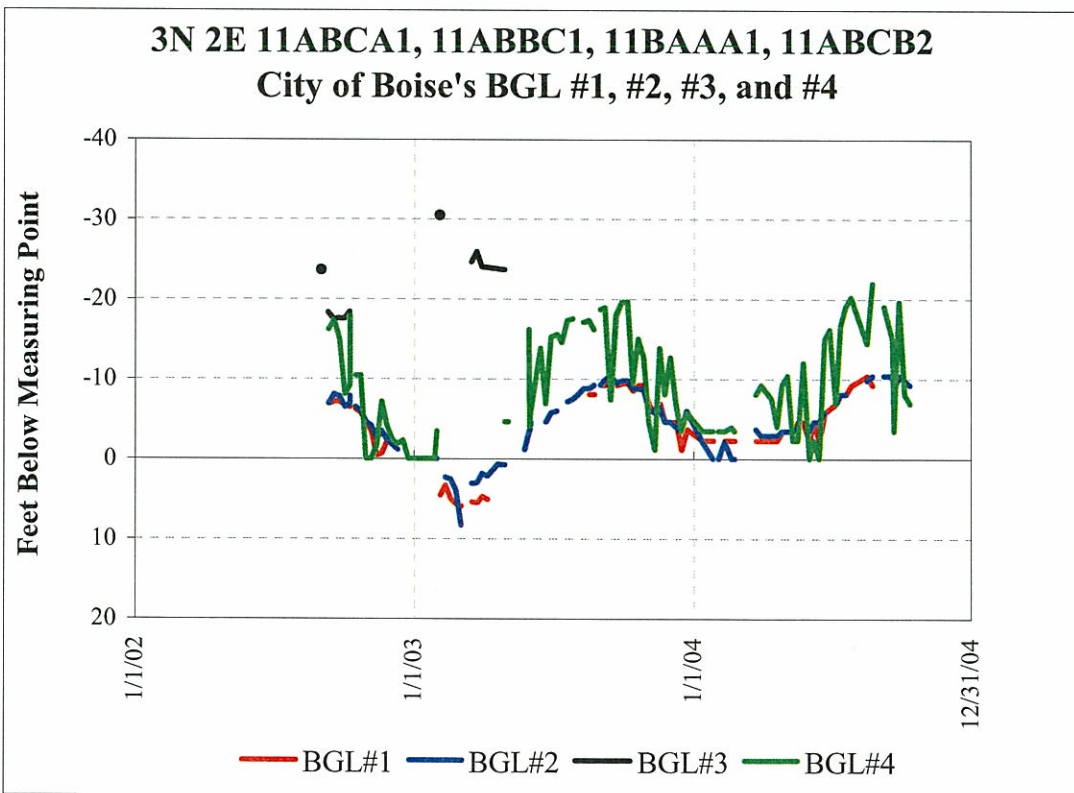


Figure 5. Water level hydrograph for the BGL #1, #2, #3, and #4 wells.

