DEER CREEK
IRRIGATION DISTRICT

2009
TEHAMA COUNTY
GROUNDWATER EXTRACTION PERMIT
SUMMARY REPORT

April 2010

Prepared By:
Deer Creek Irrigation District

In Cooperation with
Department of Water Resources, Northern Region Office

2009 DCID SUMMARY REPORT
FOR THE
TEHAMA COUNTY GROUNDWATER EXTRACTION PERMIT
April 2010

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INTRODUCTION

This report is the 2009 annual summary of the groundwater extraction that was performed by the pilot production well owned and operated by the Deer Creek Irrigation District (DCID). It was prepared by the Department of Water Resources Northern Region Office on behalf of DCID. It is the third report written to document the annual operation of the pilot production well. Figure 1 is a project location map that shows the pilot production well and all of the monitoring wells associated with the program.

2009 Summary

During spring 2009, the Department of Fish and Game (DFG) requested a pulse flow in Deer Creek to attract migrating salmon. Deer Creek Irrigation District (DCID) bypassed 16 cubic feet per second (cfs) over a 3 day period and earned an 80 acre foot credit to pump groundwater. During the summer of 2009, DCID pumped the well for 13 days and extracted 71 acre feet of groundwater.

Groundwater and surface water monitoring was performed in accordance with the guidelines set forth in the Deer Creek Flow Enhancement Program (DCFEP) and the Tehama County groundwater extraction permit. Consistent with previous years of operation, groundwater levels and water quality were not adversely impacted by the operation of the pilot production well. The static spring groundwater level in one key monitoring well was within about 2 feet of the stage one trigger level due to the current drought period California is experiencing. The Tehama County Flood and Water Conservation District, the Tehama County Department of Environmental Health, the Tehama County AB 3030 Technical Advisory Committee, and the Deer Creek Water Advisory Committee were all notified of the program's operation and initial results following the pumping of the well in 2009.

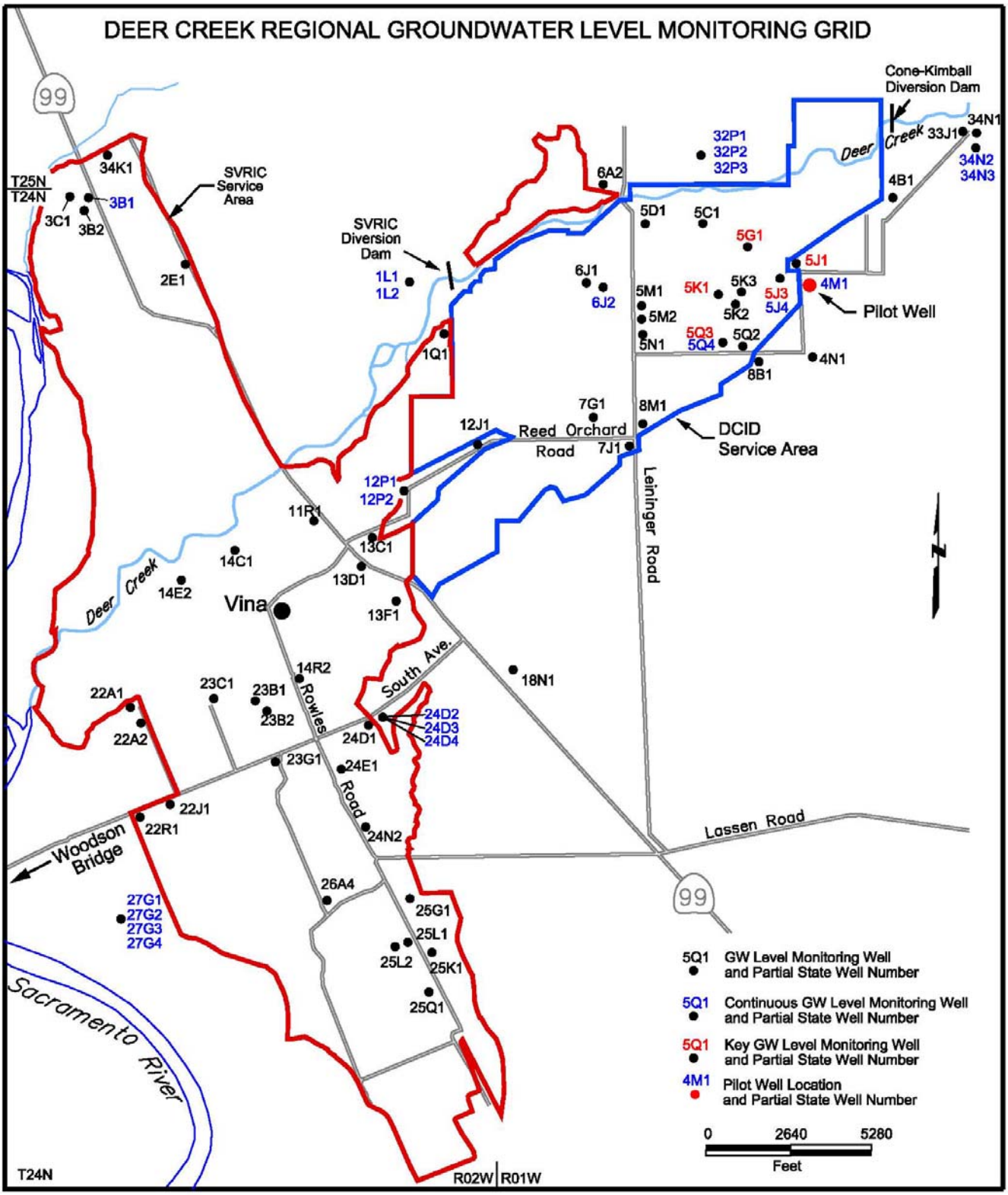


Figure 1. Project Location Map and Regional Groundwater Level Monitoring Grid.

Background

The pilot production well was installed in January of 2003 as part of the Deer Creek Flow Enhancement Program (formally the Deer Creek Water Exchange Program). The program was established to bypass Deer Creek surface water, which would otherwise be diverted for agricultural use. The bypassed surface water would remain in-stream for fish migration flows and would be exchanged for an equal amount of groundwater. The program was designed to fulfill the water needs of local agriculture while achieving the fisheries flow objectives for salmon and steelhead in Deer Creek. It was also designed to fulfill the groundwater protection requirements set forth by the Tehama County AB 3030 Groundwater Management Plan.

The pilot production well pumps groundwater into DCID's conveyance system where the water is distributed throughout their district. Under Tehama County's ordinance, a permit is required to extract groundwater for off parcel use. As such, a groundwater extraction permit is required by Tehama County to operate the well. The first permit was issued in 2003 and renewed in 2004. Due to the potential impacts associated with operating the well, issuance of these permits were subject to a set of conditions and a rigorous monitoring and reporting program. Under the 2003 permit, the well operated 85 days and pumped 450 acre feet during the summer months. The pilot production well was pumped during the summers of 2004, 2005, and 2008 under the assumptions of the 2004 permit that allowed for additional pumping of the well. During 2004, the well pumped 364 acre feet. During 2005 and 2008, the well pumped 64 and 385 acre feet, respectively (During 2009, the well only pumped 71 acre feet).

In spring of 2009, Deer Creek Irrigation District applied for, and received, another Tehama County Groundwater Extraction and Off Parcel Use Permit (see Appendix A). The permit follows the same guidelines and conditions set forth in the 2003 and 2004 permits. However, since this is the third permit and extensive monitoring and reporting have been done that indicate that pumping the well has had no adverse impacts; the 2009 permit was issued for seven years and will expire at the end of 2016.

This report summarizes the 2009 pilot well operation, monitoring, and management. Listed below are links to thee Department of Water Resources Deer Creek Project web page that includes reports, maps, permits, objectives, and agreements. These background documents and maps summarize previous years of operation, monitoring, and management, as well as, the geology, hydrogeology, and land use of the Deer Creek area. The interactive map contains direct links to current groundwater level and water quality data associated with the project. Because this is the third annual summary report much of the detailed background information has been omitted since it is available in these background documents. This report will focus on the the 2009 program and results.

Background Documents and Website

Available at:
http://www.water.ca.gov/waterdatalibrary/groundwater/projects/deer_creek/index.cfm

Reports:
- 2004 Pilot Well Groundwater Extraction Summary Report
- 2004 Deer Creek Existing Conditions Document
- 2003 Pilot Well Groundwater Extraction Summary Report

Mapping:
- Regional Map
- Interactive Map with Groundwater Level and Water Quality Data
- Geologic Cross Section

Permits/Environmental Documentation:
- 2009 Tehama County Permit for Groundwater Extraction
- 2009 Tehama County Permit Application for Groundwater Extraction
- Environmental Documentation for Groundwater Extraction: Pilot Well
- Environmental Documentation for the Pilot Well Installation Project

Objectives:
- Water Quality Standards
- 2004 WUE Grant Draft Revised Scope of Work
- Groundwater Management Objectives

Agreements:
- Deer Creek Flow Enhancement Program Memorandum of Agreement

OPERATONS, MONITORING, AND MANAGEMENT

Management of the pilot program was adapted from the conditions set forth in the 2003 Tehama County Groundwater Extraction and Exportation permit and the guidelines outlined in the Deer Creek Water Exchange Program Groundwater Management Objectives.

The overriding goal of the groundwater management objectives was to operate the program to maintain a sustainable supply of high quality and affordable groundwater for irrigation and domestic use. Management of the pilot program was designed to prevent third party impacts by linking a rigorous schedule of monitoring to a clear set of groundwater level and water quality objectives. The monitoring also corresponds to a set of guidelines for program operations and management. A detailed explanation of the pilot program monitoring and management plan is provided in the "Deer Creek Flow Enhancement Program Memorandum of Agreement" (DCFEP) as well as in the 2003 and 2004 summary reports, and all of the permit applications. A summary of the 2009 operation, management methods, and the results from the groundwater level, and groundwater and surface water quality, monitoring is provided below.

Pilot Well Design and Operation

The pilot well was designed and constructed to produce from the lower portion of the Tuscan aquifer in order to eliminate any pumping related impacts to nearby wells constructed in the upper

to middle portions of the Tuscan aquifer. The pilot well is 940-feet deep with perforations between 620 and 920 feet, and a cement-bentonite seal down to a depth of 580 feet. A well completion report and an as-built design of the pilot-well are provided in all of the permit applications as well as in several of the other background available on the Deer Creek Project website. The pilot well operates at approximately 1,100-1,200 gallons per minute.

Operation of the pilot well is based on DCID's agricultural demand. Additional water supply from the pilot well helps to increase the head in the delivery system, reduce water rotation times, and improve DCID's water reliability. Typically, the highest agricultural demand is around the end of July into the beginning of August. However, the Tehama County permit to extract groundwater was not finalized until August 18, 2009. Therefore, the pilot well did not start operation in 2009 until August 19 and continued for only 13 days until September 2, 2009. The total volume of groundwater extracted during the 2009 program was only 71 acre-feet. The Tehama County Groundwater Extraction Permit allows for a maximum annual volume of 550 acre-feet per year between April and October. But since DCID only had a credit of 80 acre feet, only 71 acre feet were pumped in 2009. DCID will forfeit the remaining 9 acre feet in 2009. Table 1 lists the pilot well operating schedule, pumping rates, and volumes for 2009.

Date & Time	Meter Reading			Total Days Pumping	Remarks
	Ave.Rate (gal/min)	Total Vol. (gallons)	Total Vol. (acre-feet)		
8/19/09 14:00	1,200	420,264,000	0.00	0	Pilot well on: 8/19/09 14:00
8/26/09 09:49	1,125	431,757,000	35.3	6.8	Pilot well pumping
9/02/09 08:30	1,125	443,484,000	71.3	13.8	Pilot well off: 9/02/09 08:30

Table 1. Pilot Well Operation Schedule, Pumping Rate, and Volume.

Groundwater Level Monitoring and Program Management

One of the key criteria for program operations was maintaining a predetermined range of acceptable groundwater levels in five "key wells" surrounding the pilot well (see Figure 1). The key wells were selected based on their depth and construction, their proximity to the pilot well, and their ability to represent groundwater levels in surrounding agricultural and domestic wells that extract groundwater from the upper to middle portions of the Tuscan aquifer. Groundwater levels in the key monitoring wells were monitored to determine compliance with the predetermined range of acceptable groundwater level fluctuations. The acceptable range of groundwater level fluctuation during program operations was established based on professional judgment and the evaluation of:

- Historic seasonal fluctuation of groundwater levels in domestic and agricultural wells surrounding the pilot well.
- The 2003 and 2004 operation of the pilot well.

- Assurances that nearby third-party groundwater users will be able to maintain an adequate and affordable supply of good quality groundwater for agricultural and domestic use.

