DEER CREEK FLOW ENHANCEMENT PROGRAM

TEHAMA COUNTY PERMIT APPLICATION
TO EXTRACT GROUNDWATER
FOR OFF PARCEL USE

April 2009

Prepared By:
Deer Creek Irrigation District

In Cooperation with
Department of Water Resources
Northern District
# DEER CREEK FLOW ENHANCEMENT PROGRAM

## PERMIT APPLICATION FOR GROUNDWATER EXTRACTION AND OFF PARCEL USE

### TABLE OF CONTENTS

- TEHAMA COUNTY APPLICATION FORM FOR GROUNDWATER EXTRACTION AND OFF PARCEL USE 1
- INTRODUCTION 3
- BACKGROUND 5
- REQUESTED INFORMATION FOR THE GROUNDWATER EXTRACTION AND OFF PARCEL USE PERMIT 8
  - 1) Plot Plans Of The Well Parcel And Any Adjacent Parcels Within 2,000 Feet of the Well 8
  - 2) All Available Reports Pertaining to the Construction and Production of the Originating Well. List of Other Well Information for the Originating Well and Any Other Wells Within 2,000 Feet of the Well 8
  - c. Anticipated Pumping Rate and Seasonal Volume Used on the Off Parcel Sites 14
  - 4) Land Use for the Originating and Off Parcel Well Locations 14
  - 5) Geology and Hydrogeology 16
    - Geology and Groundwater Bearing Units 16
    - Groundwater Levels and Direction of Groundwater Flow 21
    - Pilot Well Monitoring and Management 25
    - Groundwater Level Monitoring and Program Management 25
    - Water Quality Monitoring and Management 37

- REFERENCES 39
FIGURES

Figure 1. Project Location Map 3
Figure 2. Parcel Map of the Test-Production Well Area 9
Figure 3. As-Built Design for the Pilot Program Production Well 11
Figure 4. DWR Well Completion Report for the Production Well 12
Figure 5. Land Use for the DCID Service Area 15
Figure 6. Regional Geologic Map of the Project Area 17
Figure 7. Description of Geologic Map Units 18
Figure 8. Geologic Cross-Section A-A’, Located South of the Deer Creek Project Area 19
Figure 9. Geologic Cross-Section B-B’, Located Through the Deer Creek Project Area 20
Figure 10. Groundwater Hydrograph for Domestic Monitoring Well 24N01W-05J01 22
Figure 11. Groundwater Hydrograph for Idle Agricultural Well 24N01W-05G01 23
Figure 12. Tehama County, Spring 2008 Groundwater Contour Map 24
Figure 13. Regional Groundwater Level Monitoring Grid 27
Figure 14. Local “Key Well” Monitoring Grid 28
Figure 15. Groundwater Level Hydrograph for the DCID Pilot Well 30
Figure 16. 2004 Distance Versus Drawdown Curve in the Lower Tuscan aquifer 36
Figure 17. 2004 Groundwater Drawdown in the Lower Tuscan Aquifer During Pilot Well Pumping 37

TABLES

Table 1. Permit Information for Wells Located within 2000 feet of the Test-Production Well 10
Table 2. Permit Information for Well Located within 4000 feet of the Test-Production Well 10
Table 3. Land Use Data for DCID 14
Table 4. Key Monitoring Wells, Construction, and Use 28
Table 5. Deep Aquifer Monitoring Well Construction 29
Table 6. Approximate Deep Aquifer Drawdown from 2004 Pilot Well Operations 36

APPENDIX A. 41

Groundwater Extraction and Off Parcel Use Permit NO. WE-03/01, Groundwater Extraction and Off Parcel Use Permit NO. WE-03/01, Amended May 18, 2004
APPENDIX B. 44

Deer Creek Flow Enhancement Program Memorandum of Agreement

APPENDIX C. 45

Parcel Maps of the Production Well Area

APPENDIX D. 48

Hydrographs – Key Monitoring Wells

APPENDIX E. 52

Hydrographs – Deep Aquifer
GROUNDWATER EXTRACTION & OFF PARCEL USE

Type of Well: New Construction [   ] Existing Well [ X ]
Owner's Name: Deer Creek Irrigation District

Mailing Address:

Applicant's Name: John Edson, President; Deer Creek Irrigation District
Mailing Address: Post Office Box 154
Vina, CA  96092

Site Location: NW ¼, SW ¼, Sec 4, T24N, R01W.
APN: 079-040-32

Requested Well Information:

1. Provide two copies of a scaled plot plan of the well parcel and any adjacent parcels within 2,000 feet of the well. Note locations of natural waterways, on-site sewage disposal systems, other wells (including their uses and depths, if known), structures, etc.
   - See (1) in the Requested Well Information section of the attached document, page 8.

2. Provide copies of all available reports pertaining to the construction and production of the originating well (DWR Well Driller's Report, PG&E pumping data, etc.). List the following information for the originating well and any existing well within a 2,000 feet radius of the production well.
   - See (2) in the Requested Well Information section of the attached document, pages 8-10.

   a. Well Use:
   b. Casing Diameter:
   c. Total Well Depth:
   d. Perforation Interval:
   e. Depth of Annular Seal:
   f. Pump Type & Horsepower:
   g. Depth of Pump:
   h. Static Groundwater Level:
   i. Pumping Groundwater Level:
3. a. What is the anticipated maximum draw of the groundwater in gallons per minute and gallons per-day? List the anticipated daily, weekly and monthly pumping schedule.

- See (3a) in the Requested Well Information section of the attached document, page 10.

b. List the anticipated rate in gallons per minute or gallons per day, and the total seasonal volume or amount in gallons or acre-feet of water that will be used on the originating parcel.

- See (3b) in the Requested Well Information section of the attached document, page 13.

c. List the anticipated rate in gallons per minute or gallons per day, and the total seasonal volume or amount in gallons or acre-feet of water that will be used on the off-parcel sites.

- See (3c) in the Requested Well Information section of the attached document, page 14.

4. List the existing land use and the proposed land use changes for the originating and off parcel well locations.

- See (4) in the Requested Well Information section of the attached document, page 14.

5. Describe the general hydrology and geology of the area. Discuss the proposed use of the well in terms of specific capacity, recharge, safe yield, and radius of influence. A further specific hydrogeological study identifying the effects this proposed use would have on the affected groundwater, and the affected aquifer or aquifers may be required, including the hydraulic gradient; hydrology; percolation; permeability; piezometric surface; porosity; recharge; safe yield; salt water intrusion; specific capacity; spreading water; transmissivity; usable storage capacity; water table; and zone of saturation.

- See (5) in the Requested Well Information section of the attached document, pages 14-38.
Introduction

In cooperation with the Northern District Department of Water Resources (DWR), the Deer Creek Irrigation District (DCID) is applying for a permit to extract groundwater from the test production well (State Well Number 24N01W04M01M) for off parcel use. All of the groundwater extracted from the production well will be pumped into the DCID canal and distributed to parcels within the Deer Creek Irrigation District service area.

DCID has received two prior permits for operating well 24N01W04M01M up to 550 acre-feet in 2003 and 2004. Copies of the 2003 and 2004 permits are included in Appendix A. Figure 1 below shows the project area and the location of the pilot production well. The project area is the DCID district boundary and is located northeast of the town of Vina and Highway 99 in the southeastern portion of Tehama County. The Stanford Vina Ranch Irrigation District (SVRIC) service area is also shown on Figure 1. Several wells are monitored in and around the SVRIC area as part of the DCID project.

![Figure 1. Project Location Map](image-url)
The extraction well is part of the Deer Creek Flow Enhancement Program (formally the “Deer Creek Water Exchange Pilot Program”) designed to test the effectiveness of increasing the fish transportation flows in Deer Creek by seasonally substituting bypassed surface water for groundwater. A secondary element of the pilot program in 2003 and 2004 was to implement and test the effectiveness of newly developed guidelines for program operations and management. The guidelines, or Groundwater Management Objectives, were designed to eliminate third party impacts by combining a rigorous program of groundwater monitoring with a clear set of groundwater level and groundwater quality criteria for groundwater pumping operations.

In September, 2007, a Memorandum of Agreement (MOA) for the Deer Creek Flow Enhancement Program (DCFEP) was entered into between the Department of Fish and Game (DFG) and the Department of Water Resources (DWR), and the Deer Creek Irrigation District (DCID). The DCFEP is designed to fulfill the water needs of local agricultural and domestic water users, while achieving the fisheries flow objectives for salmon and steelhead in Deer Creek and the groundwater protection requirements set forth by the Tehama County AB 3030 Groundwater Management Plan. The DCFEP includes implementation of a long-term agreement with DCID to bypass Deer Creek surface water, which would otherwise have been diverted for agricultural use. The bypass surface water will remain in-stream for fish migration flows in exchange for developing and supplying groundwater in an amount equal to the bypassed flows. The main components of the DCFEP include development of a supplemental water supply, implementation of agricultural water use efficiency improvements, and incorporation of groundwater and fish passage assessment monitoring. The DCFEP will be implemented in two phases:

- **Phase 1** - The installation and operation of up to two additional agricultural supply wells, and/or the retrofitting and leasing of up to two existing agricultural wells to create a capacity of 10 cubic feet per second (cfs) of groundwater, which will be used in exchange for surface water bypassed by DCID.
- **Phase 2** - Determine what amount of additional transportation flow can be made available to the Program through the implementation of the agricultural water use efficiency measures and water management improvements.

The MOA, as it pertains to this permit application, includes the Groundwater Monitoring and Management Guidelines. The guidelines are similar to the management objectives used successfully during DCID’s 2003 pilot program and the 2004 test-pumping program and establish a clear set of criteria for program monitoring, reporting, and management. The Groundwater and Management Guidelines also conform to the newly developed Trigger Level criteria for the Vina Sub-basin, developed by the Tehama County Flood Control and Water Conservation District for the county-wide Groundwater Management Plan. The DCFWP Groundwater Monitoring and Management Guidelines include the following:

- Program Coordination and Institutional Authority
- Groundwater Level Criteria
- Groundwater Quality Criteria
- Annual Reporting

DCID proposes using these guidelines to operate the pilot well program as part of this permit application. The MOA is included in Appendix B of this document. The Groundwater Monitoring and Management Guidelines are included in Appendix C of the MOA.
Background

Deer Creek Irrigation District is a political subdivision of the State of California, duly organized and existing under Division 11 of the California Water Code and providing water service for the irrigation of lands and crops and for domestic and municipal purposes within the county of Tehama.

Deer Creek represents one of the State’s largest undammed watersheds and provides valuable habitat for anadromous fish, particularly the listed or threatened, spring-run, fall-run, and late fall-run Chinook salmon, and steelhead trout. With over 38 miles of ideal spawning and holding habitat, Deer Creek has been identified as having the greatest potential of all Sacramento Valley streams for increasing naturally spawning populations of steelhead and spring-run Chinook salmon. Deer Creek also contributes to valuable surface water beneficial uses, including agriculture, recreation, freshwater habitat, migration, spawning, and wildlife habitat.

Due in part to naturally occurring low flows and diversions by DCID and Stanford Vina Ranch Irrigation Company, the upstream migration of spring-run salmon adults or downstream migration of juvenile spring-run salmon may be impeded or blocked during April, May, June, or October. In 1989, the Upper Sacramento River Fisheries and Riparian Habitat Management Plan concluded that the most serious impact to the Deer Creek fishery is the reduction of transportation flows. In the 1993 report, Restoring Central Valley Streams; A Plan for Action, CDFG assigned an A-1 priority to negotiating an agreement to obtain adequate instream transportation flow. In 1997, USFWS published the Revised Draft Restoration Plan for the Anadromous Fish Restoration Program. The USFWS plan prioritized reasonable actions to ensure passage of spring-run salmon in Deer Creek and assigned a high priority to negotiating agreements to supplement instream flows in the lower ten miles of Deer Creek. Although what constitutes sufficient flow for migration is not known, the blockage or impediments to migration can be alleviated, in part, by DCID bypassing surface water that it would otherwise divert for irrigation purposes.

In 1994, the Delta Pumps Fish Protection Agreement Advisory Committee agreed to fund the development of a Deer Creek Water Exchange Project with a goal of providing 50 cfs of supplemental transportation flow during times of critical need.

From 1994 to 2003, DWR worked with Tehama County and DCID to study various scenarios to increase fish transportation flows in Deer Creek. In 1998 and 1999, several dedicated groundwater monitoring wells were constructed and a comprehensive groundwater monitoring program was developed. During the next few years that followed, continued investigations and data collection worked to map the local aquifer systems, determine aquifer properties, and estimate possible impacts from program-related groundwater pumping. Findings from these studies indicated that a lower aquifer system exists beneath the upper aquifer system, which is currently utilized by the agricultural and domestic wells in the surrounding project area. Although these two aquifer systems are not completely separate, borehole sampling, groundwater level monitoring, and aquifer testing indicated that pumping from the lower Tuscan aquifer greatly reduces or eliminate groundwater level drawdown-related impacts to existing wells producing from the upper Tuscan aquifer.
These findings were incorporated into the operations, management, and technical design for the 2003 one-year pilot program that tested the feasibility and effectiveness of a surface water-groundwater exchange by pumping groundwater from the lower Tuscan aquifer.

Previous Permits

In April 2003, the Tehama County Board of Supervisors approved Groundwater Extraction and Off Parcel Use Permit Number WE-03/01 for Deer Creek Irrigation District up to 550 acre-feet (Appendix A). The permit allowed DCID to augment agricultural supply in their service area by pumping groundwater from the deep-aquifer pilot production well (SWN: 24N01W04M01M) and distributing the water through the DCID distribution system to DCID service area members. Due to uncertainties regarding the potential impacts associated with operating the well, issuance of the permit was subject to a set of conditions, and a rigorous monitoring and reporting program. An annual summary report was produced that documented the pilot well operation, monitoring, and management (DCID, Dec. 2003).

Findings from the 2003 pilot program indicate that 85-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 indicated 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 1.3 feet at a distance of 12,480 feet from the pilot well.
- The monitoring and web-based reporting methods were successful in disseminating data to the public in a timely manner.
- The WAC membership and the chain of partnerships that were utilized during development and implementation of the pilot program proved valuable for providing input and dispensing information to local, county, and state groups.
- Although the production of the pilot well was less than anticipated (1,200 gpm instead of 1,500 gpm), the additional water helped to increase the head in the delivery system, reduce water rotation times, and improve water reliability.
- The fixed and annual operating costs associated with the pilot well program were relatively high and point out the need to explore additional methods of assuring an adequate water supply during surface water bypass periods. These methods should include evaluating the cost, benefit, and impacts associated with improving the efficiency of the water delivery and on-farm irrigation systems, and using existing wells to augment supply.
- With proper program management, comprehensive partnerships, and the implementation of a good monitoring program, local agricultural, domestic, and environmental water needs can be met without impacts to local and regional water users.

In May of 2004, Deer Creek Irrigation District applied to amend and renew the 2003 groundwater extraction permit for use during 2004. The 2003 permit was approved for an additional 550 acre-feet of pumping from the test-production well (Appendix A). The permit follows many of the guidelines and conditions set forth in the 2003 permit. However, due to the lack of impacts and the knowledge gained during the 2003 operation of the Deer Creek pilot well, some modifications were made to the monitoring and reporting requirements. Instead of
downloading data loggers every two weeks, the 2004 permit was changed to download data loggers every month, and instead of holding WAC meetings in Vina, information regarding the monitoring program was mailed to the 2004 WAC members and reported in person to the Tehama County Flood Control & Water Conservation TAC. Similar to the 2003 permit, an annual summary report was produced that documented the pilot well operation, monitoring, and management (DCID, Jan. 2005).