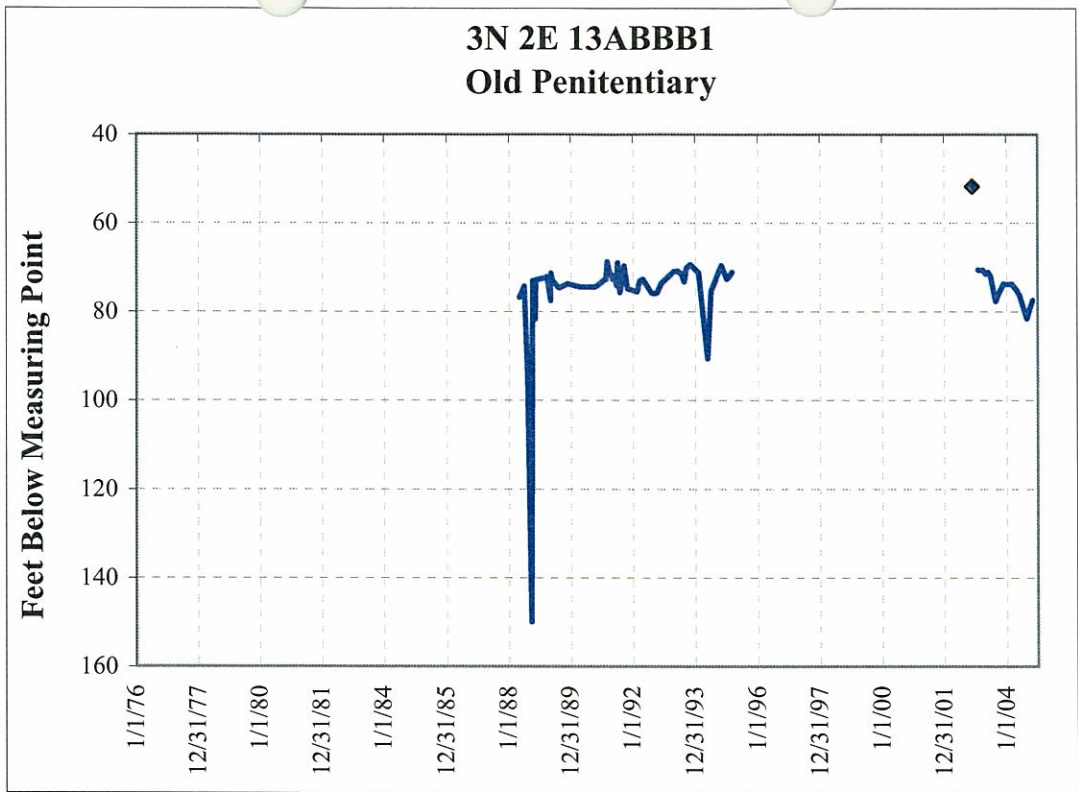


Figure 6. Water level hydrographs for the Old Penitentiary well.

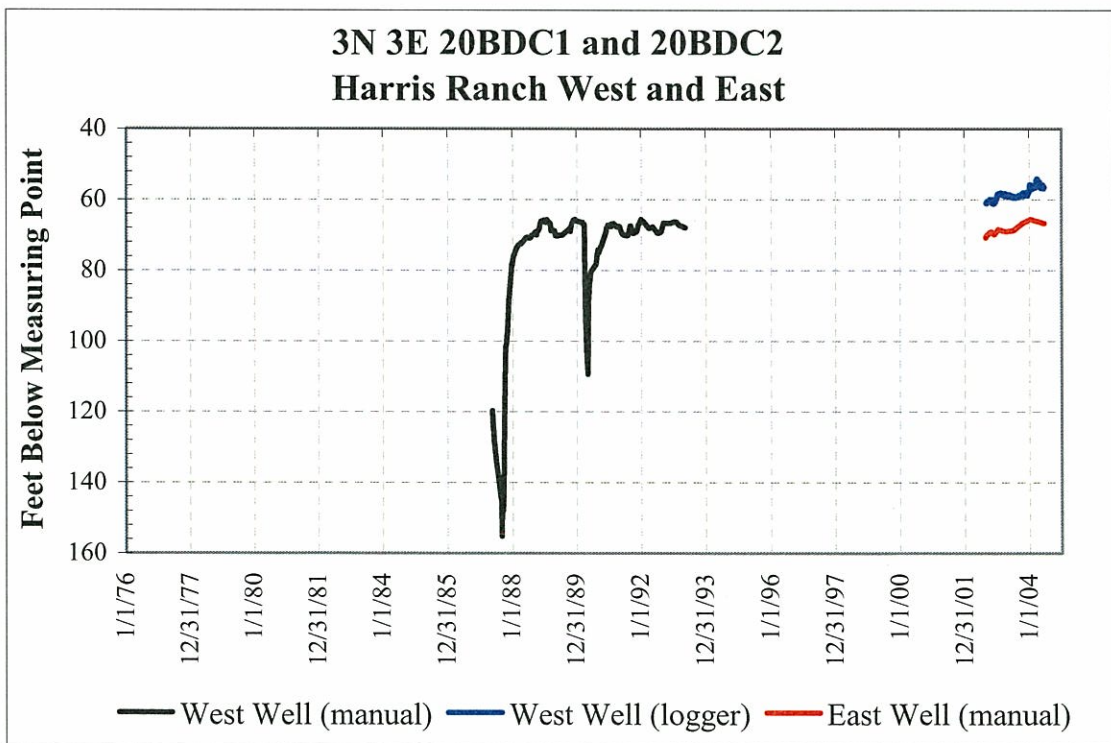


Figure 7. Water level hydrographs for the Harris Ranch wells.