The groundwater level criteria were divided into three stages, or levels, which serve as trigger points for reevaluating, altering, or shutting-down program operations and alleviating any additional groundwater level decline. Management guidelines allowed for the pilot program to proceed as long as groundwater level monitoring indicated compliance with the predetermined range of acceptable groundwater level decline. At the onset of the 2003 program it was understood that adjustments to the warning stage criteria may be needed as additional data was collected and experience was gained during the pilot program. Additional information regarding the development of the groundwater level warning stages is available in the 2003 and 2004 summary reports, all of the permit applications, and in the Deer Creek Flow Enhancement Memorandum of Agreement listed above and available on the Deer Creek Project web site.

Groundwater Level Monitoring Grids:

Groundwater level monitoring was divided into local and regional monitoring grids. The regional grid covers much of the Stanford Vina Ranch Irrigation Company. These wells range in depth from 100 to 500 feet and represent groundwater levels associated with the upper to middle portions of the Tuscan aquifer. Both grids are a combination of agricultural, domestic, and industrial wells. Figure 1 shows the complete groundwater level monitoring grid for the Deer Creek program that includes both regional and local grids.

The local groundwater level monitoring grid covers approximately a 2-mile radius surrounding the pilot well. Six local wells closest to the pilot well were selected as “key wells” and were used to evaluate potential groundwater level impacts to the middle and upper portions of the Tuscan aquifer, and compliance with the groundwater level criteria. Since 2004, access was lost to one of the wells (24N01W05R02) and is no longer monitored resulting in five key wells. The multi-completion monitoring wells that were installed as part of an earlier phase of the water exchange program were constructed as a nested set of wells, to monitor the middle and lower portions of the Tuscan aquifer and are also a part of the local monitoring grid. Figure 2 shows the location of the local monitoring grid that includes the key monitoring wells, dedicated multi-completion monitoring wells, and key water quality sampling locations. All of monitoring wells in the local grid are outfitted with continuous groundwater level recorders.

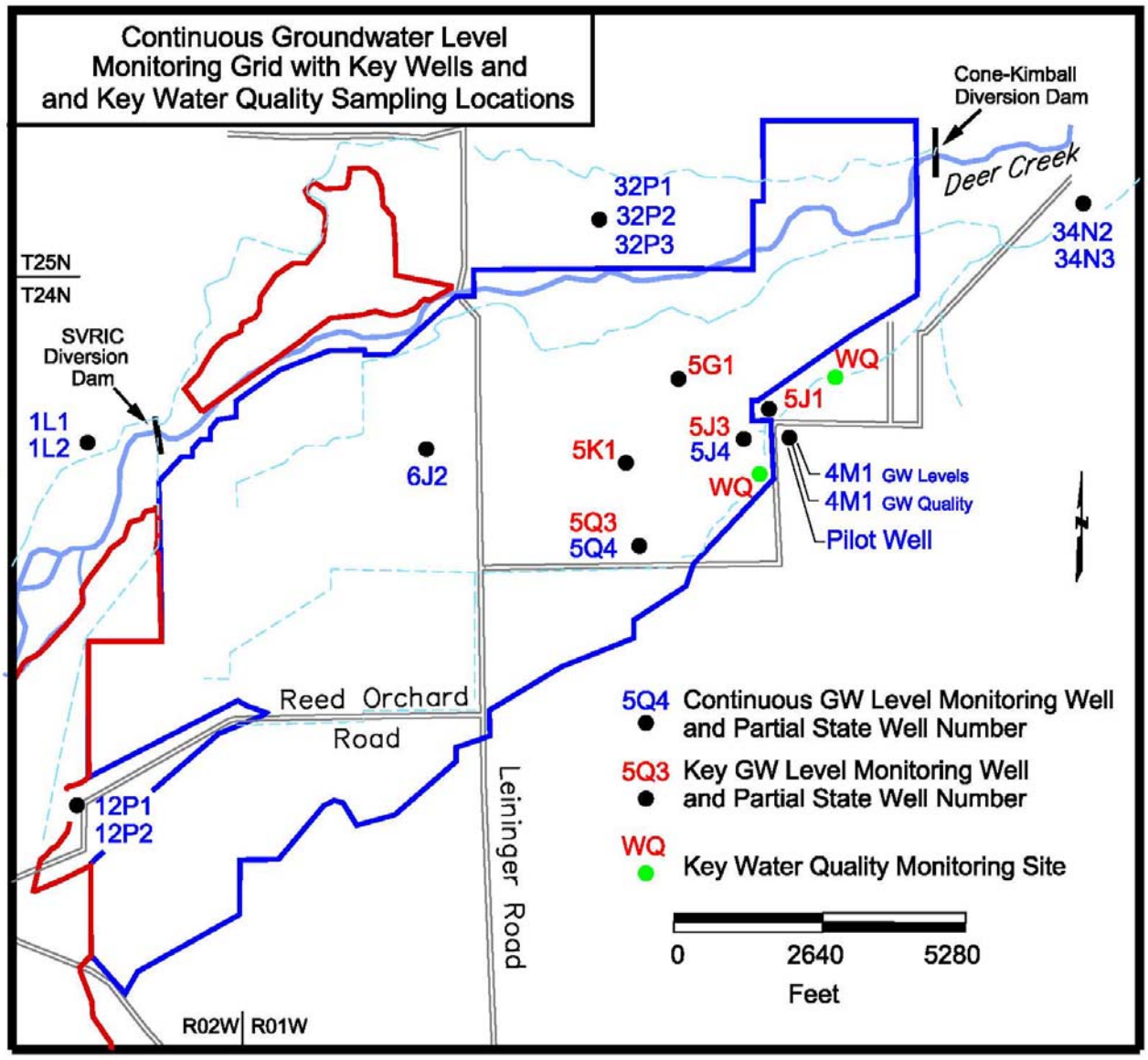


Figure 2. Key Well and Continuous Level Recording Groundwater Level Monitoring Grid.

Key well construction and well use information is provided below in Table 2. Well construction data in Table 2 shows that the groundwater level monitoring of the key wells allows evaluation of groundwater levels over a wide range of the upper to middle portions of the Tuscan aquifer, from 58 feet to 520 feet deep.

State Well Number	Distance from Pilot Well (ft)	Well Use	Aquifer Production Zone	Total Depth (feet)	Perforation Interval (feet)
24N01W05J03	375	Monitoring Well	Upper Tuscan	385	271-385
24N01W05J01	390	Cemetery Well	Upper Tuscan	178	58-178
24N01W05G01	1823	Active Irrigation Well	Middle Tuscan	490	130-490
24N01W05K01	2730	Idle Irrigation	Upper Tuscan	260	27-260
24N01W05Q03	3200	Monitoring Well	Middle Tuscan	415	280-415

Table 2. Key Monitoring Well Construction Information.

Groundwater level fluctuations within the lower Tuscan aquifer were monitored using the deep-zone of the dedicated multi-completion monitoring wells. Construction information for the deep aquifer wells is shown in Table 3. The deep aquifer is where the pilot production well extracts groundwater from and has the greatest impact.

State Well Number	Distance from Pilot Well (ft)	Well Use	Aquifer Production Zone	Total Depth (feet)	Perforation Interval (feet)
24N01W05J04	375	Monitoring Well	Lower Tuscan	760'	650-722'
24N01W05Q04	3,200	Monitoring Well	Lower Tuscan	840'	700-790'
25N01W32P03	5,180	Monitoring Well	Lower Tuscan	720'	640-720'
25N01W34N03	6,930	Monitoring Well	Lower Tuscan	743'	468-743'
25N02W01L02	12,480	Monitoring Well	Lower Tuscan	900'	660-900'
24N02W12P02	14,070	Monitoring Well	Lower Tuscan	900	560-900'

Table 3. Deep Aquifer Monitoring Well Construction Information.

Geologic plan-view and cross-sectional maps showing well depths and the vertical extent of the Tuscan aquifer zones are provided in the 2003 and 2004 summary reports, all of the permit applications, the DCFEP, available on the Deer Creek Project web site.

Groundwater Level Monitoring Schedule:

The frequency of groundwater level monitoring varies according to the monitoring well location, type, and the pilot well pumping schedule. During pilot program operations, the depth to groundwater was measured in the Deer Creek monitoring wells east of Highway 99, at a frequency of once per month between April and October. Within the localized grid, the five key wells plus the pilot production well, and the other twelve wells that are equipped with automated groundwater level recording equipment (data loggers) measured groundwater levels at a frequency of once per hour and were downloaded once per month between April and October.

Groundwater Level Monitoring Results

Pilot Well Results: Groundwater level monitoring results for the pilot well are illustrated in the hydrograph shown in Figure 3. The hydrograph shows the entire period of record since the well was installed in 2003 up to mid September 2009. It also shows the amount of groundwater extracted each season that the well operated. Figure 3 shows that the pumping that occurred in 2009 is consistent with pumping levels during the other years of pumping. In fact, due to the short pumping period in 2009 (13 days), the pumping level remained at a higher level than the pumping level in 2008 reached. Groundwater levels recovered quickly after termination of pumping in the Pilot Production Well. The static groundwater levels show the seasonal trend of high in the spring and low in the fall with a slight downward trend since 2007 due to the current drought conditions.

At the start of pumping, the well was discharging 1,200 gpm. But after seven days of pumping, the discharge had fallen to about 1,125 gpm. This is typical, as the well draws itself down and the height to lift water to the surface increases.

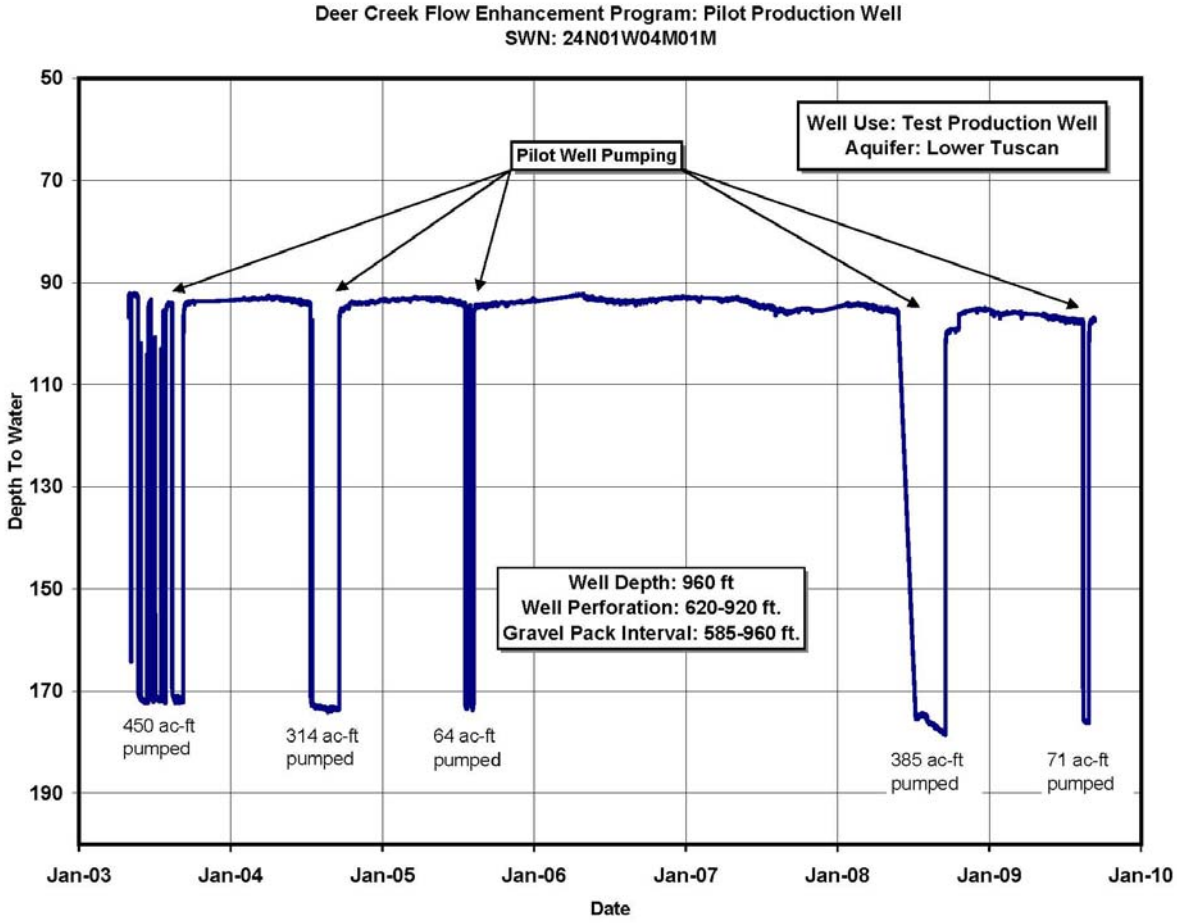


Figure 3. Groundwater Level Hydrograph for the DCID Pilot Well.