Findings from the 2004 pilot well pumping indicate that 69-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 0.7 feet at a distance of 14,070 feet from the pilot well.
- 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 to high to be supported by agricultural benefit alone.

The 2003 and 2004 permit applications and summary reports are listed below. The applications and summary reports are also included in the References section of this document.

- Deer Creek Water Exchange Pilot Program, Tehama County Permit Application to Extract Groundwater for Off parcel Use, February 2003
- Deer Creek Water Exchange Pilot Program, Summary Report, December 2003
- Request to Amend Deer Creek Irrigation District Groundwater Extraction and Off Parcel Use Permit No. WE-03/01, March 2004
- Deer Creek Irrigation District, 2004 Tehama county Groundwater Extraction Permit Summary Report, January 2005

From 2004 until present, the pilot production well was pumped during the summers of 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.
REQUESTED INFORMATION FOR THE GROUNDWATER EXTRACTION AND OFF PARCEL USE PERMIT

WELL INFORMATION

1. Provide two copies of a scaled plot plan of the well parcel and any adjacent parcels within 2,000 feet of the well. Note locations of natural waterways, on-site sewage disposal systems, other wells (including their uses and depths, if known), structures, etc.

   Figure 2 below is a map of the production well area that includes well locations and parcel information in the DCID area within, and beyond, 2,000 feet from the test-production well. Two additional copies of Figure 2 are included in Appendix C. Tables 1 and 2 show all the wells located within 2,000 feet and 4,000 ft, respectively, from the production well. Tables 1 and 2 also show the well uses, well depths, and other well construction information where available.

2. Provide copies of all available reports pertaining to the construction and production of the originating well (DWR Well Driller’s Report, PG&E pumping data, etc.). List the following information for the originating well and any existing well within a 2,000 feet radius of the production well.

   Originating Well
   (Production Well)

   a. Well Use: Irrigation
   b. Casing Diameter: 16-inch
   c. Total Well Depth: 940 feet.
   d. Perforation Interval: 620-840’ and 880-920’.
   e. Depth of Annular Seal: 580 feet.
   f. Pump Type & Horsepower: Electric, 75 horsepower motor
   g. Depth of Pump: Approx. 250 feet
   h. Static Groundwater Level: Approx. 95 feet below ground surface
   i. Pumping Groundwater Level: Approx. 180 feet below ground surface

   Figures 3 and 4 below are the DWR “As-Built” design of the production well and the DWR well driller’s report, respectively. Specific information for the Originating Well (production well) is listed above. Information for the production well and all other wells within a 4,000 foot radius of the production well are shown in Tables 1 and 2 above.

   Reports pertaining to the production of the well, include the summary reports for the 2003 and 2004 groundwater extraction permits (DCID, Dec. 2003 and DCID, Jan. 2005), show the well pumped an average of 1,200 gpm. Additional information on the production of the well is from groundwater level and discharge measurements performed by DWR during 2005 and 2008. Based on DWR field measurements from 2005 to 2008, flows from the production well have ranged from 1,125 gpm to 1,175 gpm with an average of 1,155 gpm.
Figure 2. Parcel Map of the Production Well Area.
### Table 1. Permit Information for Wells Located within 2,000 feet of the Production Well.

<table>
<thead>
<tr>
<th>Well Number</th>
<th>Distance from PW</th>
<th>Well Use</th>
<th>Casing Dia.</th>
<th>Total Depth</th>
<th>Perforation Interval</th>
<th>Seal Depth</th>
<th>Pump Type</th>
<th>Pump hp</th>
<th>Pump Depth</th>
<th>Static GW Level</th>
<th>Pumping GW Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>4M1/PW-1</td>
<td>0</td>
<td>Production</td>
<td>16&quot;</td>
<td>940'</td>
<td>620-920'</td>
<td>580'</td>
<td>Turbine</td>
<td>75</td>
<td>~250'</td>
<td>~95'</td>
<td>~176'</td>
</tr>
<tr>
<td>MW-2 s</td>
<td>345</td>
<td>Dedicated Mont.</td>
<td>2&quot;</td>
<td>385'</td>
<td>295-335'</td>
<td>271'</td>
<td>none</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>MW-2 d</td>
<td>345</td>
<td>Dedicated Mont.</td>
<td>2&quot;</td>
<td>760'</td>
<td>650-722'</td>
<td>616'</td>
<td>none</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>5J1</td>
<td>390</td>
<td>Pub. (Cemetery)</td>
<td>8&quot;</td>
<td>178'</td>
<td>58-178'</td>
<td>~20'</td>
<td>Sub.</td>
<td>?</td>
<td>~75'</td>
<td>30-35'</td>
<td>45-50'</td>
</tr>
<tr>
<td>5J2</td>
<td>850</td>
<td>Abandoned Dom.</td>
<td>8&quot;</td>
<td>30'</td>
<td>?</td>
<td>none</td>
<td>none</td>
<td>na</td>
<td>~5'</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>4L1</td>
<td>1280</td>
<td>Abandoned Irr.</td>
<td>10&quot;</td>
<td>520'</td>
<td>117-520'</td>
<td>~20'</td>
<td>na</td>
<td>na</td>
<td>95-100'</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>5G1</td>
<td>1823</td>
<td>Idle Irrigation</td>
<td>16&quot;</td>
<td>490'</td>
<td>130-490'</td>
<td>none</td>
<td>Turbine</td>
<td>~100</td>
<td>150'</td>
<td>75-80'</td>
<td>~100'</td>
</tr>
</tbody>
</table>

### Table 2. Permit Information for Wells Located within 4,000 feet of the Production well.

<table>
<thead>
<tr>
<th>Well Number</th>
<th>Distance from PW</th>
<th>Well Use</th>
<th>Casing Dia.</th>
<th>Total Depth</th>
<th>Perforation Interval</th>
<th>Seal Depth</th>
<th>Pump Type</th>
<th>Pump hp</th>
<th>Pump Depth</th>
<th>Static GW Level</th>
<th>Pumping GW Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>5R2</td>
<td>2120</td>
<td>Idle Dom/Stock</td>
<td>6&quot;</td>
<td>160'</td>
<td>118-160'</td>
<td>~20'</td>
<td>Sub.</td>
<td>~75'</td>
<td>~100'</td>
<td>75-80'</td>
<td>~82'</td>
</tr>
<tr>
<td>4B2</td>
<td>2200</td>
<td>Domestic</td>
<td>8&quot;</td>
<td>230'</td>
<td>125-230'</td>
<td>20'</td>
<td>Sub.</td>
<td>?</td>
<td>?</td>
<td>~100'</td>
<td>~110'</td>
</tr>
<tr>
<td>5K3</td>
<td>2220</td>
<td>Domestic</td>
<td>8.5&quot;</td>
<td>~82'</td>
<td>?</td>
<td>~20'</td>
<td>Sub.</td>
<td>?</td>
<td>~50'</td>
<td>15-20'</td>
<td>~30</td>
</tr>
<tr>
<td>5K2</td>
<td>2230</td>
<td>Irrigation</td>
<td>16&quot;</td>
<td>505'</td>
<td>266-505'</td>
<td>~20'</td>
<td>Turbine</td>
<td>?</td>
<td>~150'</td>
<td>73-78'</td>
<td>~82'</td>
</tr>
<tr>
<td>4N1</td>
<td>2230</td>
<td>Abandoned Dom.</td>
<td>6&quot;</td>
<td>122'</td>
<td>119-122'</td>
<td>~20'</td>
<td>Sub.</td>
<td>na</td>
<td>60-62'</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>5K1</td>
<td>2320</td>
<td>Domestic</td>
<td>8&quot;</td>
<td>70-100'</td>
<td>70-100'</td>
<td>~20'</td>
<td>Sub.</td>
<td>?</td>
<td>?</td>
<td>55-60'</td>
<td>~65'</td>
</tr>
<tr>
<td>5K1</td>
<td>2730</td>
<td>Idle Irrigation</td>
<td>12&quot;</td>
<td>260'</td>
<td>27-260'</td>
<td>~27'</td>
<td>none</td>
<td>na</td>
<td>65-70'</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>5Q2</td>
<td>2835</td>
<td>Domestic</td>
<td>8&quot;</td>
<td>150'</td>
<td>60-150'</td>
<td>~20'</td>
<td>Sub.</td>
<td>?</td>
<td>~70'</td>
<td>43-47'</td>
<td>~50'</td>
</tr>
<tr>
<td>8B1</td>
<td>3001</td>
<td>Domestic</td>
<td>6&quot;</td>
<td>150'</td>
<td>83-150'</td>
<td>~20'</td>
<td>Sub.</td>
<td>?</td>
<td>~70'</td>
<td>46-48'</td>
<td>~55'</td>
</tr>
<tr>
<td>MW-3 s</td>
<td>3200</td>
<td>Dedicated Mont.</td>
<td>2&quot;</td>
<td>415'</td>
<td>310-330'</td>
<td>280'</td>
<td>none</td>
<td>na</td>
<td>85-90'</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>MW-3 d</td>
<td>3200</td>
<td>Dedicated Mont.</td>
<td>2&quot;</td>
<td>840'</td>
<td>700-790'</td>
<td>650'</td>
<td>none</td>
<td>na</td>
<td>87-92'</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>33N</td>
<td>3351</td>
<td>Irrigation</td>
<td>16&quot;</td>
<td>500'</td>
<td>180-500'</td>
<td>~20'</td>
<td>Turbine</td>
<td>?</td>
<td>?</td>
<td>98-100'</td>
<td>?</td>
</tr>
<tr>
<td>8C1</td>
<td>3395</td>
<td>Domestic</td>
<td>6&quot;</td>
<td>160'</td>
<td>120-160'</td>
<td>20'</td>
<td>Sub.</td>
<td>?</td>
<td>?</td>
<td>60-65'</td>
<td>~75'</td>
</tr>
<tr>
<td>5C</td>
<td>3650</td>
<td>Irrigation</td>
<td>8&quot;</td>
<td>245'</td>
<td>70-245'</td>
<td>~20'</td>
<td>Turbine</td>
<td>~60'</td>
<td>70-75'</td>
<td>~100'</td>
<td>?</td>
</tr>
</tbody>
</table>

3. **What is the anticipated maximum draw of the groundwater in gallons per minute and gallons per-day?** List the anticipated daily, weekly, and monthly pumping schedule.

The maximum draw of groundwater that will be extracted from the production well is 1,200 gallons per minute or 1,728,000 gallons per day (5.3 acre-feet per day),

The anticipated daily, weekly, and monthly pumping schedule is difficult to estimate due to the operation of the program. Operation of the well is based on DFG’s needs for pulse flows for fish transportation and on DCID’s agricultural demand and the need for increased supply to reduce water delivery rotation times. Bypass flows for fish transportation typically are needed in the spring and fall. Peak agricultural needs typically occur from late July to early August. During
2003, the well operated from May 13 to September 9 and was only shut down three times (6/16-6/23, 7/22-7/23, and 7/28-8/13) for a total of 85 days pumping and 24 days of non operation. During 2004, the pump operated from July 12 until September 19 for a total of 69 days of pumping. The 2003 and 2004 groundwater extraction permits allowed for pumping the well from April through October.

Figure 3. As-Built Design for the Production Well.
Figure 4 (Page 1). Well Driller’s Report for the Production Well.
b. List the anticipated rate in gallons per minute or gallons per day, and the total seasonal volume or amount in gallons or acre-feet of water that will be used on the originating parcel.

None of the extracted groundwater will be used on the originating parcel. All of the water from the production well will be pumped into the Deer Creek Irrigation District canal and distributed.
parcels within the Deer Creek Irrigation District service area as needed for agricultural beneficial use.

c. **List the anticipated rate in gallons per minute or gallons per day, and the total seasonal volume or amount in gallons or acre-feet of water that will be used on the off-parcel sites.**

The anticipated pumping rate is 1,150-1,200 gallons per minute. The seasonal volume will be limited to 550 acre-feet. All of the water from the production well will be pumped into the Deer Creek Irrigation District canal and distributed parcels within the Deer Creek Irrigation District service area as needed for agricultural beneficial use.

4. **List the existing land use and the proposed land use changes for the originating and off parcel well locations.**

Figure 5 is a DWR land use map of the DCID area. Table 3 lists the broader land use categories and the associated irrigated aereages. Although DWR has completed the field work in 2005 for a more recent land use survey, the data has not been processed and is unavailable. As such, the land use data presented in Figure 5 and Table 3 are from 1999 and are the most current published land use data available for the Deer Creek area. However, based on DCID’s and DWR’s experience in the Deer Creek area, the land use has changed very little, if any since 1999 and that Figure 5 and Table 3 are representative of the current land use.

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Net Irrigated Acreage (acres)</th>
<th>ET of Applied Water</th>
<th>Applied Water (acre-feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface</td>
<td>Ground</td>
<td>Total</td>
</tr>
<tr>
<td>GRAIN</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>PASTURE</td>
<td>500</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>PASTURE - X</td>
<td>200</td>
<td>0</td>
<td>200</td>
</tr>
<tr>
<td>ALMONDS</td>
<td>300</td>
<td>200</td>
<td>500</td>
</tr>
<tr>
<td>PRUNES</td>
<td>100</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>WALNUTS</td>
<td>300</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>1,500</strong></td>
<td><strong>400</strong></td>
<td><strong>1,900</strong></td>
</tr>
</tbody>
</table>

*ET = Evapotranspiration of Applied Water*

**Table 3. Land and Water Use Data For DCID.**

Deer Creek Irrigation District has a service area of about 2,200 acres. Figure 5 and Table 3 show that about 1,900 of the 2,200 acres of the DCID service area are in agricultural production. Approximately 700 acres, or 37-percent, of the irrigated acreage is planted in pasture, while 1100 acres, or 58-percent, is planted in orchard crops consisting of almonds, walnuts, and prunes. The remaining 5-percent of the irrigated acreage is planted in grain crops. Approximately 400 acres are irrigated with groundwater and 1,500 acres were irrigated with surface water.
Figure 5. Land Use for the DCID Service Area.
5. Describe the general hydrology and geology of the area. Discuss the proposed use of the well in terms of specific capacity, recharge, safe yield, and radius of influence. A further specific hydrogeological study identifying the effects this proposed use would have on the affected groundwater, and the affected aquifer or aquifers may be required, including the hydraulic gradient; hydrology; percolation; permeability; piezometric surface; porosity; recharge; safe yield; salt water intrusion; specific capacity; spreading water; transmissivity; usable storage capacity; water table; and zone of saturation.

Geology and Groundwater Bearing Units

Deer Creek Irrigation District lies within the southeastern portion of Tehama County, along the northeastern Sacramento Valley Groundwater Basin. The local geology surrounding the project area is shown in Figure 6. An explanation of the geologic units is provided in Figure 7. Figure 6 also shows the location of two cross-sections through the Deer Creek area. Section A-A’ is shown in Figure 8 and Section B-B’ is shown in Figure 9. Section A-A is a portion of a more regional cross-section located just south of the Deer Creek that was developed as part of the Department of Water Resources Bulletin 118-7 mapping project. Section B-B’ is a more local cross-section through the project area that was developed from program-related drilling and aquifer sampling.