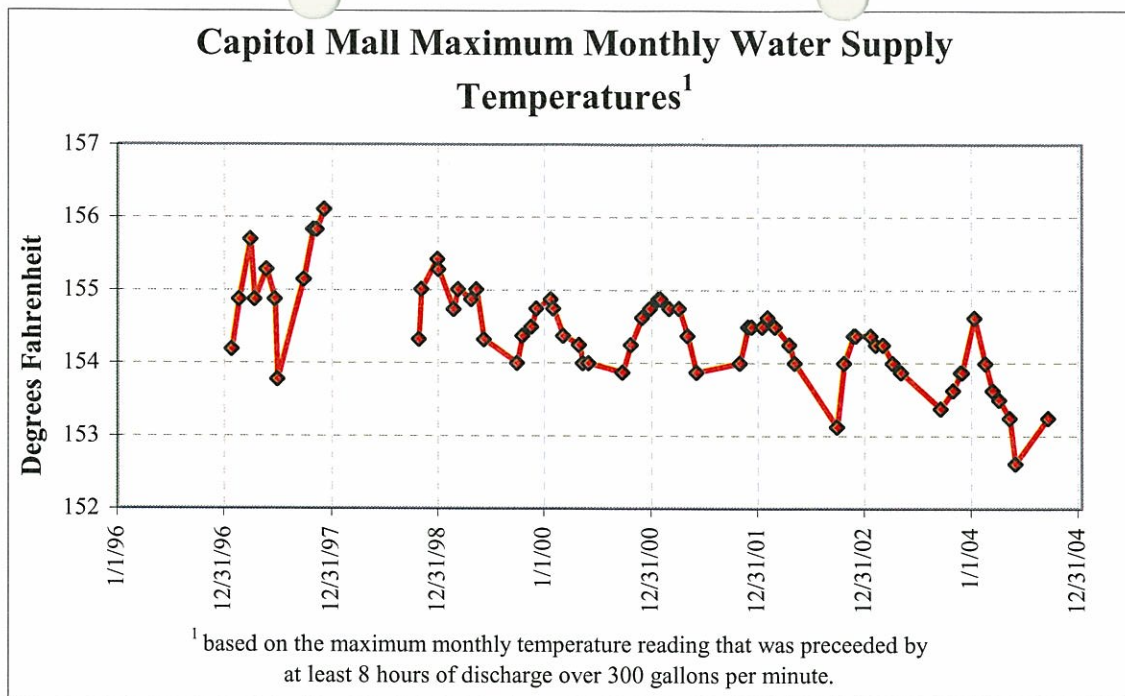


Figure 8. Maximum monthly water supply temperatures for the Capitol Mall geothermal system.

3. STEWART GULCH GROUND WATER DISTRICT 63S

Monitoring in the Stewart Gulch Ground Water District 63S (WD63S) continues to improve. In 2004, the Stralow wellhead was modified to allow for instantaneous flow, totalized flow, flowing and shut-in pressure, and water temperature measurements. However, data for this well was limited to only one measurement near the end of the water year, and it is not included in this report. In other WD63S developments, a new liner was installed in the Terteling Ranch Windsock well due to corrosion problems in the old casing. Also, the Terteling Ranch Motorcycle Club Hot well was pumped for a short period of time in April and May, 2004, for testing and maintenance (This well is actually outside of WD63S' boundaries).

In addition to the monitoring measurements submitted to IDWR by WD63S ground water users, the Water Master collected monthly measurements throughout the year. Weekly measurements were collected for two six-week periods beginning in September and February.

Table 2 shows withdrawals for WD63S wells for WY04. Total withdrawals decreased 28 million gallons from 203.9 million gallons in WY03 to 175.9 million gallons in WY04, which is a change of about -14 percent. Five of the seven production wells in WD63S had decreases in withdrawals, while two showed increases.

Water levels¹ were up slightly in the Edwards and Flora Company wells in 2004 from the previous year (Figures 9-12). Moving up Stewart Gulch, the two geothermal wells at the

¹Shut in pressure readings were converted to the equivalent feet below measuring points for flowing wells.

Quail Hollow Golf Course also showed a slight increase in water levels (Figures 13 and 14). Peak water levels were essentially the same in 2003 and 2004 for the Terteling Ranch Windsock and Pool wells (Figures 15 and 16). Water levels rose slightly in the Terteling Ranch Motorcycle Club Hot well in 2004 (Figure 17).

Hydraulic relationships between withdrawals and water levels in WD63S were previously documented by Ed Squires (Hydro Logic Inc.) through aquifer tests. Monitoring results from the last two years support Mr. Squires' interpretations. For example, a short-term declining trend in the Edwards Greenhouse well that occurred from 2001 to 2003 reversed in 2004. Declining water level trends from 2002 to 2003 in the nearby Flora Company wells also reversed in 2004. These trends coincide with the decrease in withdrawals in WY04.

Although a 20 percent reduction in the combined withdrawals for the Terteling Ranch Windsock and Pool wells did not result in increases of peak water level values at these wells, the periods of the lower (i.e. pumping) water levels were generally higher in 2004 than in 2003 for the two wells. Exceptions were the maximum low values in the Fall of 2004. The maximum low value in the Pool well definitely coincided with a higher withdrawal rate from this well as documented by monitoring data. Undoubtedly, this was the case for the Windsock well, too.

Table 2. Withdrawals from Stewart Gulch Water District 63S geothermal wells and the Terteling Ranch Motorcycle Club Hot well¹ for Water Year 2004 (October 1, 2003 through September 30, 2004).

Well	Withdrawals in WY04 (gallons)	Change from WY03 (gallons)
Flora Company Tiegs (Triangle)	0	0
Flora Company Silkey (Shed)	35,267,314	-7,280,936
Flora Company House (Office)	5,877,420	+2,662,520
Edwards Greenhouse	48,482,130	+2,967,240
Terteling Ranch Windsock	63,066,111	-11,148,019
Terteling Ranch Pool	15,389,411	-4,554,604
Quail Hollow Golf Course Upper	7,526,800	-5,904,500
Quail Hollow Golf Course Lower	256,700	-4,759,800
Total	175,865,886	-28,018,099
Terteling Ranch Motorcycle Club Hot ¹	2,131,100	+2,131,100

¹The Terteling Ranch Motorcycle Club Hot well is outside of WD63S' boundaries. However, it is included in this table since it was pumped in 2004 for maintenance and testing purposes.