Monitoring Well Results

All of the pumping impacts observed in the key monitoring wells utilizing the upper and middle aquifer zones are from the wells themselves pumping or from nearby wells (other than the pilot production well). Depending on how long the pilot well is pumping, most of the deep aquifer zone wells show measurable impacts.

Note that care should be taken when analyzing the monitoring well hydrographs to examine changes in seasonal groundwater levels as well as fluctuations occurring within the pilot well pumping periods. Groundwater level impacts from pumping or nearby pumping are typically illustrated by an abrupt decline in groundwater level in the observation well at the onset of nearby pumping or, consequently, an abrupt rise in groundwater levels at the termination of nearby pumping. Groundwater level impacts to the monitoring wells were analyzed by looking for any change in groundwater levels before, during, and after the pilot well pumping periods; keeping aware that local groundwater levels commonly show a gradual decline and rise with the natural seasonal progression from summer to fall.

Key Well Results - Upper to Middle Aquifer Monitoring: The results of groundwater level monitoring of the key wells are illustrated in the hydrographs located in Appendix B. The hydrographs show the long term groundwater level in the well and the groundwater management "warning stages" associated with static (spring) water level data. Table 2 above lists the five key wells, their distance from the pilot well and their construction. Figure 2 shows the plan-view distribution of the key monitoring wells. All of the key wells are equipped with data loggers.

Consistent with 2003 and 2004 results, the overall results from the 2009 groundwater level monitoring of the key wells within the upper to middle portion of the Tuscan aquifer indicate no groundwater level impacts due to the pilot well pumping.

Seasonally, groundwater levels in the key wells fluctuate an average of about 2 to 5 feet, with temporary short term declines of also about 2 to 5 feet when nearby irrigation wells pump for agricultural beneficial use. Comparison of seasonal groundwater level trends during non-pilot well pumping years (2006 and 2007) versus pilot well pumping years (2003-2005, 2008-2009) indicate that the gradual declines and recoveries are typical of the normal seasonal fluctuation in groundwater levels in the key wells and there is no influence from the pilot production well. In addition to the gradual (seasonal) groundwater level changes, the hydrographs for wells 24N01W05J03M, 24N01W05Q03M, and 24N01W05K01 show a series of downward spikes, or drawdowns that are attributed to groundwater pumping of nearby irrigation wells pumping from the upper and middle aquifer zones. The hydrographs for the remaining two key wells, 24N01W05J01M and 24N01W05G01M, show downward spikes of 15-30 feet due to the wells themselves pumping.

Except for well 24N01W05K01M, all of the key monitoring well hydrographs are relatively stable through 2006 and then show a downward trend of 2-3 feet from 2006 to 2009 due to the current drought conditions that are being experienced. Well 24N01W05K001M has shown an upward trend of about 8 feet from 1999 to 2006 and has remained stable from 2006 to 2009.

Deep Well Results - Lower Tuscan Aquifer Results: Groundwater level monitoring of the lower Tuscan was conducted using the deep dedicated monitoring wells that were installed in 1999. Table 3 lists the deep aquifer monitoring wells, their distance from the pumping well, and their construction. Figures 1 and 2 provide a plan-view distribution of the wells. The vertical distribution and construction of these wells are also illustrated in the geologic cross-section provided in the background documents. The results of groundwater level monitoring of the lower Tuscan aquifer are illustrated in the hydrographs in Appendix C. All of the deep aquifer monitoring wells are equipped with dataloggers.

The lower Tuscan groundwater level monitoring wells are constructed in the same deep aquifer zone as the pilot production well in order to measure impacts to the deep aquifer zone. Based on groundwater level monitoring results from continuously pumping the pilot well for 69 days in 2004 and 85 days of intermittent pumping in 2003, total drawdown to the lower aquifer ranged from approximately 16 feet in 24N01W05J04M (located 375 feet from the pilot well), to 0.7 feet in 24N01W12P02 (located 14,070 feet from the pilot well). Figure 4 is a plan view map showing the lower Tuscan monitoring wells, measured groundwater level impacts in the lower aquifer, and interpreted groundwater drawdown contour lines during pilot well pumping in 2004. Figure 4 shows that, although the majority of drawdown-related impacts to the lower aquifer subside within a distance of 2,000 feet, a small amount of drawdown (~ 1.5 feet) continues outward from the pilot well at distances of about 10,000 feet, or about 2 miles.

During 2009, the pilot well only pumped for 13.8 days (see Table 1) and therefore, observable drawdown was minimal. Three of the four closest deep monitoring wells showed impacts from the pilot well pumping and were consistent with the 2003 and 2004 results. The closest well, 24N01W05J04M, showed about 15 feet of drawdown. Well 24N01W05Q004M, 3,200 feet away, showed about 3-4 feet of drawdown during the pumping. Well 25N01W34N003M is about 6,900 feet away from the pilot well and showed about 2 feet of drawdown. The remaining 3 deep aquifer monitoring wells, located 5,180 feet, 12,480 feet, and 14,070 feet away, showed no impacts due to pumping the pilot well during 2009.

Seasonally, groundwater levels in the deep wells fluctuate on an average of about 1 to 3 feet, with temporary short term declines of also about 2 to 5 feet when nearby irrigation wells pump for agricultural beneficial use. Comparison of seasonal groundwater level trends during non-pilot well pumping years (2006 and 2007) versus pilot well pumping years (2003-2005, 2008-2009) indicate that the gradual declines and recoveries are typical of the normal seasonal fluctuation in groundwater levels in the deep wells.

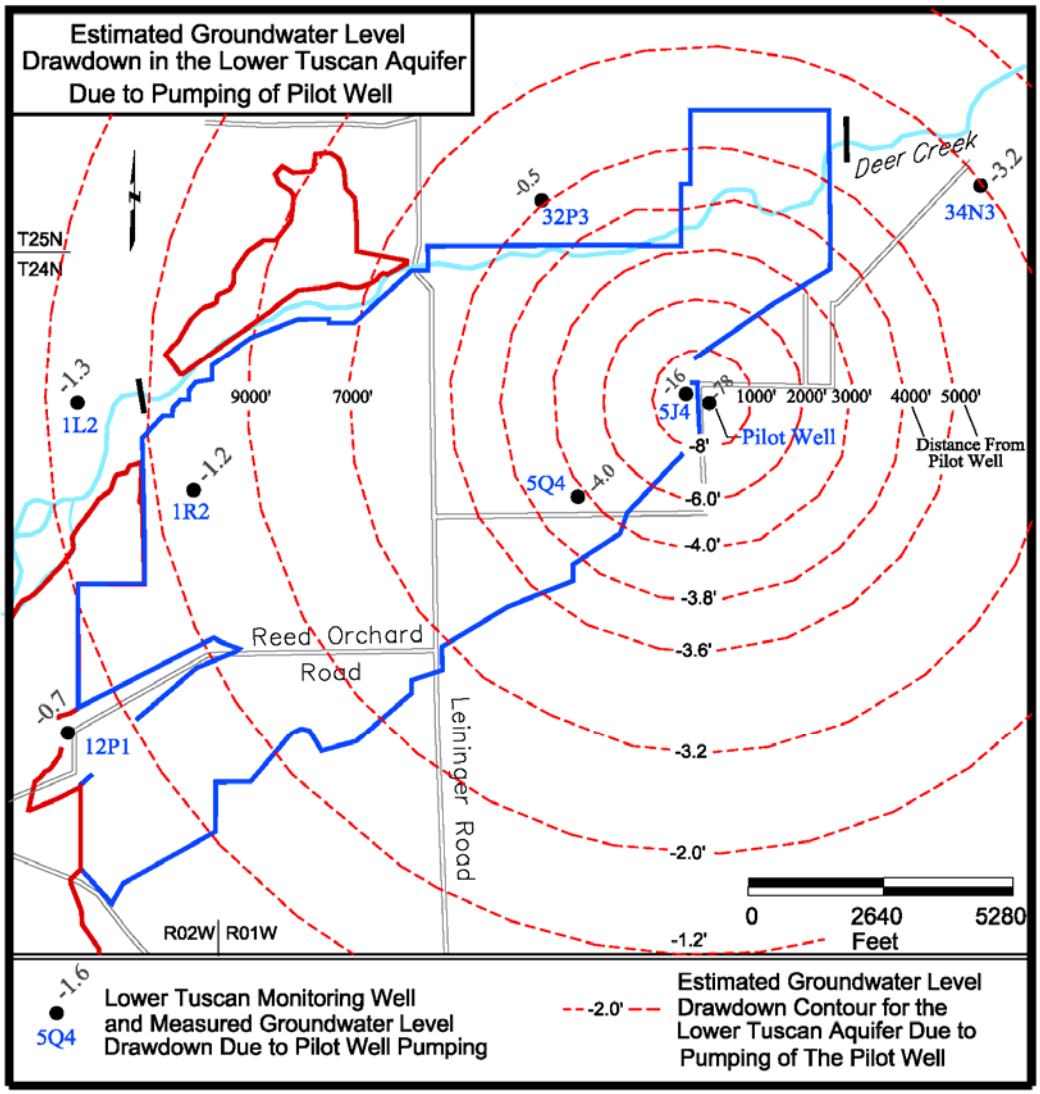


Figure 4. 2004 Groundwater Drawdown in the Lower Tuscan Aquifer During Pilot Well Pumping.

Water Quality Monitoring and Management

Maintaining a minimum level of acceptable water quality from the pilot well was the second criteria used to manage the pumping operations. The water quality criteria, established in the Groundwater Management Objectives requires that groundwater from the pilot well will be maintained above the recommended water quality goals established by the California Regional Quality Control Board. Pumping of the pilot well will proceed as long as there is compliance with these pre-agreed water quality criteria. A detailed explanation of the pilot program monitoring and management plan is provided in the Groundwater Management Objectives and the DCFEP background documents posted on the Deer Creek Project website (see page 3). The analytical results of the water quality sampling are listed in Tables 1 through 3, Appendix D. Recommended water quality standards for

agriculture and domestic use are listed in Tables 4 and 5, Appendix D. A summary of the management methods and the results from the water quality monitoring are provided below.

Three key sites were used to monitor water quality compliance. These sites are listed below and are shown in Figure 2.

- Site 1: DCID distribution system canal above the pilot well discharge point
- Site 2: Pilot well discharges prior to mixing with the DCID canal
- Site 3: DCID distribution system canal below the pilot well discharge point

The Department of Water Resources conducted the field collection and testing of surface and groundwater quality samples during the program. Analytical testing was conducted at a State of California approved laboratory and included analysis for minerals, trace metals, and nutrients.

Consistent with historical results, the water quality samples obtained during the 2009 pumping program showed no negative water quality impacts. Furthermore, the groundwater samples from the pilot production well have consistently produced high water quality results.

The sampling schedule outlined in the DCFEP and the permit application requires sampling of field parameters, minerals, trace metals, and nutrients within 5 days after pumping begins and within the last 5 days of pumping. Additionally, field parameters should also be measured monthly during pilot well pumping. During 2009, the pilot well only ran for 13 days. As such, water quality samples were only collected one time 7 days after pumping began and 6 days before pumping stopped.

Water Quality Monitoring Results: Overall, field sampling indicated consistent high quality groundwater during 2009. Field results of groundwater temperature and electrical conductivity were 61.7 degrees Fahrenheit and 136 micro Siemens per centimeter, respectively.
The results from mineral, metals, and nutrient testing, from surface water and groundwater sample locations, show that the waters are of high quality, and concentration of all constituents are well within the recommended standards for agricultural or domestic use.

Reporting: The results of the groundwater level monitoring were provided to the Deer Creek Water Advisory Committee, and the Tehama County Flood Control and Water Conservation Board on a monthly basis. Distribution of the groundwater level data was also made available to the general public over the Internet through the Department of Water Resources Water Data Library, Deer Creek Project web site.

PILOT WELL OPERATING COSTS

The pilot well is powered by a 75 horsepower electrical pump and operates under the PG&E agricultural AG-4A rate structure. Operating 24 hours per day at an average production of 1,125 gallons per minute with 174 feet of lift the pilot well consumed approximately 1,363 kilowatt-hours per day, or 264 kilowatt-hours per acre-foot during 2009. The averaged electrical cost to operate the pilot well translates to approximately $54.00 per acre-foot for the 2009 season.

CONCLUSION

Findings from the 2009 pilot well pumping indicate that 13.8 days of groundwater extraction from the lower portion of the Tuscan aquifer had no groundwater level or water quality related impacts to existing agricultural and domestic wells that produce from the upper-middle portions of the aquifer.

Findings also indicate that:

- Groundwater level drawdown impacts to the lower Tuscan aquifer ranged from approximately 16 feet at a distance of 375 feet from the pilot well, to 2 feet at a distance of 6,900 feet from the pilot well. Three of the furthest deep wells from the pilot wells showed no obvious impact.
- Additional water supply from the pilot well helped to increase the head in the delivery system, reduce water rotation times, and improve DCID's water reliability.
- The annual operating costs associated with operating the pilot well are likely too high to be supported by agricultural benefit alone.