The principal groundwater bearing unit in the Deer Creek project area consists of the Pliocene Tuscan formation. Both domestic and irrigation wells in the area rely on the Tuscan formation as the primary source of water. Quaternary terrace deposit such as the Riverbank and Modesto formations also occur in the area, but only those wells directly adjacent to Deer Creek encounter sufficient thickness to make these formations a reliable source for domestic and irrigation water.
Figure 6. Regional Geologic Map of the Project Area

The Tuscan Formation is composed of a series of volcanic mudflows, tuff breccias, tuffaceous sandstone, and volcanic ash layers. Mudflows originated in the vicinity of present-day Lassen Peak and most likely filled ancient stream channels as they flowed toward the valley. Upon reaching the valley, the mudflows fanned out across the valley floor. Some larger lahars may have continued to flow southward in the valley along various drainage channels. The Tuscan Formation is described as four separate but lithologically similar units, Units A through D, which in some areas are separated by layers of thin tuff or ash units (Helley and Harwood, 1985).
**Figure 7. Description of Geologic Map Units**

Unit A consists of the oldest and deepest of the Tuscan Formation deposits, while Unit D is the youngest. However, Unit D is exposed only in localized areas northeast of Red Bluff. Thus, in the project area Unit C is the youngest and shallowest of the Tuscan Formation deposits. The stratigraphic sequence and estimated thickness of the Tuscan deposits is shown in Figures 8 and 9.

Units A and Unit B are lithologically very similar and are commonly grouped together and described as the “Lower Tuscan”. Both units contain a fairly even distribution of lahars, volcanic conglomerate, volcanic sandstone, and volcanic siltstone. However, Unit A does have the slight distinction of comprising a small percentage of metamorphic clasts within the interbedded deposits. In addition, Unit A contains the Nomlaki Tuff, a dacitic pumice tuff, near basal portion of the unit. The Nomlaki Tuff occurs throughout the valley within the basal sections of the Tuscan, Tehama, and Laguna formations.

In the Butte County portion of the valley, Tuscan Unit B is a very productive water bearing system. Because of the lithologic similarity to Unit B, it is hypothesized that Unit A could also be a productive groundwater source. However, very few wells are constructed solely in Unit A of the Tuscan, so accurate production estimates for this aquifer zone are unavailable.
Figure 8. Geologic Cross-Section A-A’ Located South of the Deer Creek Project Area.
Figure 9. Geologic Cross-Section B-B’ Located Through the Deer Creek Project Area.
Figure 9 shows that, in the project area, Unit B of the Tuscan begins at a depth of about 400 to 600 feet. None of the agricultural wells in the Deer Creek project area appear to draw from either the Tuscan B or A Units.

Unit C consists of more massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. Towards the eastern foothill area, these lahars are well cemented and form the cap rock for the ridges and canyons that border the eastern drainages. Evidence of wood fragments found in Unit C suggests fast-moving, massive mudflows at the time of deposition. In the subsurface, the low-permeability lahars in Unit C form thick, confining layers for groundwater contained in the more permeable sediments of Unit B. Unit C is also commonly referred to as the “Upper Tuscan”.

In the project area most of the agricultural and domestic wells draw from Unit C of the Tuscan Formation. Figure 9 shows the construction and distribution of local wells along the B-B’ section line. The area indicated as “hard zone” on the map is thought to be a well cemented mudflow that appeared in several drilling logs. This deep mudflow seems to form a hard cap, or aquitard, above the Unit B in this area. Other less continuous “hard zones” also occur in the shallower portions of Unit C in the project area. Combined with flood application of agricultural water, these discontinuous mudflow layers contribute to a perched aquifer for wells constructed less than about 200 feet deep. Agricultural wells drawing solely from the upper Tuscan in the project area tend to produce between 800 and 2,000 gallons per minute.

Groundwater Levels and Direction of Groundwater Flow

Groundwater levels in the project area are a function of location and well depth. In the eastern project area, wells deeper than 200 feet tend to exhibit groundwater levels ranging from 80 to 110 feet below ground surface. Wells less than 200 feet in this area tend to tap into a perched aquifer zone which results in water levels between 30 and 50 feet below ground surface. Further to the west, towards the Sacramento River, the disparity between groundwater levels in shallow versus deep wells lessens, and the depth to groundwater decreased overall.

Groundwater hydrographs illustrate changes in groundwater levels over time. Hydrographs representing the seasonal and long-term groundwater level changes in the domestic and agricultural monitoring wells are presented in Figures 10 and 11. The locations of these wells are shown in Figures 13 and 14.

Figure 10 is a hydrograph for well 24N/01W-05J01M. Well 24N/01W-05J01M is a domestic well producing from the shallow portion of the upper Tuscan aquifer. Groundwater levels in this well were measured on a monthly basis in 1971, a semi-annual basis (spring-fall) from 1971 to 1995, and is currently being monitored four times a year during March, July, August, and October. The hydrograph for well 24N/01W-05J01M shows that the seasonal fluctuation in groundwater levels typically ranges about 5 feet. Examining the hydrograph over the last few years, which included summer monitoring, indicates that the highest groundwater levels typically take place in the summer months during periods of flood irrigation. Conversely, the lowest seasonal levels occur in the winter months when applied irrigation water is kept to a minimum. Long-term comparison of spring-to-spring water levels in Figure 10 shows approximately a 5-foot decline during the 1976-77 drought, a 5-8 foot decline during the 1986-94 drought, and a 5-8 foot decline during the 2007-09 drought. The shallow aquifer system appears to rebound
Groundwater levels are showing a downward trend since about 2006 due to the current drought.

![Groundwater Hydrograph for Domestic Monitoring Well 24N01W-05J01](image)

**Figure 10, Groundwater Hydrograph for Domestic Monitoring Well 24N01W-05J01.**

Figure 11 is a hydrograph for well 24N/01W-05G01M. Well 24N/01W-05G01M is an agricultural well producing from the lower portion of the upper Tuscan aquifer. Groundwater levels in this well were measured on a monthly basis from 1999 to late 2000, when a continuous data logger was installed. The continuous data logger was removed at the end of the 2004 irrigation season and reinstalled in 2008. Prior to 2004 this well was non-operational. Since 2004, this well has operated during the agricultural season to irrigate almonds. Maintaining a datalogger in this well has been a challenge due to access issues and the current operational status. In December, 2008 the datalogger in this well failed and efforts to remove it have been unsuccessful. We will continue attempts to reestablish a data logger in this well for the 2009 agricultural season.

Although this well is located less than 1,000 feet from the domestic well illustrated in Figure 10, the depth to groundwater averages about 50 feet deeper due to the deeper construction of the well (perforations are below the perched shallower aquifer). The hydrograph in Figure 11 shows that the seasonal fluctuation in static groundwater levels is typically less than 5 feet. The pumping groundwater level in 2004 averaged about 113 feet below ground surface and about 108 feet below ground surface in 2008. The short duration drawdown spikes (prior to 2004 when the well was non-operational) indicate interference from nearby agricultural wells which produce from the same aquifer interval. Short-term interference from surrounding agricultural pumping is
Groundwater level data are also used to develop groundwater elevation contour maps for the Sacramento Valley portion of Tehama County. Groundwater contour maps were developed using 2008 spring groundwater level data from monitoring wells in Tehama, Butte, Glenn, and Colusa counties. Groundwater contours are used to help estimate the direction and gradient of groundwater movement and the seasonal changes in groundwater levels. A groundwater contour map of the Sacramento Valley portion of Tehama County is shown in Figures 12.

Figure 12 shows groundwater contour lines that represent levels of equal groundwater elevation. Spring groundwater levels are commonly the highest of the year and best reflect the natural groundwater table distribution and direction of movement. Figure 12 shows that the spring groundwater levels vary from an elevation of about 140 feet along the Sacramento River in southern Tehama County, to an elevation of about 500 feet along the west and northwestern portions of the valley. Similar to topographic contour lines, the spacing of groundwater contour lines is an indication of the surface slope, or groundwater gradient. Figure 12 shows that adjacent to the Sacramento River the groundwater gradient is relatively flat and increases along the edges of the valley.

The direction of groundwater movement is illustrated in Figure 12 by a series of red arrows drawn perpendicular to the groundwater elevation contours. Figure 12 shows that the regional pattern of spring groundwater movement is generally towards Sacramento River and the axis of

![Deer Creek Water Exchange Program: Key Monitoring Well](image)

**Figure 11, Groundwater Hydrograph for Idle Agricultural Well 24N01W-05G01.**

Overall analysis of the long-term groundwater level data for this well indicates that the deeper portion of the upper Tuscan aquifer remains fairly stable.
the valley floor. In the Deer Creek Project area groundwater moves in a southwesterly direction, paralleling the direction of the flow of Deer Creek.

Figure 12. Tehama County, Spring 2008 Groundwater Contour Map.
PILOT WELL 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. Due to the lack of negative impacts associated with the 2003 program some modifications were made to the 2003 guidelines and adapted to the management and monitoring of the 2004 program. Instead of downloading dataloggers every two weeks, the 2004 permit was changed to download dataloggers every month, and instead of holding WAC meetings in Vina, information regarding the monitoring program was mailed to the 2003 WAC members and reported in person to the Tehama County Flood Control & Water Conservation TAC.

The overriding goal of the groundwater management objectives was to operate the program so as 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, and to a corresponding set of guidelines for program operations and management. The operation of the program during 2003 and 2004, proved the program to be successful. Unfortunately, lack of proper coordination between DWR and DCID in 2008 led to operating the test-production well past the preapproved volume of 550 acre-feet. Although the additional pumping did not result in any adverse impacts to nearby groundwater users, or exceedance of trigger levels in the key monitoring wells, the circumstances which led to the over operation of the well were examined and addressed, and are not expected reoccur.

A detailed explanation of the proposed program monitoring and management are provided in the Deer Creek Flow Enhancement Program MOA that is in Appendix B. A summary of the management methods and the results from the groundwater level, water quality, and surface water monitoring are provided below.

Groundwater Level Monitoring and Program Management

One of the key criteria for program operations is maintaining a predetermined range of acceptable groundwater levels in five “key wells” surrounding the pilot well. 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, and
- 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.
In order to have adequate time to respond and make appropriate adjustments to program operations, the groundwater level criteria were divided into three stages, or levels, which served as trigger points for reevaluating, altering, or shutting-down program operations and alleviating any additional groundwater level decline. Management guidelines allow 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.

The groundwater level warning stages were initially developed in 2003 by the DCID board in conjunction with technical assistance from the Northern District Department of Water Resources. The stage criteria were also reviewed by the Tehama County AB 3030 Technical Advisory Committee, the Tehama County Environmental Health Department, the State Regional Water Quality Control Board, and local landowners prior to adoption by the DCID board and approval by the Tehama County Board of Supervisors. Results from the 2003 program indicated that the 2003 groundwater level and water quality guidelines remained appropriate for the 2004 program and still remain appropriate for the future guidelines.

Overall management of the pilot program was governed by the 2004 Deer Creek Water Advisory Committee. Membership for the Water Advisory Committee was solicited in 2003 through public meetings and notices, and ultimately consisted of six to eight local, county, and state representatives. Water Advisory Committee (WAC) members were provided monthly updates regarding program operations and monitoring. Program updates were also presented to the Tehama County Flood Control & Water Conservation Board.

**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 and consists of agricultural and domestic wells with only a few industrial wells. 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. Two new multi-completion wells were installed in the SVRIC area in 2005 that range from approximately 70 to 1,000 feet and represent upper, middle, and lower portions of the Tuscan aquifer system. Figure 13 shows the regional groundwater monitoring grid for the project area.

The local groundwater level monitoring grid covers approximately a 2-mile radius surrounding the pilot well. The local grid and also includes a mixture of domestic and irrigation wells. The local monitoring grid also includes eight multi-completion monitoring wells. The multi-completion monitoring wells were installed as part of an earlier phase of the water exchange program and were constructed as a nested set of wells, to monitor the middle and lower portions of the Tuscan aquifer. Seven local wells closest to the pilot well were selected as “key wells” and are 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, two of the key wells are no longer measured; lost owner permission on one well (5R2) and unable to obtain an acceptable water level reading from the other (4L1). Figure 14 shows the location of the current Key Monitoring Wells and Key Water Quality sampling locations.
Key well construction and use information is provided below in Table 4. Well construction data in Table 4 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 to 490 feet.

Figure 13. Regional Groundwater Level Monitoring Grid
Groundwater level fluctuations within the lower Tuscan aquifer are monitored using the deep-zone of the dedicated multi-completion monitoring wells. Construction information for the deep aquifer wells is shown in Table 5.
<table>
<thead>
<tr>
<th>State Well Number</th>
<th>Distance from Pilot Well (ft)</th>
<th>Well Use</th>
<th>Aquifer Production Zone</th>
<th>Total Depth (feet)</th>
<th>Perforation Interval (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24N01W-05J04</td>
<td>375</td>
<td>Monitoring Well</td>
<td>Lower Tuscan</td>
<td>760'</td>
<td>650-722'</td>
</tr>
<tr>
<td>24N01W-05Q04</td>
<td>3200</td>
<td>Monitoring Well</td>
<td>Lower Tuscan</td>
<td>840'</td>
<td>700-790'</td>
</tr>
<tr>
<td>25N01W-32P03</td>
<td>5,180</td>
<td>Monitoring Well</td>
<td>Lower Tuscan</td>
<td>720'</td>
<td>640-720'</td>
</tr>
<tr>
<td>25N01W-34N03</td>
<td>6,930</td>
<td>Monitoring Well</td>
<td>Lower Tuscan</td>
<td>743'</td>
<td>468-743'</td>
</tr>
<tr>
<td>25N02W-01L02</td>
<td>12,480</td>
<td>Monitoring Well</td>
<td>Lower Tuscan</td>
<td>900'</td>
<td>660-900'</td>
</tr>
<tr>
<td>24N02W-12P02</td>
<td>14,070</td>
<td>Monitoring Well</td>
<td>Lower Tuscan</td>
<td>900'</td>
<td>560-900'</td>
</tr>
</tbody>
</table>

Table 5. Deep Aquifer Monitoring Well Construction.

Groundwater Level Monitoring Schedule

The frequency of groundwater level monitoring will vary according to the monitoring well location and type, and the pilot well pumping schedule. During pilot program operations, the depth to groundwater in the Deer Creek monitoring wells east of Highway 99 will be measured at a frequency of once per month between April and October. The depth to groundwater in these wells will be measured using a steel tape or a battery operated water level meter. Within the localized grid, the five key wells and all but two of the remaining dedicated monitoring wells within the Deer Creek monitoring grid are equipped with automated groundwater level recording equipment (dataloggers). The dataloggers are set to measure groundwater levels at a frequency of 24-times per day (once every hour). The groundwater level data stored in the dataloggers will be downloaded once per month between April and October.

Groundwater Level Monitoring Results

The results of the groundwater level monitoring will be provided to the WAC and the Tehama County Flood Control and Water Conservation Board on 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 web site at: http://wdl.water.ca.gov. This procedure for reporting monitoring results will remain the same for this permit application.