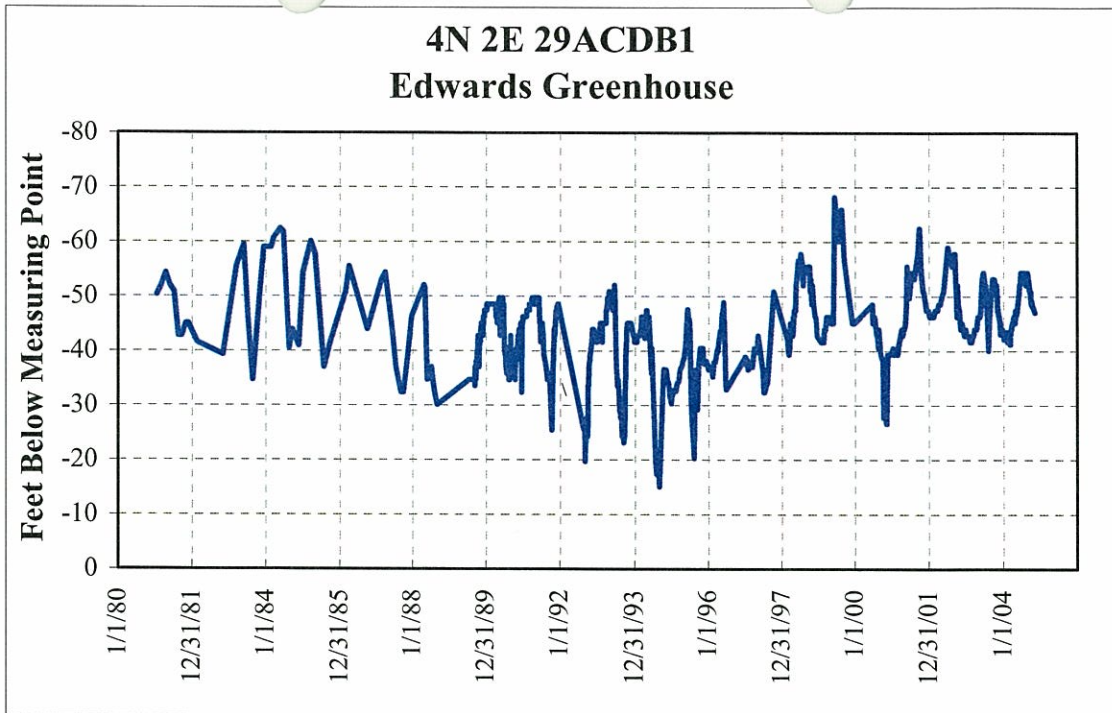


Figure 9. Water level hydrograph for the Edwards Greenhouse well.

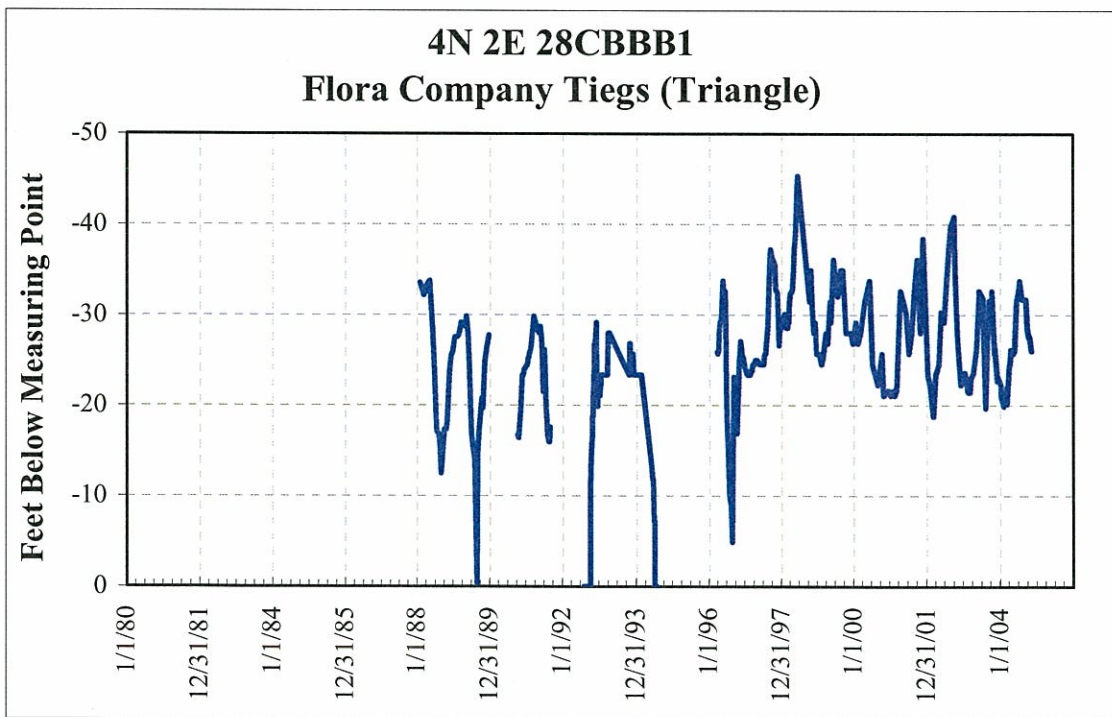


Figure 10. Water level hydrograph for the Flora Company Tieg (Triangle) well.