Appendix A

2009-2016
Tehama County Groundwater Extraction and Off-Parcel Use Permit

GROUNDWATER EXTRACTION AND OFF PARCEL USE

PERMIT NO. WE-03/01

REISSUED AUGUST 18, 2009

In accordance with Chapter 9.40 of the Tehama County Code a Groundwater Extraction and Exportation Permit is hereby granted to Deer Creek Irrigation District subject to the following conditions:

1. Overdraft of the water table shall not occur.

2. Monitoring of the surface and groundwater systems shall comply with "groundwater Monitoring and Management Guidelines" set forth on Pages 23 through 31 of Appendix B to the Permit Application.

3 Field measurement of conductivity shall be conducted and evaluated on a monthly basis.

4. Report project status and monitoring results on a monthly basis to the Tehama County Flood Control & Water Conservation AB3030 Technical Advisory Committee.

5. During the pumping period, data loggers in key wells will record changes in groundwater levels every two-hours, but downloading of data and groundwater level monitoring of extending grid shall occur monthly.

6 Members of the 2003 Deer Creek Water Advisory Committee membership shall receive monthly updates of project status and monitoring results.

7. The total volume of groundwater extracted shall be limited to a maximum of 550 acre-feet between April and October of year during the term of the Permit.

8. The "Phase one" and "Phase two" activities described on Page 4 of the Permit Application and Page 4 of Appendix B to the Permit Application are not authorized by this Permit. No extraction of groundwater for off parcel use associated with these activities shall occur unless this Permit is amended in accordance with Chapter 9.40 of the Tehama County Code.

9. This Permit shall remain in effect for seven (7) calendar years from the date of issuance, unless amended or revoked in accordance with Chapter 9.40 of the Tehama County code.

THIS PERMIT IS VOID IF NOT USED WITHIN ONE YEAR FROM DATE OF ISSUE.

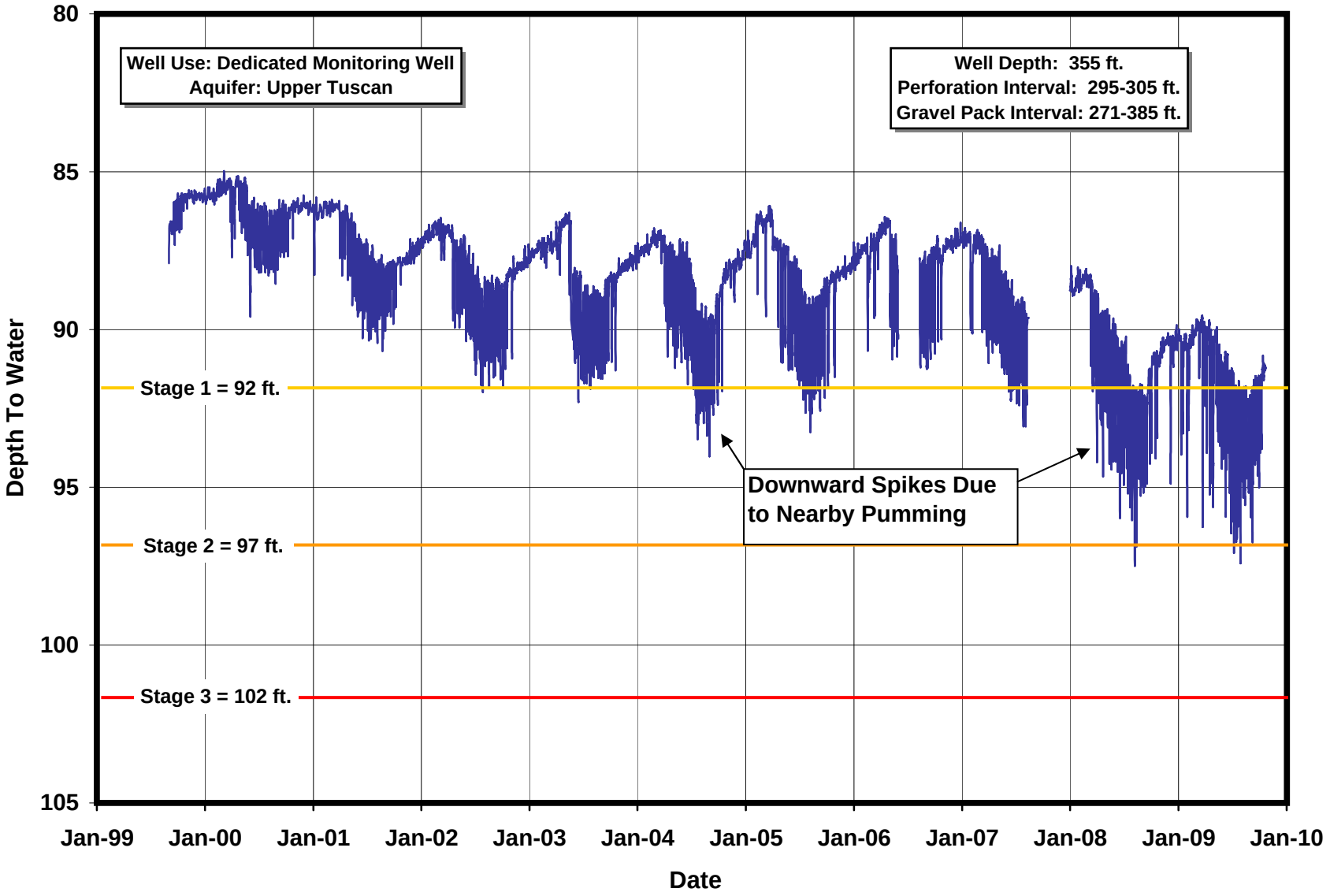
Granted August 18, 2009
DATE

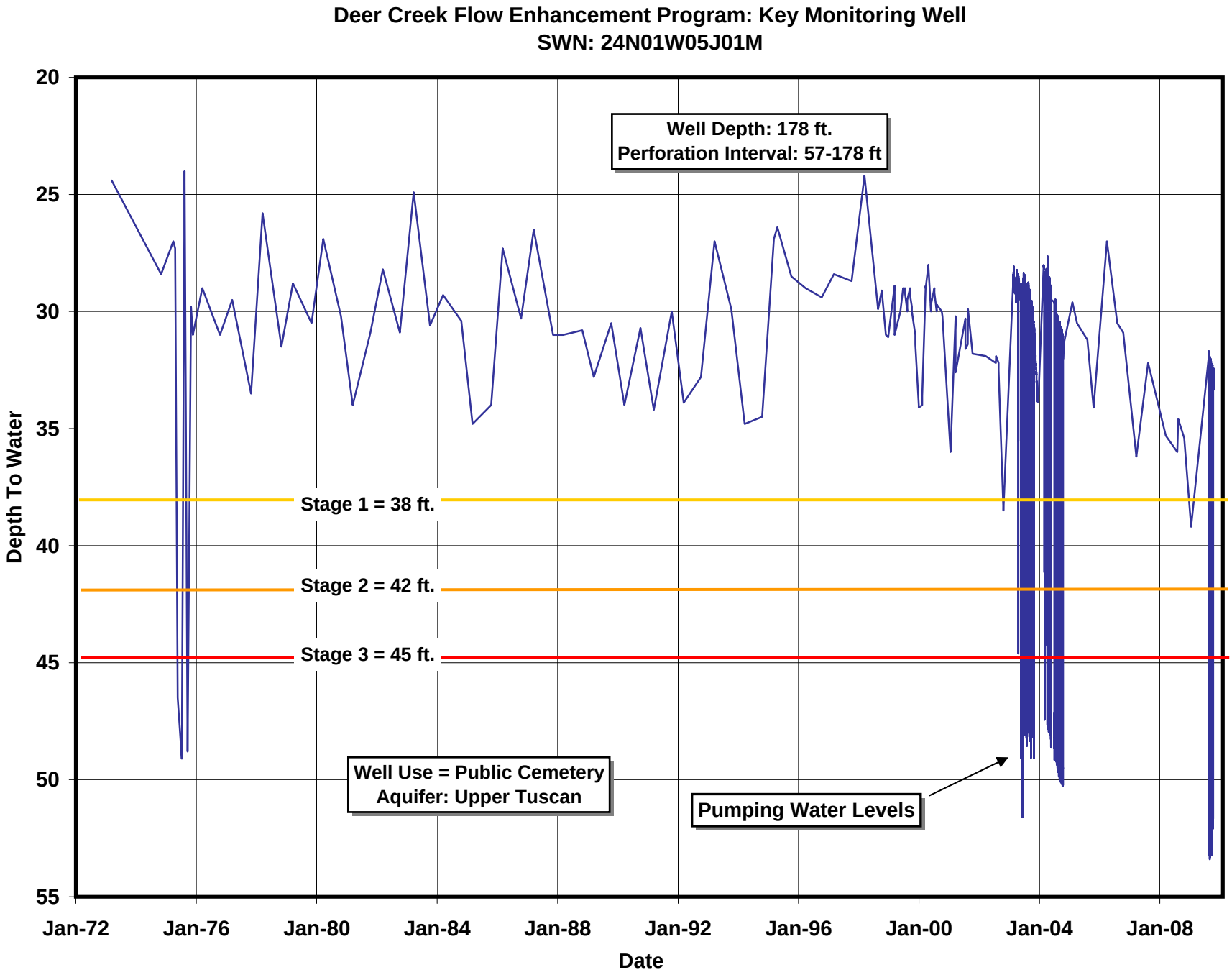
Signed Angela L. Ford
Deputy Clerk of the Board, Tehama County Board of Supervisors