Test-Production Well Hydrograph

Figure 15 is an updated hydrograph for the test-production wells. In addition to showing the change in groundwater levels over time, labels along the top of the hydrograph indicate the pilot well operating intervals during the 2003 and 2004 pumping programs and the pumping that occurred during 2005 and 2008. Figure 15 shows that the static groundwater level in the pilot well, prior to pumping is about 94 to 96 feet below ground surface. The pumping level is about 172 to 179 feet below ground surface. The hydrograph also shows that groundwater levels recovered quickly after termination of pumping, with 93 percent of total recovery occurring within the first eight hours (DCID, Jan. 2005). The relatively stable pumping levels over the pumping period, coupled with a quick recovery, indicate that aquifer properties of transmissivity and storage are sufficient to maintain a groundwater extraction rate of 1,200 gallon per minute and that mining of the aquifer was not occurring.
Key Monitoring Well Hydrographs

Updated hydrographs for the remaining key wells are provided in Figures 1 through 5, Appendix D. The hydrographs also show the groundwater management “warning stages” associated with static water level data. Table 4 lists the five key wells, their distance from the pilot well, and their construction. Figure 14 shows the plan-view distribution of the key monitoring wells and Figure 9 shows the vertical distribution of the wells within the aquifer.

Care should be taken when analyzing the key well hydrographs to examine changes in seasonal groundwater levels as well as fluctuations occurring within pumping periods. Groundwater level impacts associated with 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 key wells surrounding the pilot well were analyzed by looking for any change in groundwater levels before, during, and after the pilot well pumping; keeping aware that local groundwater levels commonly show a gradual decline and rise with the natural seasonal progression from summer to fall. Overall results from groundwater level monitoring of the key wells within the upper to middle portion of the Tuscan aquifer indicate that there are no groundwater level impacts due to pilot well pumping. A short interpretation of each of the key well hydrographs is provided below.
**Key Well 24N01W-05J03:** Key well 24N01W-5J03 is a dedicated monitoring well and is the closest of key wells to the pilot well at a distance of 375 feet. It was installed in 1999 as the shallow well in a nested set of two monitoring wells installed within the same borehole. Well 5J3 is constructed to monitor the upper to middle Tuscan aquifer between 271 and 385 feet. The hydrograph for 5J3 is shown in Figure 1 of Appendix D. Well 5J3 has been equipped with a groundwater level datalogger since 1999. Prior to the pilot program, the datalogger was set to record groundwater levels every 4 to 6 hours. During the pilot program, the datalogger was set to record groundwater levels every hour. Currently, the datalogger continues to collect hourly groundwater level measurements. The three groundwater level warning stages for 5J3 are set at depths of 92, 97, and 102 feet below ground surface.

The long-term hydrograph for 5J3 shows that spring groundwater levels have ranged from 85 to 89 feet since 1999. Seasonally, groundwater levels fluctuate on an average of 2 to 3 feet, with temporary declines of 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 versus pilot well pumping years (2003, 2004, 2005, 2008) indicate that the gradual decline and recovery is typical of the normal seasonal fluctuation in groundwater levels in 5J3, and other wells constructed in this portion of the aquifer. The drawdown spikes shown on the hydrograph are attributed to groundwater pumping of 5C1, 5G1, and 5K2 (see Figure 4). Wells 5C1, 5G1, and 5K2 are nearby agricultural wells that supply irrigation water for the almond and walnut orchards to the west-northwest and extract groundwater from the shallow and/or middle aquifer zones. Overall, groundwater levels in 5J3 remained relatively stable throughout the program, with no warning stages exceeded during static (non-pumping) groundwater level measurements. A downward trend of about 2-3 feet since 2007 exists due to drought condition over the past two years.

**Key Well 24N01W-05J01:** Key well 24N01W-05J01 is an active well located in the Vina cemetery at a distance of about 390 feet from the production well. The well is used for cemetery landscape irrigation and produces water from the upper Tuscan aquifer between 58 and 178 feet. The hydrograph for 5J1 is shown in Figure 2 of Appendix D. Groundwater levels in 5J1 have been monitored since the early 1970’s and were equipped with a groundwater level datalogger in May, 2003 and has since recorded groundwater levels every hour. The three groundwater level warning stages for 5J1 are based on static groundwater levels and are set at depths of 38, 42, and 45 feet below ground surface.

The long-term hydrograph for 5J1 shows that static spring groundwater levels have historically fluctuated between 25 and 35 feet below ground surface. During 1976, 2003, and 2004 several pumping water levels were recorded between 46 and 52 feet below ground surface. Seasonally, static groundwater levels fluctuate on an average of 2 to 7 feet.

Comparison of seasonal groundwater level trends during non-pilot well pumping years versus pilot well pumping years (2003, 2004, 2005, 2008) indicate that the gradual decline and recovery is typical of the normal seasonal fluctuation of groundwater levels in 5J1, and other wells constructed in this portion of the aquifer. The hydrograph for 5J1 also shows series of downward spikes in the 45 to 50 foot range that are associated with periods of pumping within the 5J1 well itself. The series of groundwater level drawdowns in the 35-foot range typically
occur when 5J1 is not pumping, and are attributed to periods of pumping in nearby agricultural wells other than the deeper pilot production well. No groundwater warning stages have been exceeded at well 5J1. Similar to other nearby wells, 5J1 shows a downward trend over the last couple of years due to drought conditions. The overall decline within the last few years has been about 5-feet.

**Key Well 24N01W-05G01:** Key well 24N 01W-05G01 is an agricultural irrigation well located 1,823 feet west of the pilot well. Well 5G1 was drilled to produce from the upper to middle portion of the Tuscan aquifer between 130 and 490 feet. Well 5G1 was idle between 1998 and 2004. In early 2004 5G1 began, once again, being used for agricultural irrigation. The hydrograph for 5G1 are shown in Figure 3 of Appendix D. Groundwater level monitoring of 5G1 began in 1998, with dataloggers being used over most of the 1999-2002 period. Prior to the 2003 pilot program, the datalogger was set to record groundwater levels every 4 to 6 hours. During the 2003 and 2004 pilot well pumping program to present, the datalogger has been recording groundwater levels every hour. The three groundwater level warning stages for 5G1 are based on static groundwater levels and are set at depths of 88, 92, and 94 feet below ground surface.

The long-term hydrograph for 5G1 shows that, since 1998, spring groundwater levels have remained consistent, ranging between 77 and 84 feet below groundwater surface. Seasonally, static groundwater levels fluctuate on an average of 2 to 3 feet, with temporary declines of 3 to 7 feet when nearby irrigation wells extract groundwater for agricultural beneficial use. Pumping levels within 5G1 range between 106 and 113 feet below ground surface.

Comparison of seasonal groundwater level trends during non-pilot well pumping years versus pilot well pumping years (2003, 2004, 2005, 2008) indicate that the gradual decline and recovery is typical of the normal seasonal fluctuation of groundwater levels in 5G1, and other wells constructed in this portion of the aquifer. The series of small (2-6 feet) groundwater level drawdowns are attributed to agricultural groundwater pumping of nearby wells 5K2 and 5C1 (see Figure 4). The larger downward spikes (98-113 feet) are due to the pumping of 5G1 itself. Overall, groundwater levels in 5G1 remained fairly stable and do not show a downward trend due to the recent drought. No groundwater warning stages were exceeded, and no impacts associated with pilot well pumping were identified.

**Key Well 24N01W-05K01:** Key well 24N 01W-05K01 is an idle irrigation well located 2,730 feet west of the pilot well. Well 5K1 was drilled to produce from the upper portion of the Tuscan aquifer between 27 and 260 feet. Obstructions within the well currently prevent it from being used for irrigation. The hydrograph for 5K1 is shown in Figure 4 of Appendix C. Groundwater level monitoring of 5K1 began in 1999, with dataloggers being installed at that time. The datalogger was set to record groundwater levels every 4 to 6 hours until the pilot program in 2003. Since then the datalogger has been recording groundwater levels every hour. The three groundwater level warning stages for 5K1 are set at depths of 74, 77, and 80 feet below ground surface.

The long-term hydrograph for 5K1 shows that spring groundwater levels between 1999 and 2008 have averaged about 55-64 feet below ground surface. Starting in 2002 the annual trend of groundwater levels tends to come up, with spring levels rising about 8 feet from 2002 to 2006. The reason for the rise in groundwater levels over the last two years is unknown. Seasonally, the fluctuation in static groundwater levels have remained relatively consistent; averaging between 2
and 4 feet, with temporary declines of 3 to 5 feet when nearby irrigation wells extract groundwater for agricultural beneficial use.

Comparison of seasonal groundwater level trends during non-pilot well pumping years versus pilot well pumping years (2003, 2004, 2005, 2008) indicate that the gradual decline and recovery is typical of the normal seasonal fluctuation of groundwater levels in 5K1, and other wells constructed in this portion of the aquifer. The series of temporary downward spikes are groundwater level drawdown and are similar to the other key monitoring wells, attributed to agricultural groundwater pumping of 5K2, 5G1, and 5C1 (see Figure 4). Overall, groundwater levels in 5K1 remained relatively stable throughout the program, with no warning stages exceeded. Overall, groundwater levels in 5K1 have risen about 5-7 feet between 2003 and 2006. Since 2006, groundwater levels have remained stable despite the regional drought conditions.

**Key Well 24N01W-5Q03:** Key well 24N01W-5Q03 is a dedicated groundwater level monitoring well located 3,200 feet southwest of the pilot well. It was installed in 1999 as the shallow well in a nested set of two monitoring wells at the same location. The well is constructed to monitor the upper to middle Tuscan aquifer between 280 and 415 feet. The hydrographs for 5Q3 are shown in Figure 5 of Appendix D. Well 5Q3 has been equipped with a groundwater level datalogger since 1999 collecting groundwater level measurements every 4-6 hours. Since the pilot well program in 2003, groundwater levels have been recorded on an hourly basis. The three groundwater level warning stages for 5Q3 are set at depths of 80, 83, and 87 feet below ground surface.

The long-term hydrograph for 5Q3 shows that, since 1999, spring groundwater levels have ranged from 67 to 69. Seasonally, groundwater levels fluctuate on an average of 3 to 4 feet, with additional temporary drawdowns of 3 to 7 feet when nearby irrigation wells extract groundwater for agricultural beneficial use.

Similar to the other key monitoring wells, the hydrograph for 5Q3 shows a gradual seasonal decline of about 3 to 4 feet between spring and summer. Comparison of seasonal groundwater level trends during non-pilot well pumping years versus pilot well pumping years (2003, 2004, 2005, 2008) indicate that the gradual decline and recovery is typical of the normal seasonal fluctuation of groundwater levels in 5K1. The 2004 hydrograph also shows a series of temporary groundwater level drawdowns throughout the agricultural season. Theses downward spikes in the groundwater hydrograph are similar to those seen in the other key wells and are attributed to groundwater pumping of nearby wells 5C1, 5K2, and 5G1 (see Figure 4). Overall, groundwater levels in 5Q3 have remained relatively, with no warning stages exceeded.

**Lower Tuscan Aquifer Monitoring:**
Groundwater level monitoring of the lower Tuscan is conducted using the deep dedicated monitoring wells that were installed in 1999. Table 6 lists the deep aquifer monitoring wells, their distance from the pumping well, their construction, and total drawdown after pumping the pilot well for 69 days in 2004. Figures 2 and 13 provide a plan-view distribution of the wells. The vertical distribution and construction of wells are illustrated in the geologic cross-section B-B, shown in Figure 9. Updated hydrographs for the lower Tuscan aquifer monitoring wells are provided in Figures 1 through 5 in Appendix E. All of the deep aquifer monitoring wells are equipped with dataloggers. Prior to the 2004 pumping of the pilot well, the dataloggers were set to record groundwater levels every 4 to 6 hours. Since 2004, groundwater levels have been recorded hourly.
**Lower Tuscan Well 24N01W-5J04:** Key well 24N01W-5J04 is located 375 feet northwest of the pilot well and represents the closest of lower Tuscan monitoring wells. Well 5J4 was constructed in 1999 to monitor the lower Tuscan aquifer between 650 and 722 feet. Groundwater levels in 5J4 are monitored with a datalogger that records data every hour. The hydrograph for 5J4 is shown in Figure 1 Appendix E.

The long-term hydrograph for 5J4 shows that groundwater levels declined several feet from 1999 through 2003, remained stable from 2003 through 2007, then declined again be about 4-feet during the last several years of drought. Seasonal groundwater level fluctuation during non-pilot well pumping years has averaged 1 to 2 feet, with additional temporary declines of 1 to 2 feet when nearby irrigation wells extract groundwater for agricultural beneficial use. The hydrograph for 5J4 also shows that groundwater levels are drawn down about 16 feet during years of test-production well pumping (2003, 2004, 2005, and 2008). After the initial drawdown associated with test-production well pumping, groundwater levels in 5J4 tend to stabilize and quickly rebound once the pilot well is shut down.

Overall, groundwater level data from 5J4 indicates full annual recharge but is showing a slight downward trend due to the climatic fluctuation. This is noticeable in 2003 and especially over the last two years due to drought conditions. Groundwater levels in this well are typical of the lower Tuscan aquifer in this area.

**Lower Tuscan Well 24N01W-5Q04:** Key well 24N01W-5Q04 is a deep dedicated monitoring well located 3,200 feet to the west of the pilot well. Well 5Q4 was constructed in 1999 to monitor the lower Tuscan aquifer between 700 and 790 feet. Groundwater levels in this well are monitored with a datalogger that recorded data every one to four hours. Since about 2006, data is recorded on an hourly basis. The hydrograph for 5Q4 is shown in Figures 2, Appendix E.

Similar to monitoring well 5J4, the long-term hydrograph for 5Q4 indicates a gradual decline of about 2 feet from 1999 through 2003, stable groundwater levels from 2003 through 2007, then another declined of about 4-feet during the last several years of drought. Seasonally, during non-test production well operations, groundwater levels fluctuate from 2 to 3 feet between spring and summer, with additional temporary declines of 1 to 2 feet when nearby irrigation wells extract groundwater for agricultural beneficial use. During pilot well operations in 2003, 2004, 2005, and 2008 groundwater levels temporarily were drawn down about 4 to 6 feet. Overall, groundwater level data from 5Q4 indicates full annual recharge and recovery of the lower Tuscan aquifer in this area.

**Lower Tuscan Well 25N01W-34N03:** Key well 25N01W-34N03 is a deep dedicated monitoring well located 6,980 feet to the east of the pilot well. Well 34N3 was constructed in 1999 to monitor the lower Tuscan aquifer between 468 and 743 feet. Groundwater levels in this well are monitored with a datalogger that recorded data every one to four hours. Since about 2006, data is recorded on an hourly basis. The hydrograph for 34N3 is shown in Figure 3, Appendix E.

The long-term hydrograph for 34N3 shows groundwater levels declined several feet from 1999 through 2003, rose several feet in 2006, and then declined again be about 4-feet during the last several years of drought. Seasonally, during non-pilot well operations, groundwater levels fluctuate only 1 to 2 feet between spring and summer. During pilot well operations in 2003,

**Lower Tuscan Well 24N02W-01L02:** Key well 24N02W-01L02 is a deep dedicated monitoring well located 12,480 feet west of the pilot well. Well 1L2 was constructed in 1999 to monitor the lower Tuscan aquifer between 660 and 900 feet. Groundwater levels in this well are monitored with a datalogger that recorded data every one to four hours. Since about 2006, data is recorded on an hourly basis. The hydrograph for 1L2 is shown in Figures 4, Appendix E.

The hydrograph for 1L2 show that spring groundwater levels have remained very steady through 2007. Since 2007, groundwater levels have dropped 1-2 feet each year due to drought conditions. Seasonally, groundwater levels fluctuate on an average of 2 to 4 feet between spring and summer, with additional temporary declines approximately 0.5 to 1.0 foot as the result of nearby agricultural groundwater pumping, and about 1.3 feet as the result of pilot well pumping during the summers of 2003, 2004, 2005, and 2008.