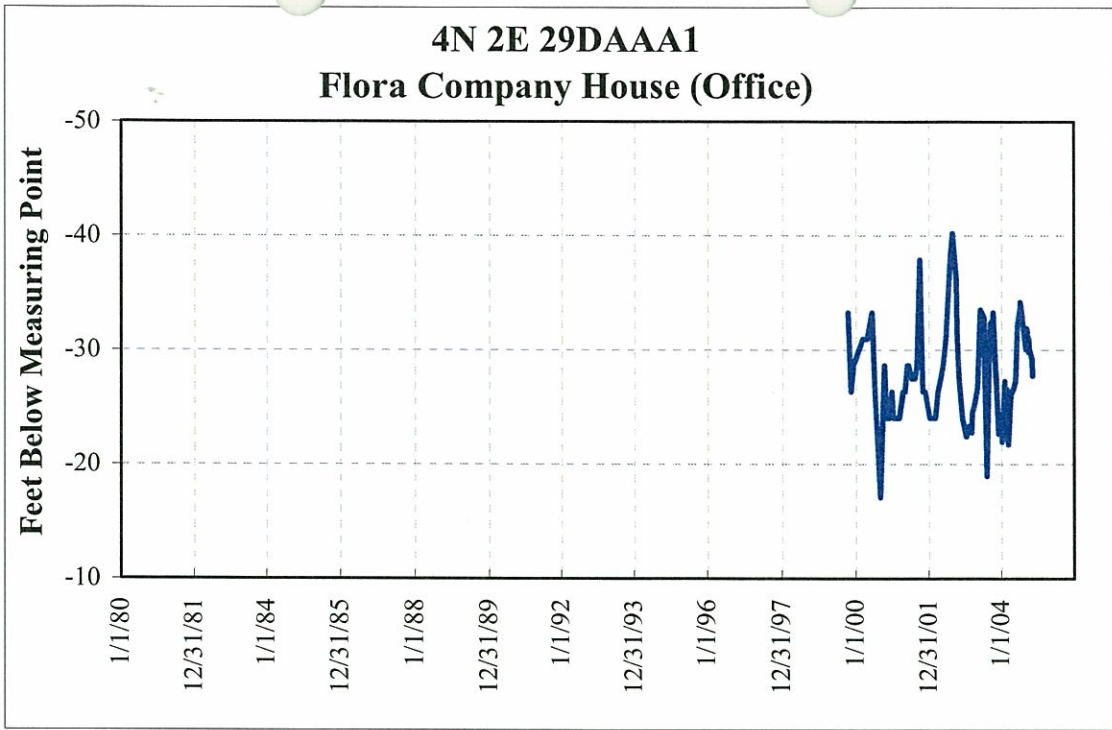


Figure 11. Water level hydrograph for the Flora Company House (Office) well.