Appendix B

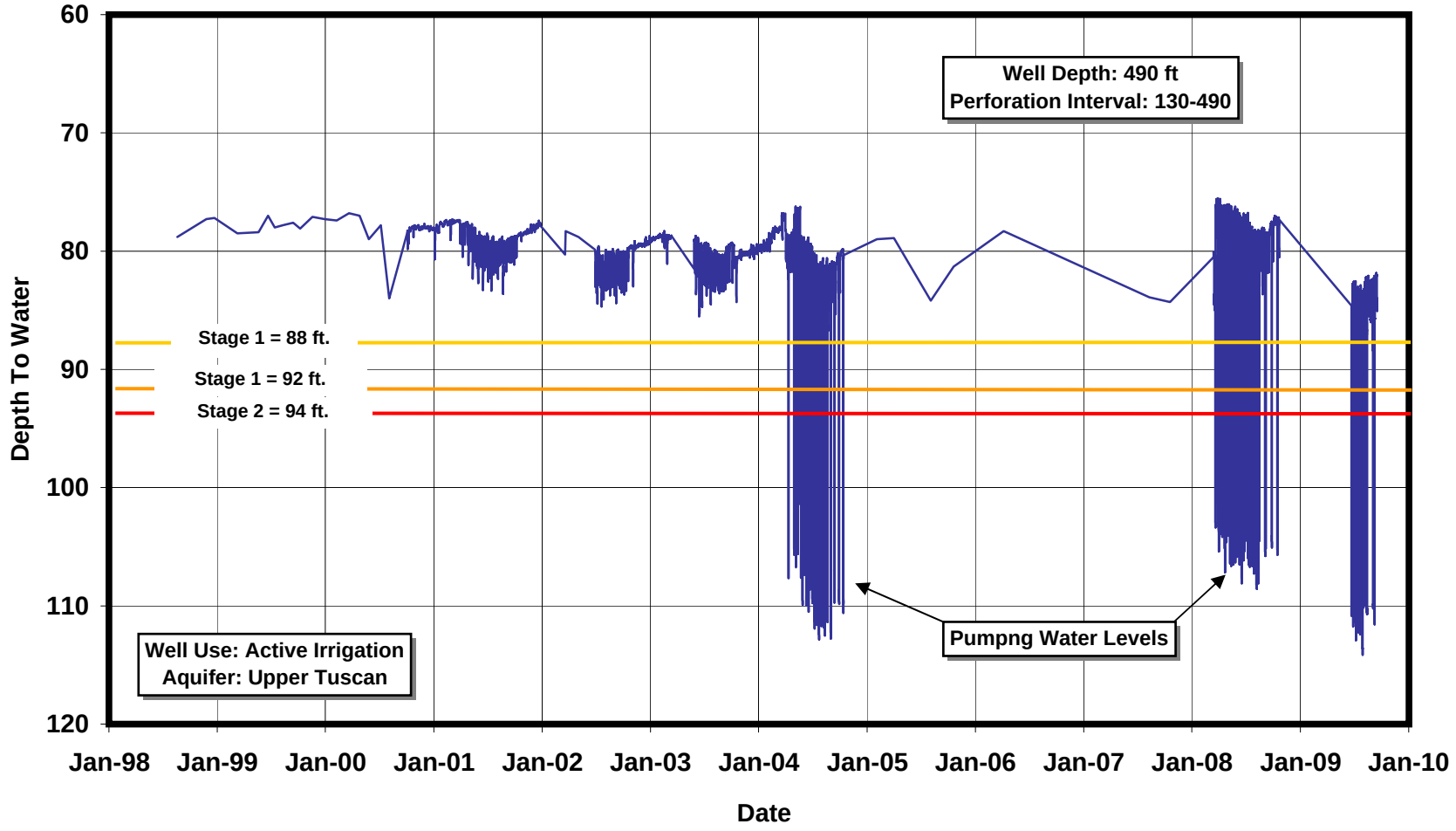
Key Well Hydrographs

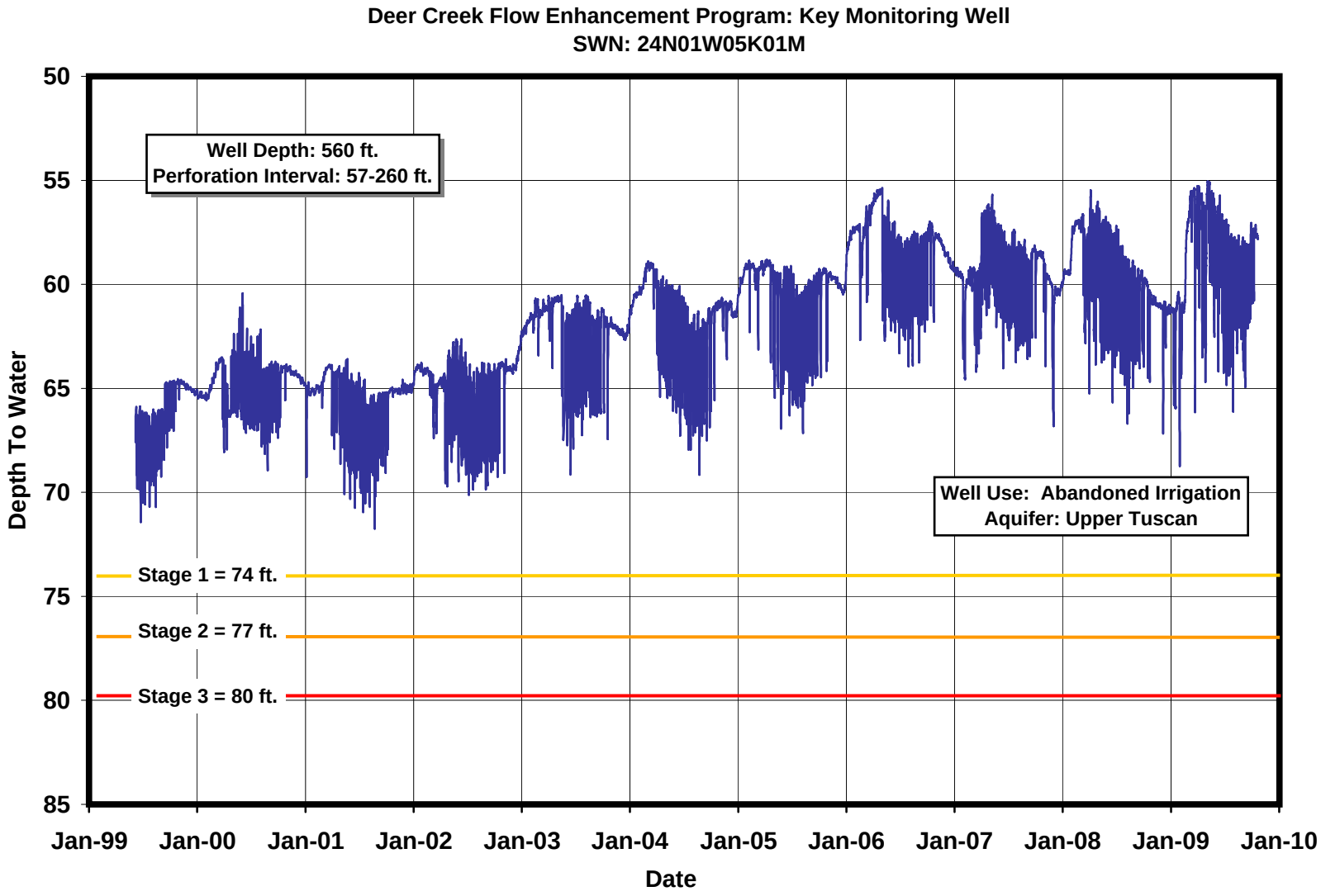
Deer Creek Flow Enhancement Program: Key Monitoring Well
SWN: 24N01W05J03M (MW-2s)

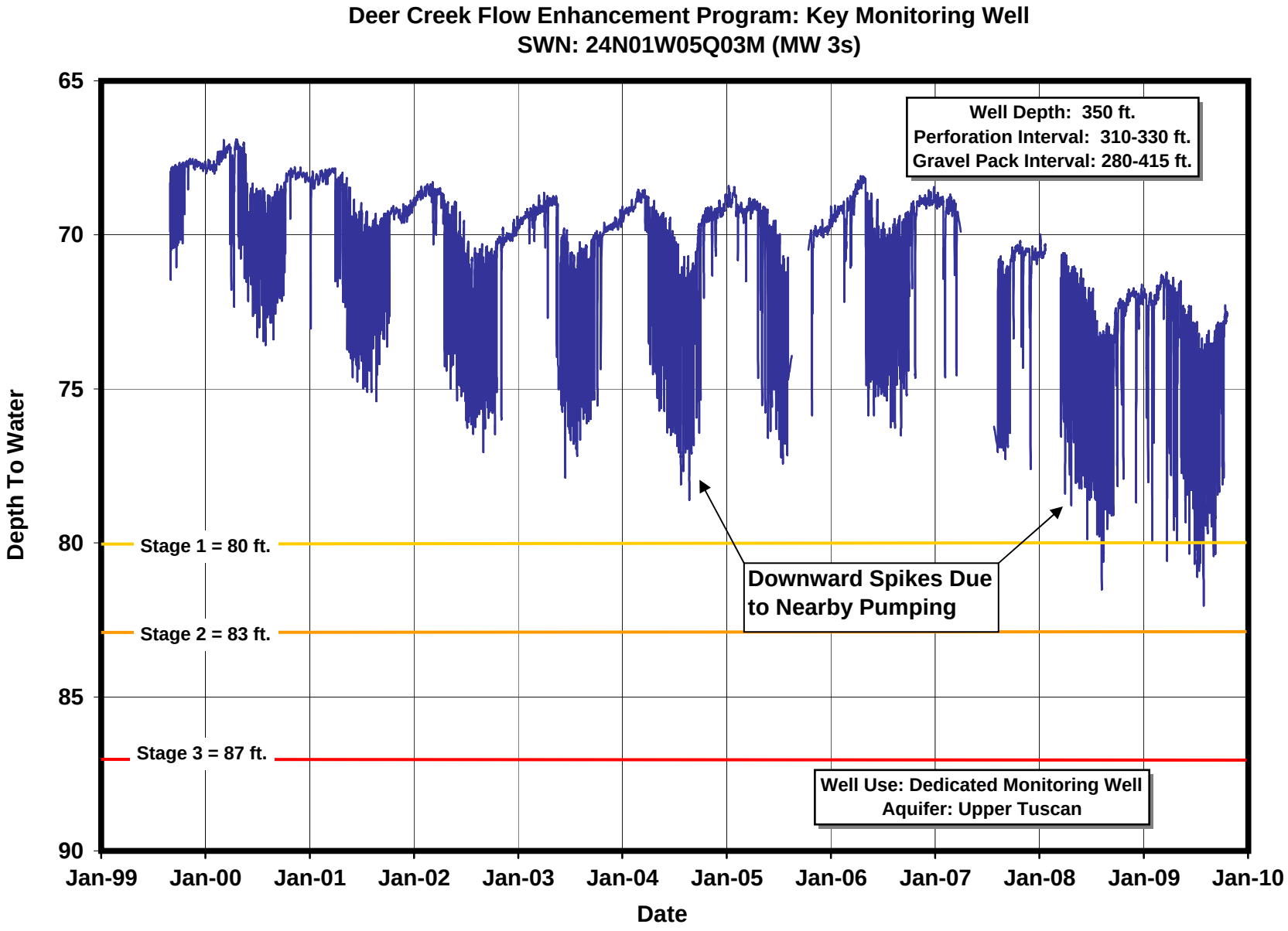



Deer Creek Flow Enhancement Program: Key Monitoring Well
SWN: 24N01W05J01M
Depth To Water
20
25
30
35
40
45
50
55
Jan-72
Jan-76
Jan-80
Jan-84
Jan-88
Jan-92
Jan-96
Jan-00
Jan-04
Jan-08
Date
Well Depth: 178 ft.
Perforation Interval: 57-178 ft
Stage 1 = 38 ft.
Stage 2 = 42 ft.
Stage 3 = 45 ft.
Well Use = Public Cemetery
Aquifer: Upper Tuscan
Pumping Water Levels