**Lower Tuscan Well 24N02W-12P02:** Key well 24N02W-12P02 is a deep dedicated monitoring well located 14,070 feet southwest of the pilot well. Well 12P2 was constructed in 1999 to monitor the lower Tuscan aquifer between 760 and 850 feet. Groundwater levels in this well have been monitored with a datalogger since 2004 that recorded data every one to four hours. Since about 2006, data is recorded on an hourly basis. The hydrograph for 12P2 is shown in Figures 5, Appendix E.

The hydrograph for 12P2 show that spring groundwater levels have remained stable through 2007, followed by a decline of several feet during the drought conditions of the last couple of years. Seasonally, groundwater levels fluctuate on an average of 4 to 5 feet between spring and summer, with additional temporary declines approximately 0.5 to 1.0 foot as the result of nearby agricultural groundwater pumping, and about 0.7 feet as the result of pilot well pumping during the summers of 2003, 2004, 2005, and 2008.

**Results for Lower Tuscan Monitoring During Previous Programs:**

The lower Tuscan groundwater level monitoring results from continuously pumping the pilot well for 69 days in 2004 were very similar to the results from 85 days of intermittent pumping in 2003. Total drawdown to the lower aquifer ranged from approximately 16 feet in 5J4 (located 375 feet from the pilot well), to 0.7 feet in 12P2 (located 14,070 feet from the pilot well). Figure 16 is a graph showing the distance versus drawdown relationship for the lower Tuscan monitoring wells during pilot well pumping. Figure 17 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. Figures 16 and 17 show 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. Additionally, although the majority of wells follow a fairly consistent relationship of exponentially decreasing impacts with distance. Monitoring well 32P2 seems to fall outside the trend of the other monitoring wells with a drawdown of only 0.5 feet. The anomalous drawdown in 32P2 could indicate lateral changes within the aquifer or could be a function of construction problems which occurred during the building of 32P2. Well 32P2 is the lowest zone of a triple completion monitoring well. During development of 32P2, groundwater level monitoring indicated that the lower zone could have been inadvertently connected to the upper zone. This connection could result in a false
groundwater levels reading in the upper and lower zone. A short interpretation of the monitoring data from five of the lower Tuscan wells is provided below.

<table>
<thead>
<tr>
<th>State Well Number</th>
<th>Distance from Pilot Well (ft)</th>
<th>Well Use</th>
<th>Aquifer Production Zone</th>
<th>Total Depth (feet)</th>
<th>Perforation Interval (feet)</th>
<th>Total Drawdown from Pilot Well Pumping (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24N01W-05J04</td>
<td>375</td>
<td>MW</td>
<td>Lower Tuscan</td>
<td>760'</td>
<td>650-722'</td>
<td>-16.0</td>
</tr>
<tr>
<td>24N01W-05Q04</td>
<td>3200</td>
<td>MW</td>
<td>Lower Tuscan</td>
<td>840'</td>
<td>700-790'</td>
<td>-4.0</td>
</tr>
<tr>
<td>25N01W-32P03</td>
<td>5,180</td>
<td>MW</td>
<td>Lower Tuscan</td>
<td>720'</td>
<td>640-720'</td>
<td>-0.5</td>
</tr>
<tr>
<td>25N01W-34N03</td>
<td>6,930</td>
<td>MW</td>
<td>Lower Tuscan</td>
<td>743'</td>
<td>468-743'</td>
<td>-3.2</td>
</tr>
<tr>
<td>24N02W-01R02</td>
<td>9,960</td>
<td>MW</td>
<td>Lower Tuscan</td>
<td>880'</td>
<td>765-880'</td>
<td>-1.2</td>
</tr>
<tr>
<td>25N02W-01L02</td>
<td>12,480</td>
<td>MW</td>
<td>Lower Tuscan</td>
<td>900'</td>
<td>660-900'</td>
<td>-1.3</td>
</tr>
<tr>
<td>24N02W-12P02</td>
<td>14,070</td>
<td>MW</td>
<td>Lower Tuscan</td>
<td>900'</td>
<td>560-900'</td>
<td>-0.7</td>
</tr>
</tbody>
</table>

Table 6. Approximate Deep Aquifer Drawdown from 2004 Pilot Well Operations.

Figure 16. 2004 Distance Versus Drawdown Curve in the Lower Tuscan Aquifer.
Maintaining a minimum level of acceptable water quality from the pilot well was the second criteria used to manage the 2004 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 to water quality criteria. A detailed explanation of the pilot program monitoring and management plan is provided in the Groundwater Monitoring and Management Guidelines in Appendix B. A summary of the management methods and the results from the water quality monitoring are provided below.

Figure 17. 2004 Groundwater Drawdown in the Lower Tuscan Aquifer During Pilot Well Pumping.

Water Quality Monitoring and Management
Three key sites are used to monitor water quality compliance. These sites are listed below and shown in Figure 14.

- 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 will conduct the field collection and testing of surface and groundwater quality samples during the program. Analytical testing will be conducted at a State of California approved laboratory and included analysis for minerals, trace metals, and nutrients. Minerals analysis included testing for conductivity, pH, temperature, alkalinity, total dissolved solids, total hardness, boron, calcium, chloride, magnesium, potassium, sodium, and sulfate. Trace metal analysis included testing for aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium, and zinc. Nutrient analysis includes testing for ammonia, dissolved orthophosphate, nitrite, nitrate, and total phosphorus.

Results from the water quality sampling during the 2003 pumping program showed no negative water quality impacts and consistently high water quality production from the pilot well. Based on the high water quality observed during the 2003 pumping program, the frequency of water quality monitoring was reduced during the 2004 program. The Groundwater Monitoring and Management Guidelines in Appendix B propose a monitoring frequency as follows:

- Sample and provide laboratory analysis for full suite of minerals, metals, and nutrients within five days of the start of the pilot well pumping and within 5 days of the conclusion of the pumping from all three sampling sites.
- Field sample for electrical conductivity from the pilot well and DCID canal monthly (monitoring for unexpected increases in salinity).
REFERENCES


APPENDIX A

GROUNDWATER EXTRACTION AND OFF PARCEL PERMIT NO. WE-0301

AND

GROUNDWATER EXTRACTION AND OFF PARCEL PERMIT NO. WE-0301,
AMENDED MAY 18, 2004
GROUNDWATER EXTRACTION AND OFF PARCEL USE

PERMIT NO. WE-03/01

In accordance with Tehama County Code, Title 9, Chapter 9.40, a Groundwater Extraction and Exportation Permit was granted to Deer Creek Irrigation District and is 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 Appendix A, Attachment 1, Groundwater Management Objectives of the project permit application and report.

3. Field measurement of conductivity shall be conducted and evaluated on a weekly 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. Report project status and monitoring results of the 30-day and 60-day summer pump testing to the Tehama County Board of Supervisors at a regularly scheduled meeting following pump testing.

6. Report all surface and groundwater levels and quality testing results to the Tehama County Flood Control & Water Conservation AB3030 Technical Advisory Committee.

7. During the 30-day and 60-day pumping times. All data collection shall occur weekly for the first three weeks, followed by semi-weekly monitoring.

8. Deer Creek Water Advisory Committee membership shall include a representative from the Tehama County Flood Control & Water Conservation District Staff.

9. The total volume of groundwater extracted shall be limited to a maximum of 550 acre-feet for a maximum of 90 days between April and October.

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

Granted APR 2 2 2003

Signed Deputy

Date

Clerk of the Board, Tehama
County Board of Supervisors
GROUNDWATER EXTRACTION AND OFF PARCEL USE

PERMIT NO. WE-03/01

AMENDED MAY 18, 2004

In accordance with Tehama County Code, Title 9, Chapter 9.40, a Groundwater Extraction and Exportation Permit was granted to Deer Creek Irrigation District and is 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 Attachment 1, Amended Groundwater Management Objectives of the project permit application and report.

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

6. 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 the extending grid shall occur monthly.

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

8. The total volume of groundwater extracted shall be limited to a maximum of 550 acre-feet between April and October.

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

Granted MAY 18, 2004

Signed [Signature]

DATE

Deputy Clerk of the Board, Tehama County Board of Supervisors
APPENDIX B

DEER CREEK FLOW ENHANCEMENT PROGRAM
MEMORANDUM OF AGREEMENT
MEMORANDUM OF AGREEMENT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF FISH & GAME, DEPARTMENT OF WATER RESOURCES, AND DEER CREEK IRRIGATION DISTRICT FOR CONSTRUCTION, OPERATION, MAINTENANCE AND MONITORING OF A FLOW ENHANCEMENT PROGRAM ON DEER CREEK IN TEHAMA COUNTY

This Memorandum of Agreement (“Agreement”), made this 14 day of August, 2007, is between the Department of Fish and Game (DFG) and the Department of Water Resources (DWR)(collectively “the State”), and the Deer Creek Irrigation District (DCID).

RECITALS

The State and DCID (collectively “the Parties”) recognize the need for a long-term solution to fish transportation issues in Deer Creek. In furtherance of that mutual goal, the proposed Deer Creek Flow Enhancement Program (“Program”) is intended to augment fish transportation flows in Deer Creek and meet the groundwater protection requirements of Tehama County’s AB 3030 Groundwater Management Plan. Therefore, the State enters into this Agreement to provide funding for the feasibility, planning and California Environmental Quality Act (“CEQA”) documentation for the proposed Program. Upon completion of CEQA process, the Parties shall decide whether to proceed with the proposed Program, which will be subject to modification based upon the results of the process.

DCID is a political subdivision of the State of California, duly organized and existing under Division 11 of the California Water Code and providing water service for the irrigation of lands and crops within the county of Tehama.

Deer Creek provides many important surface water beneficial uses, including agriculture, recreation, wildlife habitat, freshwater habitat, and anadromous fish habitat, particularly for spring-run Chinook salmon (Oncorhynchus tshawytscha) listed as threatened under the Federal and State Endangered Species Acts and steelhead trout (Oncorhynchus mykiss) listed as threatened under the Federal Act. Due in part to naturally occurring low flows, agricultural diversions, channel morphology and excessive temperatures, the upstream migration of adults
and/or downstream migration of juvenile salmon and steelhead may be impeded or blocked in some years.

DCID has adjudicated rights to divert Deer Creek surface water for irrigation.

Historically, DCID has cooperated with DFG by temporarily bypassing some of DCID’s surface water to provide a short term pulse flow for fish transportation in Deer Creek.

AGREEMENT

I. General Terms

A. Under the proposed Program, Program Wells (as defined in § I.1) will be installed and operated to provide DCID with a supplemental agricultural water supply in an amount equal to the quantity of surface water diversions which DCID may forego in order to provide fish transportation flows.

B. This Agreement may be amended to include additional water supplies from efficiency improvements to DCID’s distribution system or new water management techniques if it can be demonstrated that such improvements or techniques will allow DCID to forego additional surface water diversions in order to provide increased fish transportation flows under the proposed Program.

C. The Parties recognize that the timing of fish transportation flows is dependent on many variables and can change significantly based on annual climatic conditions, water temperature, agricultural diversions, channel morphology, etc. Although existing Deer Creek data is insufficient to predict the timing of salmon immigration and emigration with certainty, preliminary data indicates that increasing the transportation flow during late spring (April, May and June) and early fall (October and November) may be beneficial to Chinook Salmon and Steelhead populations. Therefore, initial operation of the proposed Program will be tied to real-time fisheries monitoring and limited to the months of April, May, June, October and November.
During these periods, flow-related impediments to migration may be alleviated, in part, by DCID bypassing surface water that it could otherwise divert for irrigation purposes.

D. The Parties also recognize that the exact amount of flow necessary to provide for immigrating of adult salmon and steelhead and emigrating juvenile salmon and steelhead in Deer Creek is unknown but also dependent upon on annual climatic conditions, water temperature, agricultural diversions, channel morphology, etc. However, a preliminary adult upstream fish transportation flow objective of 50 cubic feet per second (cfs) was developed for the proposed Program based on an examination of comparable east-side streams in the Northern Sacramento Valley. A preliminary estimate of flow to move downstream migrating juvenile salmon and steelhead is defined as a contiguous flow from the lowermost diversion to the Sacramento River.

E. In accordance with the initial cost planning and permitting estimates (set out in Appendix A, attached), the proposed Program will operate from April 1 through June 30 and October 15 through November 15 when the Deer Creek flow, as measured below the Stanford Vina Diversion Dam, is equal to or less than 50 cfs, or upon mutual consent of DCID, DFG, and DWR. Program operations carried out pursuant to this Agreement will change from year to year, but will be within the projected range of initial planning and permitting estimates. Program operations will be implemented in flow capacity intervals which are practical for monitoring and approximately equal to the increased capacity associated with individual Program Well capacity and/or capacity intervals associated with water savings due to application of AgWUE measures. As such, Base Flow contribution by DCID may result in Deer Creek flow greater than 50 cfs, as measured below the Stanford Vina Diversion Dam.

F. An adaptive management methodology linked to a comprehensive Deer Creek Annual Monitoring Program (DCAMP) will be incorporated into the proposed Program in order to operate the proposed Program effectively and adequately evaluate its potential benefits and impacts. The DCAMP will include baseline surface water monitoring, (both instream and in-district), temperature monitoring, identification of critical channel morphology impediments, groundwater monitoring, and fisheries monitoring for the proposed Program. The DCAMP will
be implemented regardless of whether DCID water is bypassed or not to the extent necessary to provide the proposed Program with baseline data needs for assessment of fish movement timing, documentation of annual surface water diversions, and fulfillment of the requirements set forth by the Tehama County Groundwater Extraction and Off-Parcel Use Permit.

G. The proposed Program will be implemented in two phases:

(1) Phase one will fund installation and operation of up to two additional new agricultural water supply wells, and/or the retrofitting and leasing of up to two existing agricultural wells to create a capacity of 10 cfs of groundwater to be used in exchange for surface water bypassed by DCID. As further defined in this Agreement, phase one will also include Program-related operations, maintenance, permitting, and monitoring, as well as annual baseline monitoring associated with DCAMP.

(2) Phase two will be initiated after completion of the work being funded under Section A of DCID’s 2004 Agricultural Water Use Efficiency (Ag WUE) Grant. In Phase two, the Parties will determine what amount of additional transportation flow can be made available to the Program through implementation of the agricultural water use efficiency measures and water management improvements described in DCID’s 2004 AgWUE Grant application (attached as Appendix B).

Upon completion of both phases, DCID may have the additional capacity to provide approximately 15 to 18 cfs of instream transportation flow while meeting agricultural water demand requirements in the District. As noted above, the portion of this flow to be achieved through water use efficiency improvements would be subject to field monitoring and assessment. The timing, quantity of, and payment for operation, maintenance or other costs associated with additional flows shall be determined by mutual agreement of the Parties.

H. The Parties agree that any water pumped by Program Wells to replace foregone surface water diversions that is left in-stream to provide fish transportation flows under the Program will not be transferred for export outside of the Deer Creek watershed. The
Parties agree that any water that is left in-stream under this Proposed Program will be solely for the purpose of preserving or enhancing fish and wildlife resources.

I. Definitions for the Agreement are as follows:

(1) **Program Wells.** Those production wells designed, constructed, retrofitted or leased to provide groundwater in exchange for bypassed surface water.

(2) **Ag WUE.** DCID Agricultural Water Use Efficiency Grant work.

(3) **DCAMP.** Deer Creek Annual Monitoring Program.