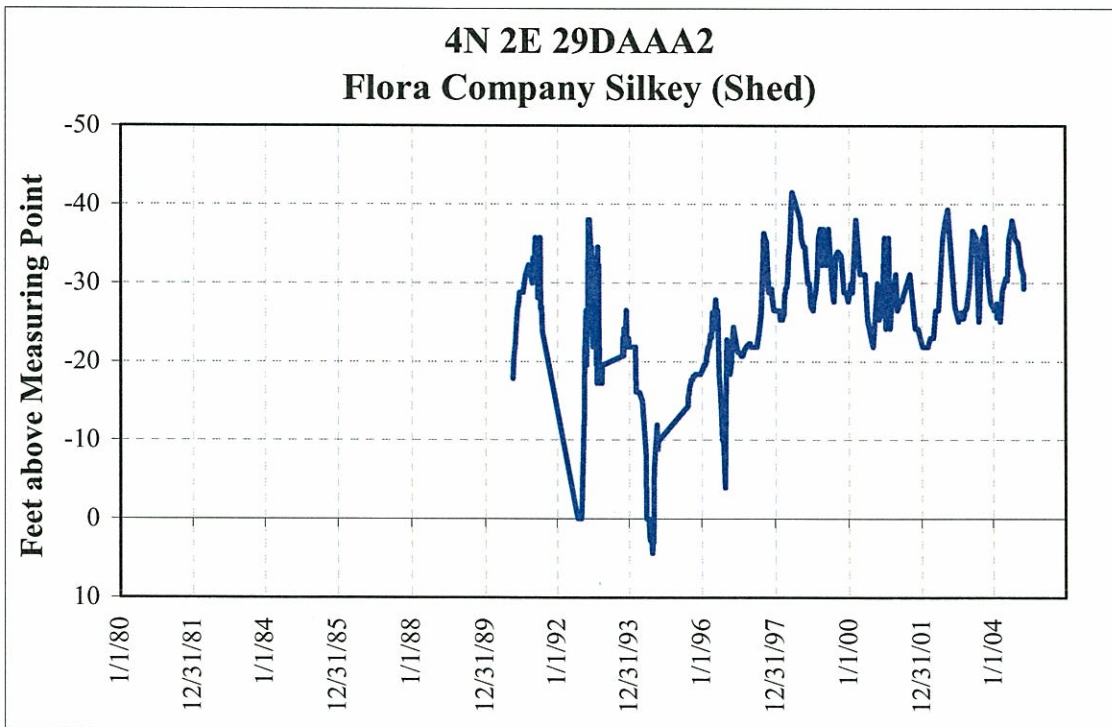


Figure 12. Water level hydrograph for the Flora Company Silkey (Shed) well.

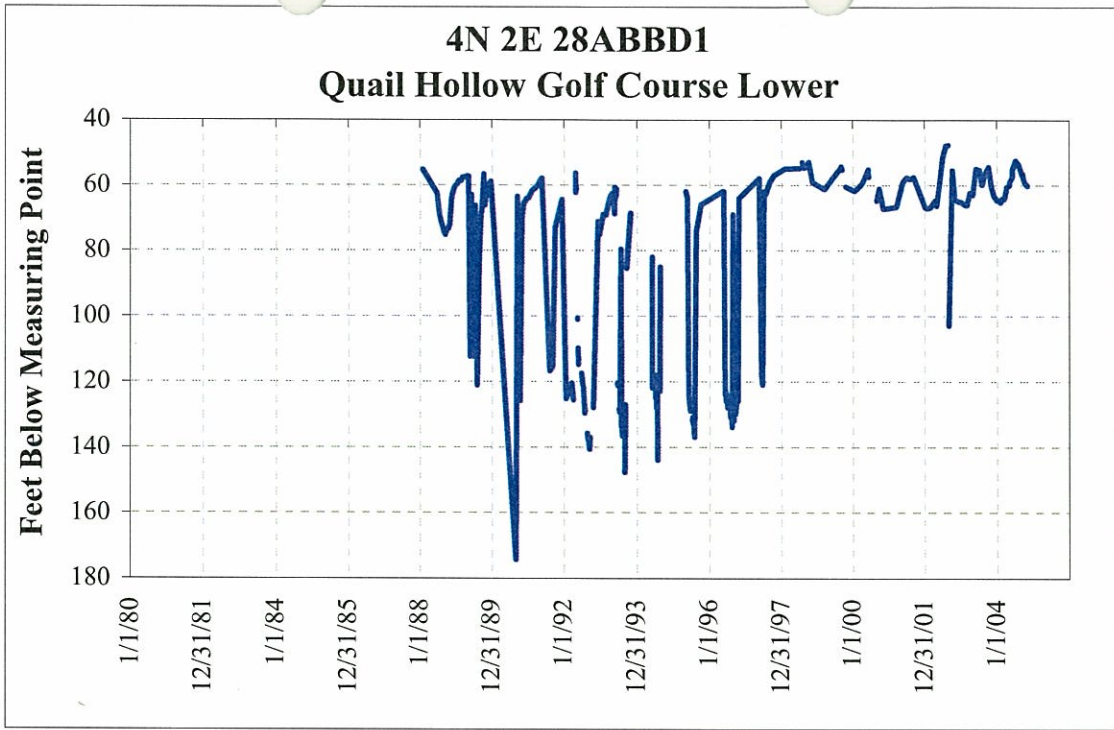


Figure 13. Water level hydrograph for the Quail Hollow Lower well.