Deer Creek Flow Enhancement Program: Key Monitoring Well
SWN: 24N01W05G01M

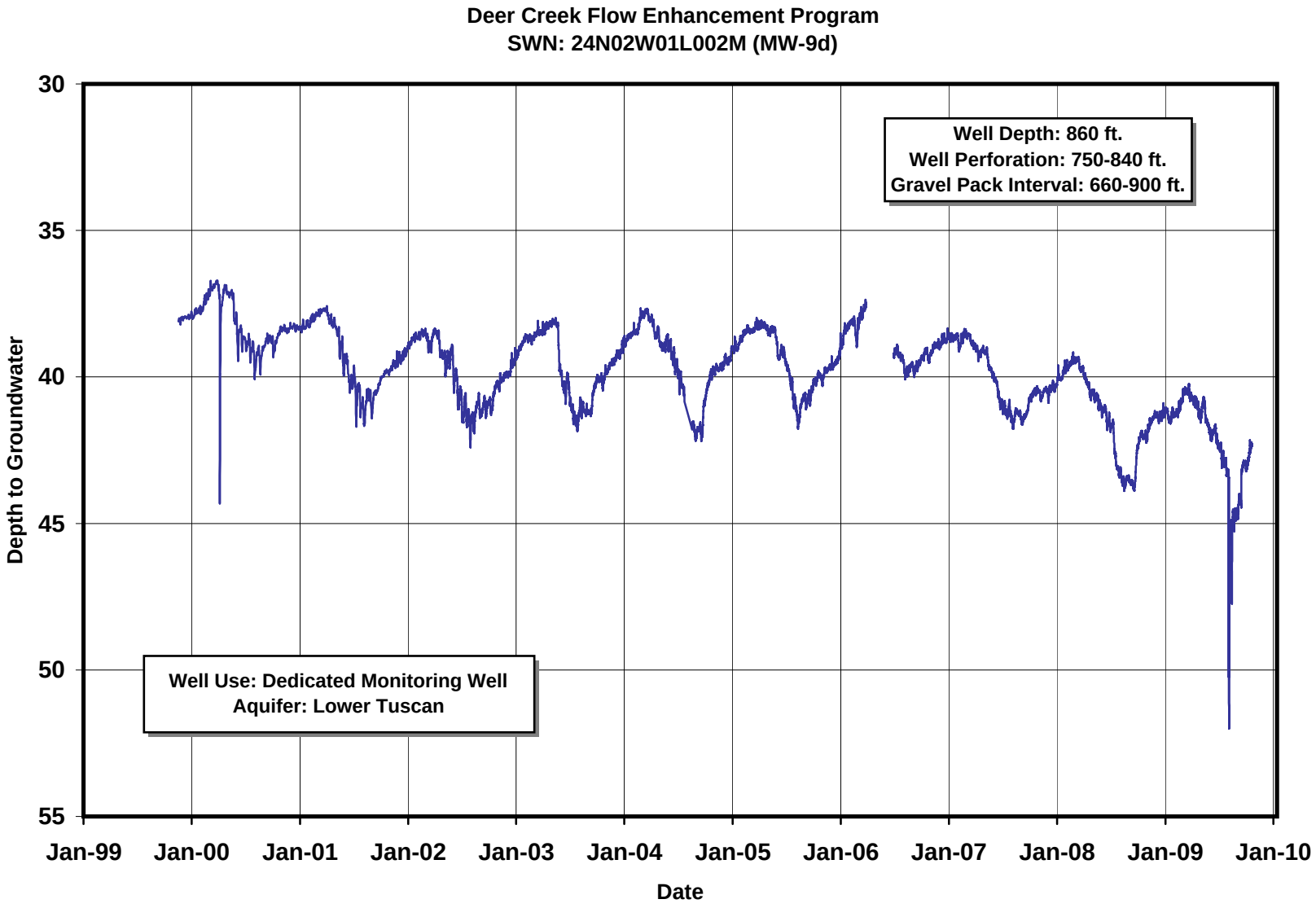


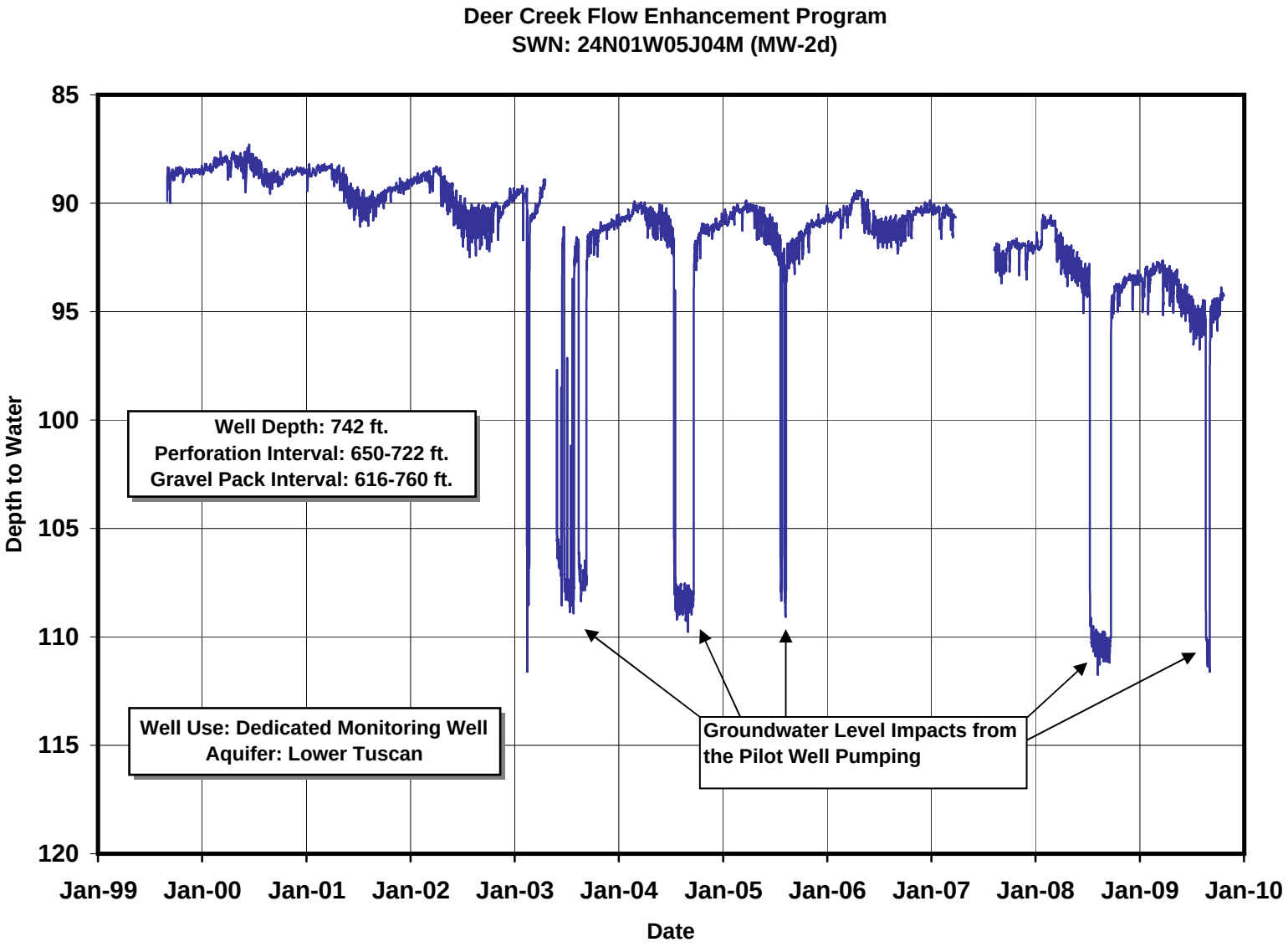

Deer Creek Flow Enhancement Program: Key Monitoring Well
SWN: 24N01W05K01M
Well Depth: 560 ft.
Perforation Interval: 57-260 ft.
Well Use: Abandoned Irrigation
Aquifer: Upper Tuscan
Stage 1 = 74 ft.
Stage 2 = 77 ft.
Stage 3 = 80 ft.
Depth To Water
50
55
60
65
70
75
80
85
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date

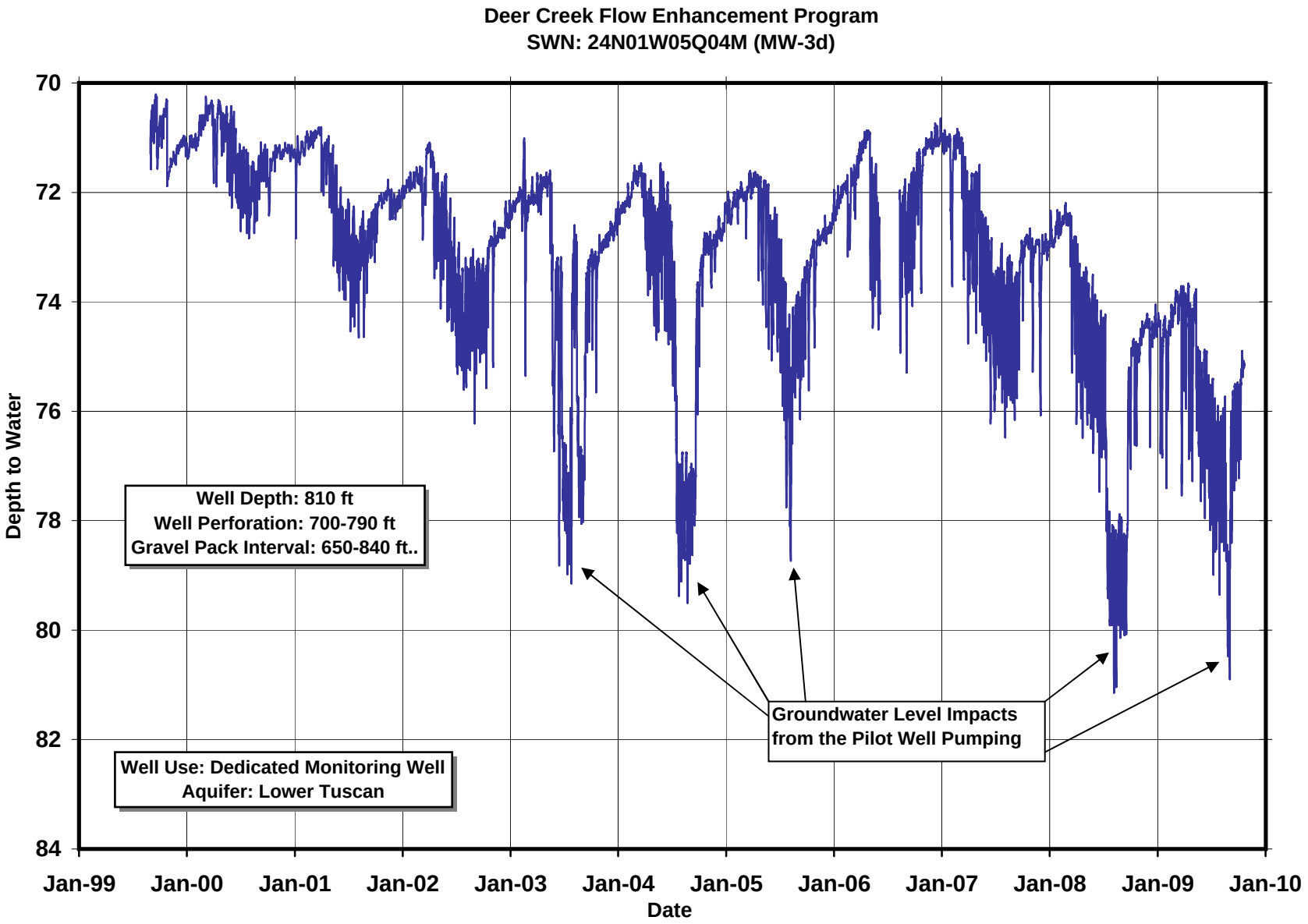

Deer Creek Flow Enhancement Program: Key Monitoring Well
SWN: 24N01W05Q03M (MW 3s)
Depth To Water
65
70
75
80
85
90
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date
Well Depth: 350 ft.
Perforation Interval: 310-330 ft.
Gravel Pack Interval: 280-415 ft.
Stage 1 = 80 ft.
Stage 2 = 83 ft.
Stage 3 = 87 ft.
Downward Spikes Due to Nearby Pumping
Well Use: Dedicated Monitoring Well
Aquifer: Upper Tuscan