(4) **Base Flow.** The amount of surface water, bypassed by DCID, equal to the available replacement capacity from Program Wells (approximately 10 cfs), plus the additional capacity realized through implementation of Phase two Ag WUE measures (approximately 5 to 8 cfs). The Base Flow capacity will not exceed the total capacity available to DCID through the use of Program Wells and/or implementation of Ag WUE measures. The amount of capacity realized through implementation of Ag WUE measures shall be determined by mutual agreement of the Parties.

(5) **Pulse Flow.** The amount of surface water, bypassed by DCID, that exceeds the Base Flow replacement capacity of Program Wells and Ag WUE measures. Pulse Flow will only be made available upon mutual consent of DCID, DFG, and DWR.

(6) **Bypassed Flow.** The Deer Creek surface water that is bypassed by DCID, in association with this Program, which would have otherwise been diverted by DCID for agricultural use.

(7) **State Funding.** Funds which are provided by any governmental agency or person to mitigate for, or conserve and manage, species impacted by water-related operations, including but not limited to funds to offset direct losses of fish caused by the State Water Project.

(8) **Extraction Permit.** Tehama County Groundwater Extraction and Off-Parcel Use Permit required by Tehama County Ordinance 1617.
(9) Phase One. Includes DCID bypass of Deer Creek surface water at Base Flow capacity or, upon mutual consent, at pulse flow capacity, and in accordance with monitoring outlined in paragraph I.G(1) of this Agreement.

(10) Phase Two. In accordance with paragraph I.G(2), this includes DCID bypass of Deer Creek surface water at Base Flow equal to Program Wells capacity plus the capacity attributed to Ag WUE improvements or, upon mutual consent, at pulse flow capacity.

(11) Exchange Water. The groundwater made available to DCID by the Program Wells, and equal to the amount of surface water bypassed.

(12) Key Monitoring Well. Are groundwater level monitoring wells used to monitor compliance with the predetermined range of acceptable groundwater level fluctuations, as defined in Appendix C.

II. Specific Provisions

1.0. Well Design, Construction, Operations and Maintenance

1.1 DWR, as administrator of this Agreement, will pay all reasonable costs associated with the construction and operation, and maintenance Program Wells in accordance with both the budget as set forth in Appendix A and the terms set forth in Section 9.0 on payment. DWR will not be obligated to pay for operation and maintenance related to any non-Program use of the wells by DCID. The total capacity of Program Wells, including the previously constructed Pilot Well, will be at least 10 cfs.

1.2 DWR will provide technical assistance for the design, construction, development and testing of the Program Wells. DCID will consult with DWR in determining the location of the Program Wells.

1.3 DWR, with DFG concurrence, will pay to obtain access easements for installation and operation of Program Wells and related facilities, including any necessary leases of wells.

1.4 DCID will maintain and repair the Program Wells as needed, according to the manufacturer’s recommended methods. DCID will operate all project related equipment in a
manner both safe and consistent with the proposed Program and keep accurate records of daily project well operations and annual flow volume.

1.5 DWR will pay DCID’s approved costs associated with Program-related operation and maintenance of the Program Wells and expenses to administer the program in accordance with both the budget set forth in Appendix A and the terms set forth in Section 9.0 of this Agreement.

2.0 Ownership of Wells.

DCID shall hold all right, title and interest to any new wells, well housing, monitoring equipment, electrical and other appurtenances associated with the wells if such wells are constructed for the proposed Program utilizing State funding provided through this Agreement. DCID will be the Lessee for any existing wells to be leased as part of this program. However, DCID shall not enter into any Lease as part of this proposed Program without the prior written consent of DWR and DFG as to the terms of such Lease.

2.1 In the event that DCID withdraws from this Agreement within the Initial Program Term of the Agreement, or fails to comply with the terms of this agreement during the Initial Program Term resulting in the termination of the Agreement, DCID shall convey to the State all right, title and interest in the Program Wells, as well as all well-related leases or easements.

2.2 In the event the proposed Program is suspended or terminated through no fault of DCID, and DCID has fulfilled its obligations under this Agreement, then the ownership and use of the wells will be retained by DCID.

3.0 Groundwater Monitoring.

DCID will be responsible for obtaining groundwater extraction permits required by Tehama County. DWR shall perform groundwater monitoring and reporting and assist with obtaining any required groundwater extraction permits.

3.1 DWR will pay for the installation and operation of Program-related groundwater monitoring equipment for the Program Wells and the surrounding Key Monitoring Wells. The monitoring equipment will include flow meters on project production wells, continuous groundwater level recording instrumentation in project production wells, dedicated monitoring
wells, and key third-party monitoring wells. Flow meters in the project production wells will have the capability to record instantaneous discharge rate and total volumetric production.

3.2 DCID will obtain a Groundwater Extraction and Off Parcel Use Permit as required by Tehama County Ordinance 1617. DCID will coordinate with DWR and Tehama County to implement a groundwater monitoring and management program following the Guidelines outlined in Appendix C of this Agreement.

3.3 DWR will perform annual groundwater monitoring and reporting associated with the Groundwater Extraction and Off Parcel Use Permit through the first three years of the Initial Program Term, as defined in Section 12.0. Thereafter, and upon mutual agreement of all parties, funding and obligation for groundwater monitoring, the permitting, and reporting obligations may be transferred to DCID for the remainder of the term of this Agreement.

4.0 Surface Water Monitoring.

4.1 As it relates to the proposed Program, DWR will operate and maintain the surface monitoring equipment for DCID’s Deer Creek diversion. At a minimum, continuous monitoring of DCID’s surface water diversion from Deer Creek will be operated and maintained between April 1st and November 30th using the existing parshall flume and datalogging equipment. DCID will measure and maintain surface water monitoring within the District’s service area. Unless alternative funding is identified and approved by DWR and DFG, it is anticipated that funds from DCID’s Ag WUE grant will pay for start-up of DCID’s surface water monitoring within the District.

4.2 DWR will continue to operate and maintain the surface water gauging station below the Stanford Vina Ranch Irrigation Company (SVRIC) Diversion Dam through existing program funding. DWR will periodically monitor flow in Deer Creek above the SVRIC Dam for the first three years of initial program operations to determine the losses or gains in Deer Creek flow between the USGS gauge and the SVRIC diversion dam.

4.3 DWR will conduct additional surface water monitoring if it is deemed necessary by DFG and DWR to implement the program, especially during dry to critically dry water years.

5.0 Fish Passage Management Assessment.
5.1 DFG will conduct a Fish Passage Management Assessment Program which will evaluate the productivity of any flow actions. These assessments will be used to adaptively manage the program and address four important issues related to the project: 1) When flow augmentation is necessary to achieve fish passage 2) How much flow is necessary to achieve fish passage 3) How to best utilize the available flow to achieve fish passage And, 4) How to gauge the effectiveness of the project. If necessary, DWR will provide funding to DFG to conduct the annual fish passage evaluation and reporting. Protocols for assessing and reporting the metrics necessary to address the issues set forth above have been developed by DFG and are included in Appendix D of this Agreement.

5.2 DCID will coordinate with DFG to implement the Fish Passage Management Assessment Program, as outlined in Appendix D, to identify the volume and timing of flow necessary to pass fish upstream in Deer Creek. The results of these assessments will be continuously evaluated to develop appropriate protocols for long-term assessment of instream flow in Deer Creek.

6.0 Environmental Documentation.

6.1 DCID will be the lead agency for CEQA. To aid DCID in completing CEQA for the construction of Program Wells, DWR will provide DCID with the work products detailed and budgeted in Appendix A. In addition, DFG will provide DCID with the information regarding potential impacts to salmon and steelhead which is necessary to prepare that portion of the CEQA biological resources analysis relating to anadromous fish. DCID recognizes that other sources of information may be needed to complete the CEQA biological resources analysis.

6.2 DWR shall reimburse DCID up to $50,000 to complete an appropriate CEQA document. The State’s share of these costs shall not exceed $50,000 unless approved in accordance with Section 10.0.

6.3 If DCID is unable to fulfill the CEQA obligation for the program, DWR and DFG may, through mutual agreement, provide additional funds or staff services to assist DCID in the completion of the necessary environmental review, with DCID remaining as the lead agency.

7.0 Program Operations.
7.1 DFG designates the following person as responsible for real-time decisions regarding operation of bypass flows according to Section 7.1:

Randy Benthin  
Senior Fisheries Biologist  
North Central North Coast Region  
Department of Fish and Game  
601 Locust Street  
Redding, CA 96001  
(530) 225-2372  
RBenthin@dfg.ca.gov

7.2 DFG may request from DCID Base Flow for fish transportation in Deer Creek, below the DCID diversion. Upon such request by DFG, DCID shall provide such Base Flow. During Phase Two the additional Base Flow capacity will not exceed the total capacity available to DCID through the use of Program Wells and/or implementation of Ag WUE measures. The amount of capacity realized through implementation of Ag WUE measures shall be determined by mutual agreement of the Parties.

7.3 Upon request of DFG and mutual consent of DCID, DCID will bypass Pulse Flows for fish transportation in Deer Creek, below the DCID diversion. Pulse Flows will only be made available upon mutual consent of DCID, DFG, and DWR.

7.4 DCID will have full use of the Program Wells outside the needs of this proposed Program. Such use by DCID will be within the operating parameters of the Tehama County Groundwater extraction and Off Parcel Use Permit and the groundwater monitoring and management guidelines in Appendix C. If the wells are used to provide other than Program water, DCID shall pay the operations costs to pump such water. Any such use of Program Wells for non-Program purposes is also subject to the restriction set forth in Section H.

7.5 In the event that the funding is not available to pay for the operation of Program Wells in any given year, up to the amount budgeted in Appendix A, DCID will have no obligation to the State under this Agreement to bypass water. This release of the obligation to provide bypass water shall not apply to funds which DCID requests which have not been approved by DWR and DFG and are either or both of the following: 1) not explicitly authorized by Appendix A; or, 2) exceed the amounts contained in Appendix A.

8.0 Water Accounting Methodology.
8.1 Accounting of DCID’s foregone surface water will be based on the change in DCID’s Deer Creek diversion, as measured at the DCID’s gauged Parshall closest to their Deer Creek Diversion, for the times immediately prior to and after the bypassed flow was requested.

8.2 DCID shall keep daily records of the amount of Base Flow or Pulse Flow bypassed by DCID. DCID shall provide DWR and DFG with a monthly accounting of these flow measurements.

8.3 DCID shall be able to substitute groundwater from the Program Wells in an amount equal to the surface water bypassed. DCID will have one year from the date the surface water is bypassed to make such a groundwater substitution.

8.4 Accounting of groundwater extraction shall be expended in the order it is accrued so as to allow maximum flexibility of groundwater use within the one-year period.

8.5 DCID shall keep a daily groundwater extraction record. A monthly copy shall be provided to DWR and DFG. DCID shall also provide DWR and DFG with a monthly reconciliation sheet showing the earliest date of bypassed surface water (i.e., the one-year limitation) and the amount of groundwater pumping costs (in volume) accrued.

8.6 If the program is suspended or terminated and DCID has fulfilled its obligations under this Agreement, DWR will continue to pay for the operations and maintenance to pump wells equal to the amount of bypass flow provided by DCID, but not yet substituted through groundwater extraction with Project Wells.

9.0 Maintenance of Bypass Flow.

9.1 In accordance with Sections 7.2, DCID is responsible for ensuring water is bypassed by the DCID Diversion Dam in an amount equal to the requested Base Flow or Pulse Flow.

9.2 DFG and DWR, with the support of DCID, will request downstream diverters to voluntarily cooperate in the bypass of water made available by DCID through this Agreement. If downstream diverters do not cooperate in allowing DCID Bypassed Flow past their diversions, then the State may suspend the Program upon thirty (30) days written notice. During the suspension, as owner of the Program Wells, DCID may use and pay for the operation and maintenance of the wells pursuant to Section 7.4. Additionally, DCID will be allowed to pump pursuant to Section 8.6. The parties may decide by mutual concurrence during the suspension to
continue some portions of the proposed Program. Any continuance of portions of the Program during suspension shall be by the mutual consent of DCID, DWR and DFG and shall be in writing.

9.3 Upon mutual agreement of DCID, DWR, and DFG, if it is determined that legal proceedings are necessary to ensure the bypass of water, then this Agreement may be amended to provide funding for such proceedings. However, before DCID incurs any costs or fees pursuant to this section, DWR and DFG must both agree in writing as to whether any proceeding shall be undertaken and, if so, the estimated budget of reasonable costs and fees.

10.0 Payment

DFG and DWR shall jointly approve of the final budget for planning and environmental review set forth in Appendix A. In addition, Appendix A includes proposed construction and operational budgets. Following completion of the CEQA process, DFG and DWR shall approve the final construction and operational budgets and amend Appendix A, if necessary. DWR will reimburse DCID on a monthly basis for those expenses directly associated with the proposed Program in accordance with the approved budget set forth in Appendix A. DWR may reimburse DCID for those expenditures which are within both the categories and amount of any final budget without further DFG concurrence unless DFG requests that a particular expenditure be discussed with the Program Management committee established in Section 11.0. In addition, any request for payment which exceeds or is inconsistent with Appendix A shall be subject to approval by both DFG and DWR.

11.0 Program Management

The parties shall establish a management committee of two representatives from each party (DCID, DFG, and DWR), to discuss issues regarding program implementation, reporting, budgets, finances, and dispute resolution.

12.0 Term of this Agreement

This Agreement becomes effective when all Parties have signed. If, upon completion of the CEQA process, the Parties decide to proceed with the Program the Program start date shall
be April 1, 2009. The Program term will be ten years with an end date of November 15, 2018. Adjustments to the start date will only be made upon mutual consent of DCID, DWR, and DFG.

13.0 Dispute Resolution

The management committee shall make reasonable efforts to resolve any disputes that may arise from this Agreement in a prompt and timely manner. In the event of a dispute, the Party claiming a dispute shall give notice of the dispute to the other Parties. Such notice shall include a brief description of the matter in dispute and the relief sought. The management committee shall hold at least two informal meetings to resolve the dispute, commencing within 45 days after the dispute notice is sent to the parties.

If the dispute is not resolved by the management committee through the informal meetings, the directors of DFG, DWR, and DCID shall decide whether to use a third-party mediator. The decision whether to pursue mediation shall be made within 20 days after the conclusion of the informal meetings set forth above. The disputing Parties shall agree on an appropriate allocation of any costs of the mediator employed under this section. Mediation shall not occur if the disputing Parties cannot agree on the allocation of costs. The disputing Parties shall select a mediator within 30 days of the decision to pursue mediation, including the agreement of allocation of costs. The mediation process shall be concluded no later than 60 days after the mediator is selected. The above time periods may be shortened or lengthened upon mutual agreement of the disputing Parties.

The Parties shall also bear their own costs and attorneys’ fees related to any dispute resolution proceeding.

14.0 Withdrawal

Any Party to this Agreement wishing to withdraw from this Agreement must provide a written notice to each other Party specifying the reason the notifying Party wishes to withdraw. The Parties shall promptly meet and confer in a good faith effort to address and resolve, if possible, the issue(s) causing the notifying Party to wish to withdraw from this Agreement. If following such meeting the notifying Party still wishes to withdraw, such Party can withdraw 30 days after the date of the written notice and, notwithstanding Section 15.0, this Agreement shall terminate.
15.0 **Termination.**

15.1 The Agreement shall be subject to termination if the State does not fund the one time estimated start up costs set forth in Table 2 of Appendix A. The Parties acknowledge that the funding of this Agreement may be delayed for reasons beyond the control of either DWR or DFG, and that a delay in funding shall not automatically terminate this Agreement. At least 45 days prior to termination, the Parties shall meet and confer in order to explain the reason for any delay in funding, and DCID shall allow the State a reasonable amount of time to resolve any issues regarding funding, including finding alternative sources of funding for the Program.