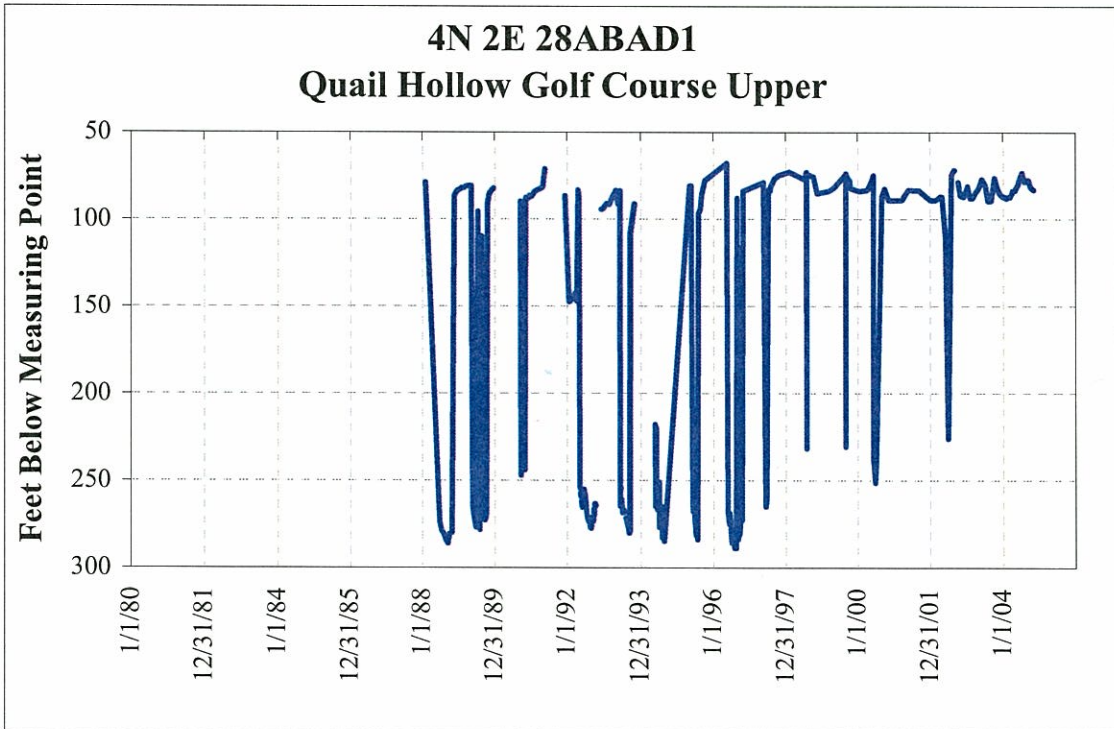


Figure 14. Water level hydrograph for the Quail Hollow Upper well.

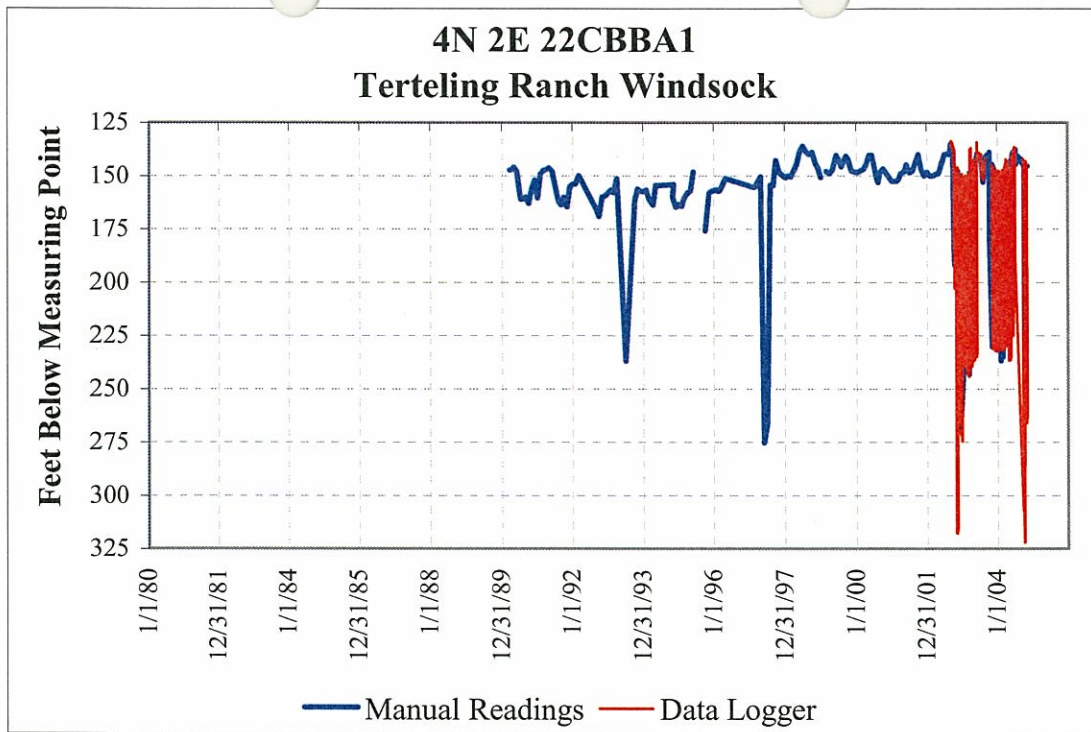


Figure 15. Water level hydrograph for the Terteling Ranch Windsock well.