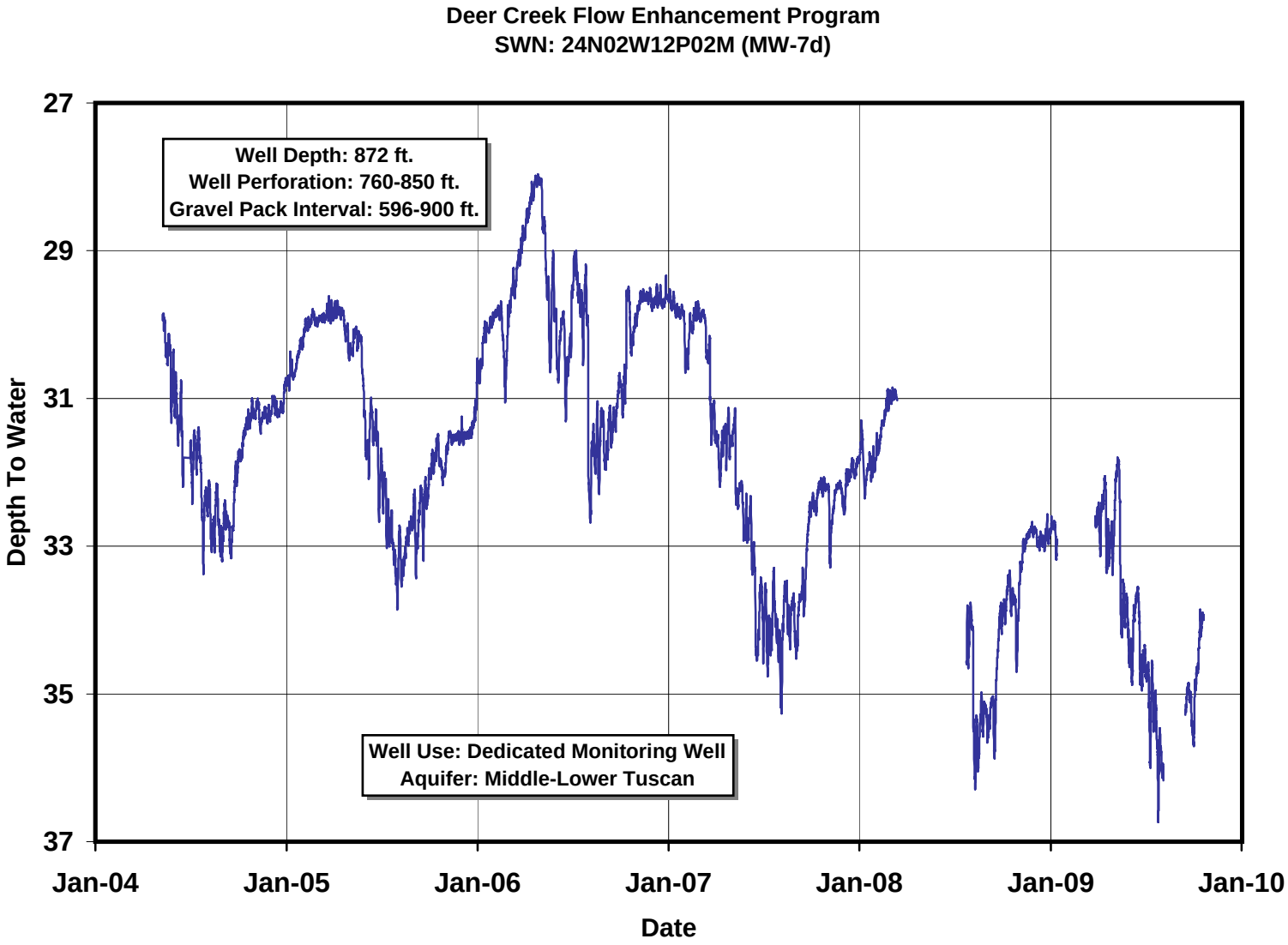
Appendix C

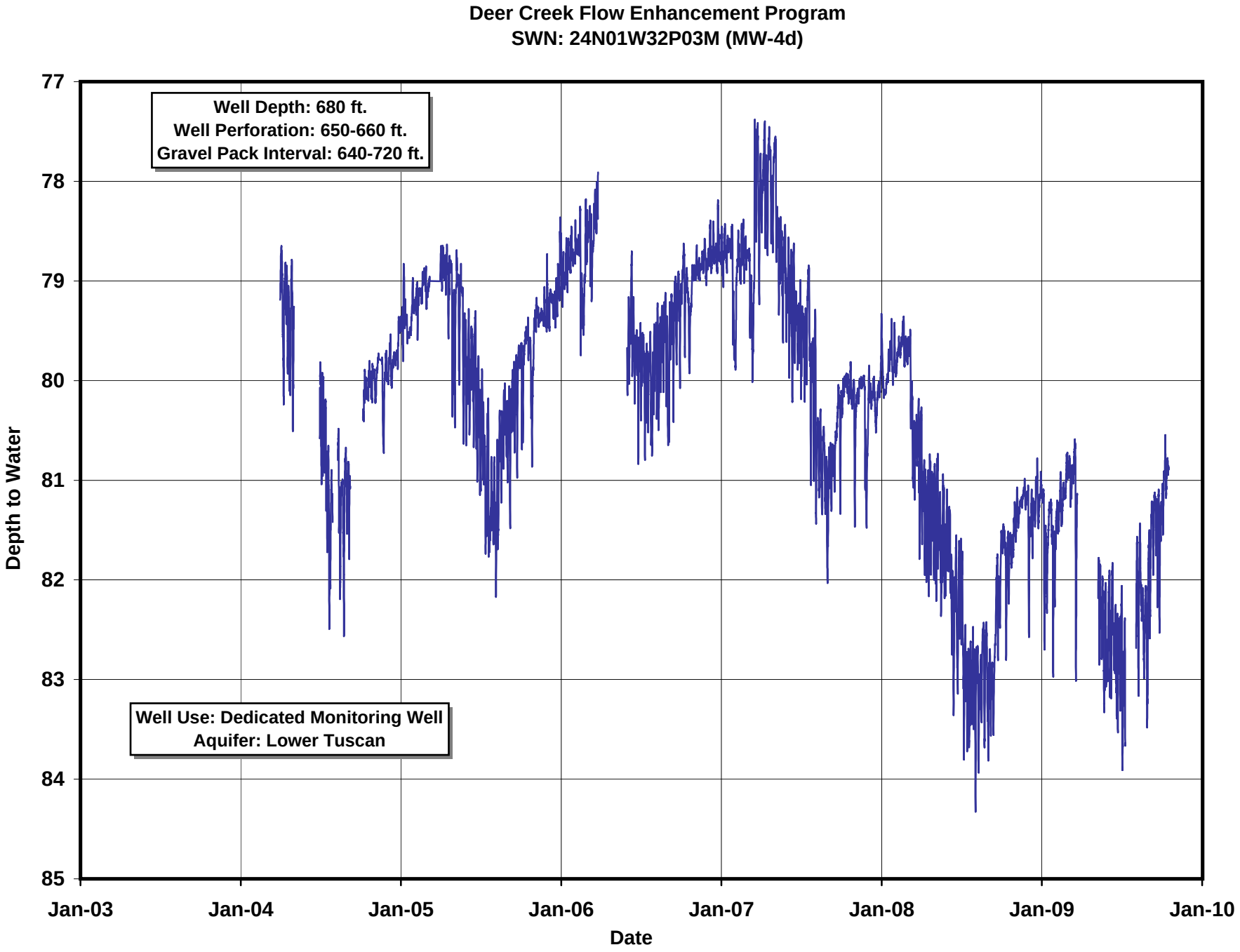
Deep Aquifer Hydrographs

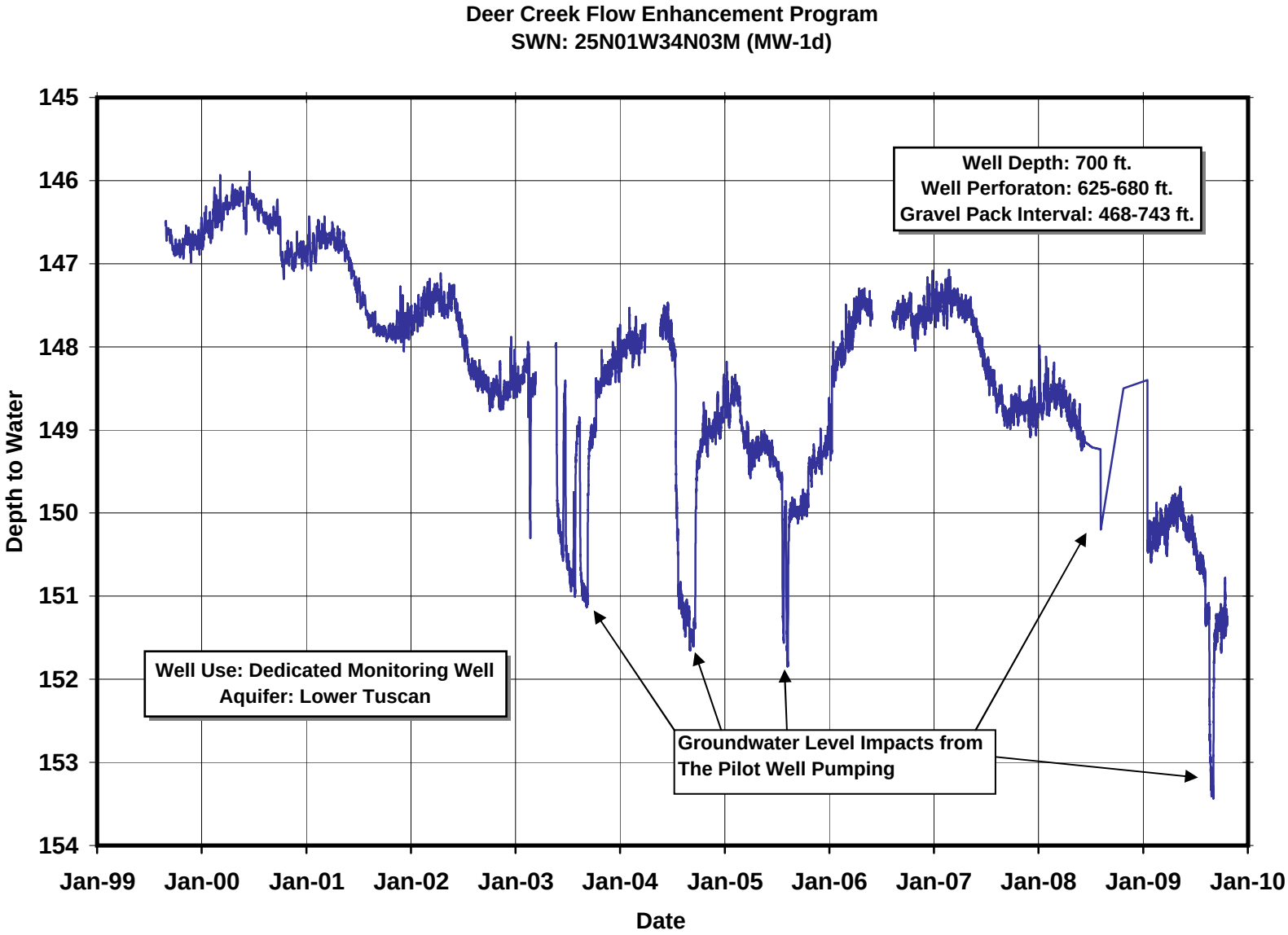

Deer Creek Flow Enhancement Program
SWN: 24N02W01L002M (MW-9d)
Depth to Groundwater
30
35
40
45
50
55
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date
Well Depth: 860 ft.
Well Perforation: 750-840 ft.
Gravel Pack Interval: 660-900 ft.
Well Use: Dedicated Monitoring Well
Aquifer: Lower Tuscan


Deer Creek Flow Enhancement Program
SWN: 24N01W05J04M (MW-2d)
Depth to Water
85
90
95
100
105
110
115
120
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date
Well Depth: 742 ft.
Perforation Interval: 650-722 ft.
Gravel Pack Interval: 616-760 ft.
Well Use: Dedicated Monitoring Well
Aquifer: Lower Tuscan
Groundwater Level Impacts from the Pilot Well Pumping


Deer Creek Flow Enhancement Program
SWN: 24N01W05Q04M (MW-3d)
Depth to Water
70
72
74
76
78
80
82
84
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date
Well Depth: 810 ft
Well Perforation: 700-790 ft
Gravel Pack Interval: 650-840 ft..
Well Use: Dedicated Monitoring Well
Aquifer: Lower Tuscan
Groundwater Level Impacts
from the Pilot Well Pumping


Deer Creek Flow Enhancement Program
SWN: 24N02W12P02M (MW-7d)
Well Depth: 872 ft.
Well Perforation: 760-850 ft.
Gravel Pack Interval: 596-900 ft.
Well Use: Dedicated Monitoring Well
Aquifer: Middle-Lower Tuscan
Depth To Water
27
29
31
33
35
37
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date


Deer Creek Flow Enhancement Program
SWN: 24N01W32P03M (MW-4d)
Well Depth: 680 ft.
Well Perforation: 650-660 ft.
Gravel Pack Interval: 640-720 ft.
Well Use: Dedicated Monitoring Well
Aquifer: Lower Tuscan
Depth to Water
77
78
79
80
81
82
83
84
85
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date


Deer Creek Flow Enhancement Program
SWN: 25N01W34N03M (MW-1d)
Depth to Water
145
146
147
148
149
150
151
152
153
154
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Date
Well Depth: 700 ft.
Well Perforaton: 625-680 ft.
Gravel Pack Interval: 468-743 ft.
Well Use: Dedicated Monitoring Well
Aquifer: Lower Tuscan
Groundwater Level Impacts from
The Pilot Well Pumping

Appendix D

Water Quality Data

Table 1
Temperature and Electrical Conductivity Measurements
at the Pilot Well (24N01W-04M01) and the DCID Canal

2009 DCID Water Quality Field Data				
Date	**Time**	**Location**	**EC**	**Temp.**
8/26/2009	8:15 AM	DCID Canal upstream from Pilot Well Discharge	159	67.5
8/26/2009	8:45 AM	Pilot Well at Discharge Line	136	61.7
8/26/2009	9:15 AM	DCID Canal downstream from Pilot Well Discharge	152	67.3
Note: EC is reported in µS/cm. Temp is reported in degrees Farenheit.				

Table 2

Minerals Analysis from the Pilot Well, DCID Canal Upstream, and DCID Canal Downstream of Pilot Well Discharge.

DCID 2009 Water Quality Data; Minerals			
WATER QUALITY CONSTITUENTS	**SAMPLE DATE,TIME AND LOCATION**		
	8/26/2009		
	Canal US	**Pilot Well**	**Canal DS**
MINERALS	8:15 am	8:45 am	9:15 am
pH (lab)	7.7	7.8	7.7
EC (lab)	173	160	171
Potassium (diss) (mg/L)	2.3	2.0	2.1
Sodium (diss) (mg/L)	13	9	12
Calcium (total) (mg/L)	13	13	13
Calcium (diss) (mg/L)	13	12	12
Magnesium (total) (mg/L)	8	10	8
Magnesium (diss) (mg/L)	8	10	8
Total Alkalinity (as CaCO3)	78	77	76
Sulphate (diss) (mg/L)	3	2	2
Chloride (diss) (mg/L)	5	3	3
Nitrate (diss) (mg/L)	<0.1	0.4	0.1
Total Dis. Solids (@ 180 F)	110	114	106
Turbidity (NTU)	Not tested	2.82	Not tested
Hardness (total) (mg/L as CaCO3)	65	71	65
Hardness (diss) (mg/L as CaCO3)	65	69	63
Boron (diss) (mg/L)	0.2	0.1	0.2
Carbonate (diss) (mg/L)	1	1	1
Bicarbonate (diss) (mg/L)	75	71	75
Hydroxide (diss) (mg/L)	<1	1	<1

Table 3

Metals and Nutrients sampled from the Pilot Well, DCID Canal Up-stream, and DCID Canal Downstream of the Pilot Well Discharge.