15.2 The Agreement shall be subject to termination if the State does not annually fund the yearly operations costs set forth in Table 1 of Appendix A. The Parties acknowledge that the funding of this Agreement may be delayed for reasons beyond the control of either DWR or DFG, and that a delay in funding shall not automatically terminate this Agreement. At least 45 days prior to termination, the Parties shall meet and confer in order to explain the reason for any delay in funding, and DCID shall allow the State a reasonable amount of time to resolve any issues regarding funding, including finding alternative sources of funding for the Program.

15.3 The Agreement shall be subject to termination if DCID does not provide Base Flow. At least 45 days prior to termination, the Parties shall meet and confer to discuss the reasons that DCID is unable to provide Base Flow, and attempt develop a solution in order for DCID to provide Base Flow.

16.0 **Renewal**

At the end of the Initial Program Term, the parties may revise and/or renew the Agreement.

17.0 **Effect of this Agreement on Other Matters**

17.1 **As a Precedent.** Nothing in this Agreement, and nothing incorporated by reference into the terms of this Agreement, is intended or shall be construed as a precedent or other basis for any argument that the participants to this Agreement have waived or compromised their rights which may be available under state or federal law, except as to the matters addressed in this Agreement.
17.2 **As an Admission.** Nothing in this Agreement shall be construed as an admission by any Party that such Party has obligations relative to the protection of fishery or other resources and/or the maintenance of water quality standards in Deer Creek, the Delta, the Sacramento River, or its other tributaries. Similarly, nothing in this Agreement shall be construed or used in an effort to demonstrate that DCID has surplus water or water which is not being beneficially used by DCID.

17.3 **Federal and State Agency Obligations.** Nothing in this Agreement is intended to limit the authority of DWR, DFG, or any other agency of the State, to fulfill its responsibilities under federal or state law. Moreover, nothing in this Agreement is intended to limit or diminish the legal obligations and responsibilities of DWR, DFG, or any other agency of the State.

18.0 **Representation by Counsel**

This Agreement is entered into freely and voluntarily. The parties hereto acknowledge that they have been represented by counsel of their own choice, or that they have had the opportunity to consult with counsel of their own choosing, in the negotiations that preceded the execution of this Agreement and in connection with the preparation and execution of this Agreement. Each of the parties hereto executes this Agreement with full knowledge of its significance and with the express intent of affecting its legal consequences. In any action by a Party to this Agreement challenging the Agreement, each party is to bear its own fees and costs including attorney fees. Such fees and costs shall not be reimbursable as Program-related costs or expenses.

19.0 **Entire Agreement**

This Agreement, including Appendices A through E, constitutes the entire Agreement between the Parties and obligations between them. This Agreement supersedes all prior and contemporaneous agreements and/or obligations concerning those obligations which are merged into this Agreement. Each party has made its own independent investigation of the matters settled, has been advised concerning the terms of this Agreement by counsel of its choice or has had an opportunity to be so advised, and is not relying upon any representation not specified herein.
20.0 **Applicable Law**

This Agreement shall be construed under and governed by the laws of the State of California and of the United States, without giving effect to any principles of conflicts of law if such principles would operate to construe this Agreement under the laws of any other jurisdiction.

21.0 **Construction of Agreement**

This Agreement is the product of negotiation and preparation by and among each party hereto and its attorneys. Therefore, the parties acknowledge and agree that this Agreement shall not be deemed to have been prepared or drafted by any one party or another. Accordingly, the normal rule of construction to the effect that any ambiguities are to be resolved against the drafting party shall not be employed in the interpretation of this Agreement.

22.0 **Modification of Agreement**

No supplement, modification, waiver or amendment with respect to this Agreement shall be binding unless agreed to in writing by the Parties. However, this requirement does not apply to supplementing, modifying, or amending Appendix A as agreed to by the Parties.

23.0 **Counterparts of Agreement**

This Agreement may be signed in any number of counterparts by the parties hereto, each of which shall be deemed to be an original, and all of which together shall be deemed one and the same instrument. This Agreement, if executed in counterparts, shall be valid and binding on each party as if fully executed all on one copy.

24.0 **Notice**

Any written notice required to be given by this Agreement shall be deemed to have been given by the notifying party when mailed, postage prepaid or delivered to the following specified representatives or their replacements:

For DCID: Tim O’Laughlin  
2580 Sierra Sunrise Terrace, Suite 210  
Chico, CA 95928
25.0 **Signatories' Authority**

The signatories to this Agreement on behalf of all the parties hereto warrant and represent that they have authority to execute this Agreement and to bind the parties on whose behalf they execute this Agreement.

IN WITNESS WHEREOF, the following parties have executed this Agreement to be dated as effective on the day and year of the last signature:

DATED: **8-14-2007**

[Signature]
John Edson, President
Deer Creek Irrigation District

DATED: **9-10-07**

[Signature]
Lester A. Snow, Director
Department of Water Resources

DATED: **8-22-07**

[Signature]
L. Ryan Broddrick, Director
Department of Fish and Game
RESOLUTION OF THE BOARD OF DIRECTORS  
OF THE  
DEER CREEK IRRIGATION DISTRICT  
TO ENTER INTO AN AGREEMENT TO IMPLEMENT THE  
THE DEER CREEK ENVIRONMENTAL FLOW ENHANCEMENT PROGRAM

WHEREAS, the Deer Creek Irrigation District Board of Directors has reviewed the Agreement with the Department of Water Resources and the Department of Fish and Game for construction, operation, maintenance and monitoring of an environmental flow enhancement program on Deer Creek in Tehama County.

WHEREAS, upon completion of the California Environmental Quality Act Environmental Documentation, Deer Creek Irrigation District will provide Program Management services during the 10-year term of the Deer Creek Environmental Flow Enhancement Program.

NOW LET IT BE RESOLVED, that the Deer Creek Irrigation District Board of Directors approves entering into the Agreement with the Department of Water Resources and the Department of Fish and Game for the construction, operation, maintenance and monitoring of an environmental flow enhancement program on Deer Creek and authorizes the Deer Creek Irrigation District Board President, John Edson to execute the Agreement and any subsequent amendments, agreements, or contracts related to or necessary to carry out the Agreement.

Entered into and effective the 14 day of August, 2007

[Signature]
President, Board of Directors  
Deer Creek Irrigation District

[Signature]  
Secretary, Deer Creek Irrigation District

Date: 8/14/07  
Date: August 14, 2007

Ayes: 5  
Nays: 0  
Abstained: 0  
Absent: 0
## APPENDIX A
### Budgets

#### Table 1. Estimated Annual Operations, Maintenance, Monitoring and Management (O&M Budget)

<table>
<thead>
<tr>
<th>DEER CREEK FLOW ENHANCEMENT PROGRAM</th>
<th>Start Up</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
<th>Year 9</th>
<th>Year 10</th>
<th>10-YEAR TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANNUAL OPERATIONS, MAINTENANCE, MONITORING and MANAGEMENT (O&amp;M BUDGET)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRODUCTION WELL O&amp;M</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Costs (600 acf)</td>
<td>$15,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$315,000</td>
</tr>
<tr>
<td>Lease Existing Well (240 acf)</td>
<td>$2,400</td>
<td>$4,800</td>
<td>$4,800</td>
<td>$4,800</td>
<td>$4,800</td>
<td>$4,800</td>
<td>$4,800</td>
<td>$4,800</td>
<td>$4,800</td>
<td>$4,800</td>
<td>$4,800</td>
<td>$50,400</td>
</tr>
<tr>
<td>Equip Maintenance</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
<td>$200</td>
<td>$2,200</td>
</tr>
<tr>
<td><strong>MONITORING WELLS O&amp;M</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DWR LABOR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GW Mont/Reporting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. GW Levels</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$125,000</td>
</tr>
<tr>
<td>2. Permit Reporting</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$31,000</td>
</tr>
<tr>
<td>3. WQ Testing</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$33,000</td>
</tr>
<tr>
<td>SW Monitoring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. DCID Parshall</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$90,000</td>
</tr>
<tr>
<td>2. Instream Flow Monitoring</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$33,000</td>
</tr>
<tr>
<td>Program Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Overall Management</td>
<td>$7,000</td>
<td>$7,000</td>
<td>$7,000</td>
<td>$7,000</td>
<td>$7,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$61,000</td>
</tr>
<tr>
<td><strong>DFG LABOR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish Assessment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Labor/Benefits /Contract 2 PSMA</td>
<td>$27,000</td>
<td>$27,000</td>
<td>$27,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$186,000</td>
</tr>
<tr>
<td>2. Supplies/Reporting/Project Management</td>
<td>$5,000</td>
<td>$10,000</td>
<td>$8,000</td>
<td>$8,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$66,000</td>
</tr>
<tr>
<td><strong>DCID LABOR ANNUAL PROGRAM MANAGEMENT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$45,000</td>
<td>$45,000</td>
<td>$45,000</td>
<td>$45,000</td>
<td>$45,000</td>
<td>$45,000</td>
<td>$45,000</td>
<td>$45,000</td>
<td>$45,000</td>
<td>$45,000</td>
<td>$45,000</td>
<td>$315,000</td>
<td></td>
</tr>
<tr>
<td><strong>ANNUAL O&amp;M Budget</strong></td>
<td>$52,600</td>
<td>$161,200</td>
<td>$144,200</td>
<td>$129,200</td>
<td>$114,200</td>
<td>$114,200</td>
<td>$114,200</td>
<td>$114,200</td>
<td>$114,200</td>
<td>$114,200</td>
<td>$114,200</td>
<td>$1,286,600</td>
</tr>
</tbody>
</table>

**OM&M Ten-Year Total**: $1,286,600

**NOTE**:  
1. Annual Pumping Costs are considered to be an average annual cost over the 10-year period. Actual costs are unknown.  
2. The need for leasing an existing well is unknown. O&M is based on lease price of $20 per ac-ft. Actual price will be negotiated. Power costs for leased well are included in "Power Costs".  
3. If agreed to by all parties, groundwater monitoring and reporting would transfer to DCID at year 4.  
4. Potential Need for 1707 filing is unknown. Other methods for securing bypassed water will be analyzed and implemented first.
## DEER CREEK FLOW ENHANCEMENT PROGRAM
### ESTIMATED LUMP-SUM START-UP COSTS

<table>
<thead>
<tr>
<th></th>
<th>Start Up</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
<th>Year 8</th>
<th>Year 9</th>
<th>Year 10</th>
<th>10-YEAR TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DWR LABOR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEQA Documentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Site Visits</td>
<td>$2,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$2,000</td>
</tr>
<tr>
<td>2. Report Prep</td>
<td>$3,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$3,000</td>
</tr>
<tr>
<td>Drilling Contract Dev.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Drilling Contract Dev</td>
<td>$2,500</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$2,500</td>
</tr>
<tr>
<td>2. Well Drilling (2 prod wells)</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$30,000</td>
</tr>
<tr>
<td>3. Well Testing (2 prod wells)</td>
<td>$2,500</td>
<td>$2,500</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DFG LABOR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEQA Documentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Site Visits</td>
<td>$6,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$6,000</td>
</tr>
<tr>
<td>2. Report Prep</td>
<td>$5,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DCID START-UP COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well Easements (2 well sites)</td>
<td>$8,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$8,000</td>
</tr>
<tr>
<td>CEQA Documentation</td>
<td>$50,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$50,000</td>
</tr>
<tr>
<td>Program Management (1st year)</td>
<td>$80,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$80,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRODUCTION WELLS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2 new, 1 existing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Construction New Wells</td>
<td>$250,000</td>
<td>$250,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$500,000</td>
</tr>
<tr>
<td>2. Pump Bowl and Connection</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$30,000</td>
</tr>
<tr>
<td>3. Pump Motor and Panel</td>
<td>$35,000</td>
<td>$35,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$70,000</td>
</tr>
<tr>
<td>4. PG&amp;E Power Connection</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$20,000</td>
</tr>
<tr>
<td>5. Discharge Turnout &amp; Roadwork</td>
<td>$9,000</td>
<td>$9,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$18,000</td>
</tr>
<tr>
<td>6. Monitoring Equipment</td>
<td>$5,000</td>
<td>$2,500</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$7,500</td>
</tr>
<tr>
<td>7. Retrofit Existing Well</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$20,000</td>
</tr>
<tr>
<td>8. Well Housing</td>
<td>$2,000</td>
<td>$2,000</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$4,000</td>
</tr>
<tr>
<td>9. Construction Contingency (5%)</td>
<td>$16,800</td>
<td>$16,875</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$33,475</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LUMP-SUM BUDGET BY YEAR:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start Up</td>
<td>$505,800</td>
<td>$567,675</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$-</td>
<td>$873,475</td>
</tr>
<tr>
<td>Year 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL LUMP-SUM BUDGET:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$873,475</td>
</tr>
<tr>
<td><strong>OM&amp;M Ten-Year Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1,288,600</td>
</tr>
<tr>
<td><strong>ANNUAL PROGRAM TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$2,160,075</td>
</tr>
</tbody>
</table>

**NOTE:** A Contingency of 5 percent was added to estimated production well costs.
APPENDIX B

Deer Creek Irrigation District 2004 WUE Grant Revised Scope of Work

Funding for agricultural water use efficiency studies and improvements are funded through Section A and B of the Proposition 50 2004 Water Use Efficiency Grant. The main intent of the WUE improvement projects are to reduce system spillage and Deer Creek flow enhancement opportunities through improvements to DCID water diversion facilities and the ability to manage agricultural water distribution.

Section A of the WUE Grant includes funding to replace and automate main canal diversion gates, replace the canal diversion structure at the “Y”, install a Supervisory Control and Data Acquisition (SCADA) system, and train the district water manager in its use. New water control structures along with SCADA technology will provide system operators with real-time information about flows, water levels and spillage from the system and the ability to remotely control Deer Creek diversions accordingly. Section B of the WUE Grant includes monitoring and assessment of the existing distribution system to provide estimate of the effectiveness of program improvements and recommendations for future work. A summary of Section A and Section B tasks are provided below.

Section A Grant Tasks

- Establish Easements and ROW
- Prepare Final Designs, Specifications & Contract Documents
- Conduct Project Bidding
- Construct Structures
- Procure and Install SCADA Equipment
- Provide Engineering Services During Construction
- Provide SCADA Training, Troubleshooting & On-call Support
- Conduct Project Monitoring & Assessment
- Conduct Outreach & Community Involvement
- Provide Project Management & Administration
- Permits and License

Section B Grant Tasks:

- Develop Project Mapping & Surveys
- Develop Project Mapping & Surveys
- Conduct Facilities Inventory
- Design & Implement Flow Monitoring Program
- Conduct Canal Seepage Investigations
- Assemble Water Balances
- Formulate & Compare Alternative Systems Improvement Programs
- Prepare Feasibility-Level Designs & Cost Estimates
- Environmental Compliance (provided in Sec. A work)
- Outreach & Community Involvement
- Project Reporting, Management and Administration
Project Monitoring:
The WUE Grant also includes monitoring and verification components to determine pre-project and post-project efforts.

Pre-Project: The 2006 monitoring efforts will concentrate mainly on two of the largest sites where spillage will be affected by the proposed near-term improvements. Additional locations where spillage is known to occur will be inspected and operators interviewed to be sure that other spillage sites are not overlooked.