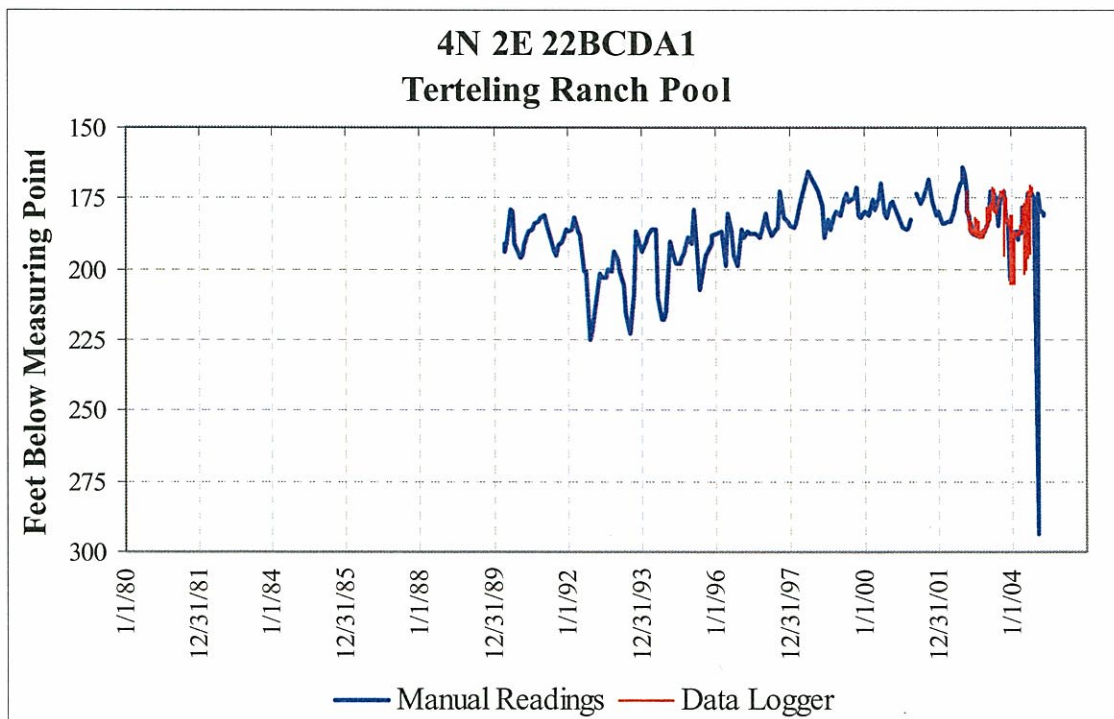


Figure 16. Water level hydrograph for the Terteling Ranch Pool well.

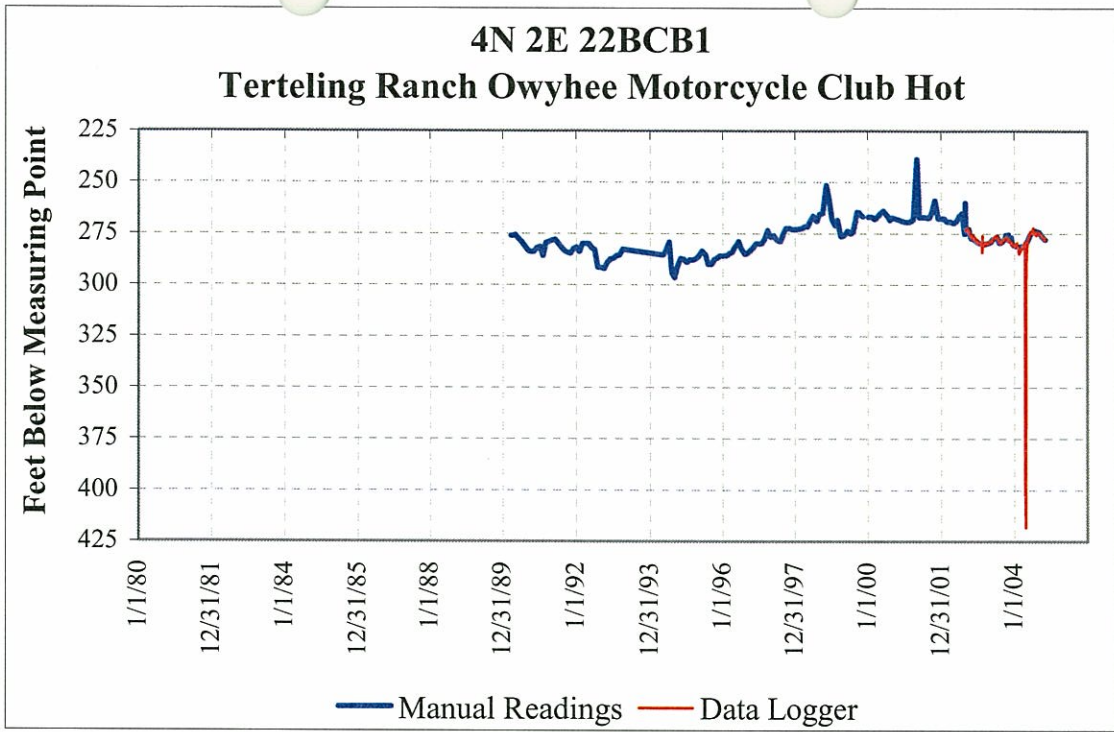


Figure 17. Water level hydrograph for the Terteling Ranch Motorcycle Club Hot well.