DCID 2009 Water Quality Data; Metals and Nutrients			
WATER QUALITY CONSTITUENTS	**SAMPLE DATE,TIME AND LOCATION**		
	8/26/2009		
	Canal US	**Pilot Well**	**Canal DS**
METALS (total)	8:15 am	8:45 am	9:15 am
Aluminum (total) (µg/L)	70	3.39	27.4
Aluminum (diss) (µg/L)	1.61	3	2.09
Arsenic (total) (µg/L)	8.02	1.54	6.04
Arsenic (diss) (µg/L)	7.83	1.44	6
Cadmium (total) (µg/L)	<0.1	<0.1	<0.1
Cadmium (diss) (µg/L)	<0.1	<0.1	<0.1
Chromium (total) (µg/L)	0.58	0.57	0.49
Chromium (diss) (µg/L)	0.31	0.54	0.37
Copper (total) (µg/L)	0.43	0.25	0.24
Copper (diss) (µg/L)	0.32	0.23	0.18
Iron (total) (µg/L)	111	8	35.4
Iron (diss) (µg/L)	15.8	5.8	12.8
Lead (total) (µg/L)	<0.04	0.055	<0.04
Lead (diss) (µg/L)	<0.04	0.053	<0.04
Manganese (total) (µg/L)	8.95	0.6	3.23
Manganese (diss) (µg/L)	0.4	0.56	0.41
Mercury (total) (µg/L)	0.2	<0.2	<0.2
Nickel (total) (µg/L)	0.4	0.12	0.27
Nickel (diss) (µg/L)	0.35	<0.1	0.2
Selenium (total) (µg/L)	<0.2	<0.2	<0.2
Selenium (diss) (µg/L)	<0.2	<0.2	<0.2
Zinc (total) (µg/L)	1.63	1.77	1.32
Zinc (diss) (µg/L)	0.41	0.49	<0.1
Silver (total) (µg/L)	<0.03	<0.03	<0.03
Silver (diss) (µg/L)	<0.03	<0.03	<0.03
NUTRIENTS	**Canal US**	**Pilot Well**	**Canal DS**
Nitrate + Nitrite (diss) (mg/L)	<0.01	0.07	0.04
Ammonia (total) (mg/L)	<0.01	<0.01	<0.01
Ammonia (diss) (mg/L)	<0.01	<0.01	<0.01
Ortho-phosphate (diss) (mg/L)	<0.01	0.03	0.01
Phosphorous (total) (mg/L)	0.01	0.04	0.02

Table 4
RWQCB Recommended Numerical Water Quality Limits for Metals

Constituent or Parameter (Synonym)	Water Quality Objective or Promulgated Criterion	Recommended Numerical Limits			G = Groundwater IS = Inland Surface Water
		Source / Averaging Period	Limit	Units	
Aluminum	Chemical Constituents	California Primary MCL	1000	ug/L	G & IS
		California Secondary MCL	200	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	5000	ug/L	G & IS
	Tastes and Odors	California Secondary MCL	200	ug/L	G & IS
	Toxicity - humans	California Public Health Goal for Drinking Water	600	ug/L	G & IS
	Toxicity - aquatic life	USEPA National Recomm. W Q Criteria / 4-day avg (total) (f)	87	ug/L	IS
		USEPA National Recomm. W Q Criteria / 1-hour avg (total)	750	ug/L	IS
Arsenic	Chemical Constituents	California Primary MCL	50	ug/L	G & IS
		USEPA Primary MCL	10	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	100	ug/L	G & IS
	Toxicity - humans	Cal/EPA Cancer Potency Factor as a drinking water level (b)	0.023	ug/L	G & IS
		USEPA National Ambient Water Quality Criteria	0.018	ug/L	IS
	CTR - aquatic life	Californa Toxics Rule (USEPA) / 4-day average (dissolved)	150	ug/L	IS
		Californa Toxics Rule (USEPA) / 1-hour average (dissolved	340	ug/L	IS
Cadmium	Chemical Constituents	California Primary MCL	5	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	10	ug/L	G & IS
	Toxicity - humans	California Public Health Goal for Drinking Water	0.07	ug/L	G & IS
	CTR - aquatic life	Californa Toxics Rule (USEPA	see Page 19 tab		IS
Chromium (III)	Chemical Constituents	California Primary MCL	see Cr (total)		G & IS
	Toxicity - humans	USEPA IRIS Reference Dose (c)	10,500	ug/L	G & IS
	NTR - aquatic life	National Toxics Rule (USEPA	see Page 21 tab		IS
Chromium (VI)	Chemical Constituents	California Primary MCL	see Cr (total)		G & IS
		Water Quality for Agriculture (Ayers & Westcot)	100	ug/L	G & IS
	Toxicity - humans	USEPA IRIS Reference Dose (c)	21	ug/L	G & IS
	CTR - aquatic life	Californa Toxics Rule (USEPA) / 4-day average (dissolved)	11	ug/L	IS
		Californa Toxics Rule (USEPA) / 1-hour average (dissolved	16	ug/L	IS
Chromium (total	Chemical Constituents	California Primary MC	50	ug/L	G & IS
Copper	Chemical Constituents	California Primary MCL	1300	ug/L	G & IS
		California Secondary MCL	1000	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	200	ug/L	G & IS
	Tastes and Odors	California Secondary MCL	1000	ug/L	G & IS
	Toxicity - humans (a)	California Public Health Goal for Drinking Water	170	ug/L	G
	CTR - humans	Californa Toxics Rule (USEPA) for sources of drinking water	1300	ug/L	IS
	CTR - aquatic life	Californa Toxics Rule (USEPA	see Page 23 tab		IS
Iron	Chemical Constituents	California Secondary MCL	300	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	5000	ug/L	G & IS
	Tastes and Odors	California Secondary MCL	300	ug/L	G & IS
	Toxicity - aquatic life	USEPA National Ambient W Q Criteria / 4-day averag	1000	ug/L	IS
Lead	Chemical Constituents	California Primary MCL	15	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	5000	ug/L	G & IS
	Toxicity - humans	California Public Health Goal for Drinking Water	2	ug/L	G & IS
	CTR - aquatic life	California Toxics Rule (USEPA	see Page 24 tab		IS
Manganese	Chemical Constituents	California Secondary MCL	50	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	200	ug/L	G & IS
	Tastes and Odors	California Secondary MCL	50	ug/L	G & IS
	Toxicity - humans	California DHS Action Level for drinking water	500	ug/L	G & IS
Mercury (see also Methylmercury)	Chemical Constituents	California Primary MCL	2	ug/L	G & IS
	Toxicity - humans (a)	California Public Health Goal for Drinking Water	1.2	ug/L	G
	Toxicity - aquatic life	USEPA National Ambient W Q Criteria / 4-day average	0.77	ug/L	IS
		USEPA National Ambient W Q Criteria / 1-hour average	1.4	ug/L	IS
	CTR - humans	Californa Toxics Rule (USEPA) for sources of drinking water	0.05	ug/L	IS
Methylmercury	Toxicity - humans	USEPA IRIS Reference Dose (c)	0.07	ug/L	G & IS
		USEPA National Ambient W Q Criteria (fish tissue	0.3	mg/kg	IS
Nickel	Chemical Constituents	California Primary MCL	100	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	200	ug/L	G & IS
	Toxicity - humans (a)	California Public Health Goal for Drinking Water	12	ug/L	G
	CTR - humans	Californa Toxics Rule (USEPA) for sources of drinking water	610	ug/L	IS
	CTR - aquatic life	Californa Toxics Rule (USEPA; dissolved	see Page 25 tab		IS
Selenium	Chemical Constituents	California Primary MCL	50	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	20	ug/L	G & IS
	Toxicity - humans	USEPA IRIS Reference Dose (c)	35	ug/L	G & IS
	NTR - aquatic life	National Toxics Rule (USEPA) / 4-day average (total)	5	ug/L	IS
		National Toxics Rule (USEPA) / 1-hour average (tota	20	ug/L	IS
Silver	Chemical Constituents	California Secondary MCL	100	ug/L	G & IS
	Tastes and Odors	California Secondary MCL	100	ug/L	G & IS
	Toxicity - humans	USEPA IRIS Reference Dose (c)	35	ug/L	G & IS
	CTR - aquatic life	Californa Toxics Rule (USEPA	see Page 28 tab		IS
Zinc	Chemical Constituents	California Secondary MCL	5000	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	2000	ug/L	G & IS
	Tastes and Odors	California Secondary MCL	5000	ug/L	G & IS
	Toxicity - humans	USEPA IRIS Reference Dose (c)	2100	ug/L	G & IS
	CTR - aquatic life	Californa Toxics Rule (USEPA	see Page 30 tab		IS

Note: Based on a Compilation of Water Quality Goals established by California Regional Water Quality Control Board, Central Valley Region

(a) For surface waters, this limit may be preempted by a Calfornia Toxics Rule or National Toxics Rule criterion.

(b) Assumes 70 kg body weight and 2 liters per day drinking water consumption.

(c) Assumes 70 kg body weight, 2 liters per day drinking water consumption, and 20 percent relative source contrubution. An additional undertainty factor of 10 is used for Class C carcinogens.

(d) Applies to "TCDD Equivalents" calculated from the concentrations of 2,3,7,8-chlorinated dibenzodioxins and 2,3,7,8-chlorinated dibenzofurans and their corresponding toxic equivalency factors (TEFs).

(e) Applies separately to Aroclors 1242, 1254, 1221, 1232, 1248, 1260, and 1016.

(f) USEPA, Region 9 has allowed acid soluble to account for suspended clay partices in receiving water.

(g) Potency Equivalency Factors, published by the Cal/EPA Office of Enviornmental Health Hazard Assessment, relate the relative cancer potencies of various polynuclear aromatic hydrocarbons to that of benzo(a)pyrene.

CTR California Toxics Rule

MFL Million fibers per liter; limited to fibers longer than 10 um.

NTR National Toxics Rule

Table 5
RWQCB Recommended Numerical Water Quality Limits for Physical, Nutrient and Mineral Parameters

Constituent or Parameter (Synonym)	Water Quality Objective or Promulgated Criterion	Recommended Numerical Limits			G = Groundwater IS = Inland Surface Water
		Source / Averaging Period	Limit	Units	
Ammonia (Ammonium)	Tastes and Odors	Odor threshold (Amoore and Hautala)	1500	ug/L	G & IS
	Toxicity - humans	USEPA Draft Health Advisory	30,000	ug/L	G & IS
	Toxicity - aquatic life	USEPA National Ambient Water Quality Criteria	see Page 17 tab		IS
Chloride	Chemical Constituents	California Secondary MCL	250,000	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	106,000	ug/L	G & IS
	Tastes and Odors	California Secondary MCL	250,000	ug/L	G & IS
	Toxicity - aquatic life	USEPA National Ambient W Q Criteria / 4-day average	230,000	ug/L	IS
		USEPA National Ambient W Q Criteria / 1-hour average	860,000	ug/L	IS
Nitrate (expressed as nitrogen)	Chemical Constituents	California Primary MCL	10,000	ug/L	G & IS
	Toxicity - humans	California Public Health Goal for Drinking Water	10,000	ug/L	G & IS
pH	Chemical Constituents	USEPA Secondary MCL	6.5 to 8.5	units	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	6.5 to 8.4	units	G & IS
	Tastes and Odors	USEPA National Ambient W Q Criteria / taste & odor	5 to 9	units	G & IS
	Toxicity - aquatic life	USEPA National Ambient W Q Criteria / Inst Min & Max	6.5 to 9	units	IS
Sodium	Chemical Constituents	Water Quality for Agriculture (Ayers & Westcot)	69	mg/L	G & IS
	Tastes and Odors	Taste and odor threshold (USEPA Drinking Water Advisory)	30 to 60	mg/L	G & IS
	Toxicity - humans	USEPA draft Drinking Water Advisory	20	mg/L	G & IS
Specific conductance (Electrical Conductivity)	Chemical Constituents	California Secondary MCL	900	umhos/cm	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	700	umhos/cm	G & IS
		Basin Plan for Feather River	150	umhos/cm	IS
	Tastes and Odors	California Secondary MCL	900	umhos/cm	G & IS
Sulfate	Chemical Constituents	California Secondary MCL (Ambient level)	250	mg/L	G & IS
		California Secondary MCL (upper level)	500	mg/L	G & IS
	Tastes and Odors	California Secondary MCL (Ambient level)	250	mg/L	G & IS
	Toxicity - humans	USEPA Proposed MCL Goal	500	mg/L	G & IS
Total Dissolved Solids (TDS)	Chemical Constituents	California Secondary MCL	500,000	ug/L	G & IS
		Water Quality for Agriculture (Ayers & Westcot)	450,000	ug/L	G & IS
	Tastes and Odors	California Secondary MCL	500,000	ug/L	G & IS

Note: Table is Based on a Compilation of Water Quality Goals established by California Regional Water Quality Control Board, Central Valley Region

(a) For surface waters, this limit may be preempted by a Calfornia Toxics Rule or National Toxics Rule criterion.
(b) Assumes 70 kg body weight and 2 liters per day drinking water consumption.
(c) Assumes 70 kg body weight, 2 liters per day drinking water consumption, and 20 percent relative source contrubution. An additional undertainty factor of 10 is used for Class C carcinogens.
(d) Applies to "TCDD Equivalents" calculated from the concentrations of 2,3,7,8-chlorinated dibenzodioxins and 2,3,7,8-chlorinated dibenzofurans and their corresponding toxic equivalency factors (TEFs).
(e) Applies separately to Aroclors 1242, 1254, 1221, 1232, 1248, 1260, and 1016.
(f) USEPA, Region 9 has allowed acid soluble to account for suspended clay partices in receiving water.
(g) Potency Equivalency Factors, published by the Cal/EPA Office of Enviornmental Health Hazard Assessment, relate the relative cancer potencies of various polynuclear aromatic hydrocarbons to that of benzo(a)pyrene.

CTR California Toxics Rule
MFL Million fibers per liter; limited to fibers longer than 10 um.
NTR National Toxics Rule