Post-Project: Spillage monitoring will be continued in 2007 and beyond to support the five annual benefit/cost reports. This will provide a record of spillage with the efficiency improvements in place. Considering that the effectiveness of the proposed SCADA improvements depends somewhat upon operator skill and learning, a multi-year record is preferable to capture initial and ultimate project performance. Thus, monitoring will be continued through at least 2011 to capture this transition period and to provide the basis for the annual updates of project benefit/cost.

Conventional, proven methodologies will be used to measure, record and quality-control all targeted spillage flows. This will include use of standard measurement structures where possible, with a preference for broad-crested and sharp-crested weirs as primary flow measurement devices. Non-standard structures might also be employed, provided that reliable stage-discharge functions can be developed through current metering.

Because spillage tends to be highly variable with time, frequent observations are needed to compute reliable spillage volumes. Flow monitoring studies on other irrigation systems indicate that several measurements are required daily to adequately capture the variability in flow inherent to irrigation operations, especially spillage. The plan is to automate data recording at standard intervals of about 15 minutes, and in no case more than hourly. Sites will be visited weekly or biweekly to check for proper flow conditions and to swap out data loggers.

WUE Project Deliverables:
- Quarterly Progress Reports and associated documents
- Final Report and associated documents
- Any applicable engineering and permitting documents
- Annual Reports of Benefits & Costs for 5 years
- Construction Contract Documents
- Construction Technical Report
- Monitoring and Assessment Report

WUE Project Budget:
The WUE project was originally approved and funded as a collaborative project between Deer Creek Irrigation District (DCID) and Stanford Vina Ranch Irrigation Company (SVRIC). In May 19, 2005, the Stanford Vina Ranch Irrigation Company Board of Directors voted to withdraw from participating with DCID in the 2004 WUE Grant. Subsequently, DWR and DCID negotiated to fund only the DCID improvement portions of the original grant project.
Funding for the revised Section A and Section B budgets were approved for $453,035 and $172,850, respectively.

**WUE Project Timeline:**
Timeline for completion of the proposed grant activities is three years from the final award.
APPENDIX C

Groundwater Monitoring and Management Guidelines
For the
Deer Creek Flow Enhancement Program

INTRODUCTION

The following Groundwater Monitoring and Management Guidelines are included as part of the attached Agreement between DWR, DFG and DCID to enhance fish transportation flows in Deer Creek through utilization of groundwater in-lieu of bypassed surface water. The following guidelines establish a clear set of criteria for program monitoring, reporting and management and are similar to the management objectives use successfully during DCID’s 2003 pilot program and the 2004 test-pumping program.

The overall management goals of the Deer Creek Irrigation District are to maintain the groundwater surface elevation at a level that will assure an adequate and affordable irrigation water supply, and to assure a sustainable supply of good quality groundwater for agricultural and domestic use. In order to maintain this goal, it is recognized that the operational criteria presented in the Groundwater Monitoring and Management Objectives may need to be adjusted as additional operational data for the program are established.

PROGRAM COORDINATION and INSTITUTIONAL AUTHORITY

Deer Creek Irrigation District is signatory to the Tehama County AB 3030 Groundwater Management Plan. The Tehama County AB 3030 Groundwater management Plan is administered by the Tehama County Flood Control and Water Conservation District (TCFCWCD). The TCFCWCD has established a Technical Advisory Committee (AB 3030 TAC) that serves as an advisory body to the TCFCWCD Board. The TCFCWCD Board and the AB 3030 TAC hold monthly meetings to implement the AB 3030 plan, and to develop policy on local groundwater management issues.

Tehama County also administers several groundwater-related ordinances. Chapter 9.4, "Aquifer Protection", of the Tehama County Code incorporates County Ordinance No. 1617. Tehama County Ordinance No. 1617 requires a permit to extract groundwater for the purpose of using or selling the water for use on lands other than the parcel from which the extraction occurs. Permitting authority of this ordinance is through the Tehama County Board of Supervisors (BOS), but administration of the permitting process is through the Tehama County Health Agency, Environmental Health Division (EHD). The EHD also oversees permitting associated with drilling and installation of all new wells.

With respect to operation, monitoring and reporting of DCID’s groundwater pumping associated with the Deer Creek Flow Enhancement Program, primary coordination and reporting will be through the Tehama County EHD, via the Board of Supervisors. Secondary coordination at the
county level will be through the AB 3030 TAC, via the TCFCWCD. At the local level, coordination will be through the DCID Board, the Deer Creek Watershed Conservancy, and through stakeholder meetings associated with ongoing program operations.

During operation of the Deer Creek Flow Enhancement Program, a Deer Creek Water Advisory Committee (WAC) will be established. The WAC will help oversee the development and compliance of the program, interface with the local, county and State representatives, and work towards a more compressive groundwater management plan for the Deer Creek watershed.

The Deer Creek WAC will invite representatives from each of the following entities to participate.

- Deer Creek Irrigation District,
- Tehama County AB 3030 TAC,
- Tehama County Health Agency, EHD
- Northern District Department of Water Resources,
- California Department of Fish and Game,
- UC Davis Agricultural Extension Farm Advisor,
- Deer Creek Watershed Conservancy,
- Stanford Vina Ranch Irrigation Company, and
- Private groundwater users outside DCID and SVRIC area, but within the lower Deer Creek watershed area.

A Deer Creek WAC was developed during the 2003 Pilot Program and proved valuable for providing program input and dispensing information to local, county and state groups. Under the current program, it is anticipated that the WAC will initially meet monthly between April and October to discuss program operations and monitoring results. As the program develops it is envisioned that meetings will be limited and program status/updates will be provided electronically. Official reporting and annual program review associating with the permitting process for the Deer Creek Flow Enhancement Program will be coordinated directly with the Tehama County Health Agency EHD.

**GROUNDWATER LEVEL CRITERIA**

One of the key criteria for program operations is maintaining a predetermined range of acceptable groundwater levels surrounding the program-related production wells. The acceptable range of groundwater level fluctuation during program operations was established based on historic groundwater level data, and the estimated worse-case decline in groundwater levels associated with previous test-production well pumping. The predetermined range of acceptable groundwater level fluctuation will be reviewed by the WAC and included as part of the Tehama County Groundwater Extraction Permit. Operation of the program production wells will proceed as long as there is compliance with the pre-agreed groundwater level criteria. The groundwater level monitoring location, timing, data reporting, acceptable range of fluctuation during program operations, and procedures for noncompliance determination, evaluation and program shutdown are presented below.
Groundwater Level Measurements
The Department of Water Resources will be responsible for monitoring groundwater levels during the Deer Creek Flow Enhancement Program. Groundwater monitoring will include a regional County-wide grid, a regional Deer Creek monitoring grid, and a local Key Well grid. Tehama County typically also measures summer groundwater levels in portions of the regional County-wide grid.

Regional County-Wide Groundwater Level Monitoring Network
DWR has maintained a groundwater level monitoring grid in Tehama County for over 50 years. Within this period, the annual size of the monitoring grid has fluctuated from as few as 3 wells in 1951, to about 128 wells in 2006. The County-wide groundwater level monitoring grid consists predominantly of domestic and irrigation wells, along with several dedicated multi-completion monitoring wells. The County-wide grid surrounds the Deer Creek Environmental Flow Enhancement Program on three sides and provides a good regional estimate of seasonal versus long-term groundwater level fluctuations.

Regional Deer Creek Groundwater Level Monitoring Network
A regional groundwater level monitoring network for the lower Deer Creek area was developed in 1998 and 1999, and utilized in the 2003 and 2004 pumping program at DCID. The monitoring grid consists of dedicated multi-completion monitoring wells, as well as, a combination of surrounding domestic and irrigation wells. The grid includes all of DCID and SVRIC, extending from the Sacramento River to the eastern portion of DCID, and from Thomas Creek to Singer Creek. The regional groundwater level monitoring grid, along with the larger Tehama County groundwater monitoring grid, will be used to help identify seasonal trends and long-term fluctuations in groundwater levels at a regional scale.

Local Key Well Groundwater Level Monitoring Network
Groundwater levels in key monitoring wells will be located adjacent to the program-related production wells and will be used to monitor compliance with the predetermined range of acceptable groundwater level fluctuation identified by the criteria below. Key monitoring wells will be selected by the WAC based on their construction, proximity to project wells, and their ability to represent groundwater levels in surrounding agricultural and domestic wells drawing from the upper Tuscan aquifer. Key groundwater monitoring wells were successfully utilized during the 2003 and 2004 pumping programs at DCID to help identify potential impacts to local water users from program-related pumping.

Frequency of Groundwater Level Measurements
Monitoring frequency will vary depending upon monitoring well location and type, and the program operations schedule.

During Periods of Non-Pumping: During non-program operations, the depth to groundwater will be measured in all wells within the County-wide and Deer Creek regional monitoring grids at a minimum frequency of three times per year, and according to the following schedule.
• Spring: (March or April)
• Summer: (July or August)
• Fall: (October)

In addition to the above monitoring, during periods of non-program operations, the selected key wells and the dedicated multi-completion monitoring wells within the Deer Creek regional network will be equipped with automated groundwater level recording equipment. The automated equipment will be set to measure groundwater levels at a minimum frequency of six times per day. The data from this equipment will be downloaded a minimum of three times per year during non-pumping periods, according to the above schedule.

**During Periods of Program-Related Pumping:** During periods of program-related pumping, the depth to groundwater will be measured in the Deer Creek monitoring wells that are east of Highway 99, at a minimum frequency of once per month between April and October.

In addition to the above monitoring, during periods of program-related pumping, the selected key wells and multi-completion monitoring wells within the Deer Creek regional monitoring network will be equipped with automated groundwater level recording equipment. The automated equipment will be set to measure groundwater levels at a minimum frequency of twelve times per day. The data from this equipment will be downloaded once per month between April and October, and every three months from November through March.

**Acceptable Range of Groundwater Level Fluctuation During Program-Related Pumping**
The acceptable range of groundwater level fluctuation during program-related pumping will be determined for each key monitoring well. These ranges are based on static water level readings and were developed based on:

- review of the historic seasonal fluctuation of groundwater levels in domestic and agricultural wells surrounding the program-related production wells,
- the estimated program-related decline in groundwater levels in private wells surrounding the program production wells, and
- the ability of nearby third-party groundwater users to maintain an adequate and affordable supply of good quality groundwater for agricultural and domestic use.

In order to have adequate time to respond and make appropriate adjustments to program operations, the range limits are divided into a series of three warning stages. Each warning stage corresponds to a progressive increase in the decline in groundwater levels, and represents further movement towards noncompliance with the groundwater level criteria and eventual shutdown of program operations. Each warning stage also triggers a sequence of program management review and actions designed to alleviate any additional groundwater level decline.
Definition of Groundwater Level Warning Stages

The groundwater level warning stages are based on static water level readings. The groundwater level data will be plotted on a hydrograph along with warning stage levels similar to those shown in Figure 1. The warning stages will be developed by the Deer Creek WAC and DCID, and are subject to approval by the Tehama County BOS through the permitting process under Tehama County Ordinance No. 1617. It is understood that adjustments to the warning stage criteria may be needed as data is collected during program operations. Procedures for adjustment to a warning stage will be similar to the initial development of the warning stage(s). Historic fluctuation in groundwater level in the key wells will be used as a baseline for developing subsequent water stage levels.

Warning stages will be divided into three stages corresponding to three increasing levels of groundwater decline, with Stage 1 being the upper-most level and Stage 3 being the lowest level. The warning stages will be defined according to the following criteria:

- Stage 1 Warning will be declared when the static groundwater level in any of the Key Wells falls below the Stage 1 warning line.
- Stage 2 Warning will be declared when the static groundwater level in any of the Key Wells falls below the Stage 2 Warning line.
- Stage 3 Warning will be declared when the static groundwater level in any of the Key Wells falls below the Stage 3 Warning line.

![Figure 1. Example Key Well Hydrograph Showing Level Stages](image-url)
Upon recommendation of the DCID Board and approval of the Tehama County BOS, a Stage 1 and Stage 2 Warning may be rescinded when the groundwater levels rise above the corresponding Stage 1 Warning Line in the non-compliant Key Well(s).

Upon recommendation of the DCID Board and approval of the Tehama County BOS, the Stage 3 Warning may be rescinded when the groundwater levels rise above the Stage 2 Warning Line in the non-compliant Key Well(s). A Stage 3 Warning may also be temporarily downgraded to a Stage 2 Warning if, after review of all of the groundwater level data, the affected landowners, the DCID Board, and the Tehama County BOS unanimously agree to the temporary groundwater level decline.

Evaluation for Compliance with Groundwater Level Criteria
Following each monitoring period, the DWR will evaluate the groundwater level data for determination of compliance with the groundwater level criteria as stated in the Groundwater Management Objectives.

Compliance Reporting and Groundwater Level Data
During periods of program-related pumping, the DWR will make groundwater level data available over the internet within 10 working days of each monitoring period. The data will provide Key Well hydrograph data and indicate compliance or non-compliance with warning stage trigger levels.

If wells are found to be in noncompliance with the groundwater level criteria, a noncompliance report will be submitted by the DWR to the Deer Creek WAC, the DCID Board, and the Tehama County EHD within 7 days of the last monitoring period. The noncompliance report will include information as to the regional extent and magnitude of the noncompliance and the character of the compliance violation (Stage 1, 2 or 3 Warning Level).

Response Action for Noncompliance with Groundwater Level Criteria
A series of response actions for each warning level are listed below. The intent of the following list is to provide a minimum level of required response actions, thereby maintaining flexibility for further action, as needed and appropriate, to maintain the general program goals of sustaining the groundwater resource while minimizing third-party impacts. Therefore, the magnitude and extent of possible response actions shall not be limited to those identified below:

**Stage 1 Warning** - Stage 1 response actions shall include measuring groundwater levels and reassessing the appropriateness of the GMO groundwater level criteria with respect to the given circumstances. DWR shall collect and present all pertinent hydrological data to the Deer Creek WAC, the DCID Board, the Tehama County EHD, and the Tehama County AB 3030 TAC for review. The DCID and DWR shall investigate possible causes for the noncompliance, and develop recommend actions to resolve the Stage 1 noncompliance. These recommendations shall be made in a timely manner not to exceed 7 days after the reporting of the Stage 1 noncompliance. It shall be the intent of the review group to first make recommendations that focus on resolving the noncompliance through management actions and negotiations with all parties in the affected area. Additional action to help identify the cause for the noncompliance
may include, but not be limited to, increasing the frequency of groundwater monitoring and re-
assessing the existing appropriateness of the groundwater level criteria.

**Stage 2 Warning** - Stage 2 response actions shall include more extensive monitoring and
evaluation of the GMO groundwater level criteria with respect to the given circumstances. DWR
shall collect and present all pertinent hydrological data to the Deer Creek WAC, the DCID
Board, the Tehama County EHD, and the Tehama County AB 3030 TAC for review. The DCID
and DWR shall investigate possible causes for the noncompliance, and develop recommend
actions to resolve the Stage 2 noncompliance. These recommendations shall be made in a timely
manner not to exceed 7 days after the reporting of the Stage 2 noncompliance. Depending upon
the circumstances surrounding the Stage 2 noncompliance, actions at this time could include
shutting down the pilot program well if a Stage 3 noncompliance appears imminent. If the
progression of groundwater levels towards a Stage 3 noncompliance appears slow or unlikely,
other operational management methods may be implemented to avoid further decline of
groundwater levels. The methods may include, but not be limited to, partial shutdown of the pilot
well during periods of peak interference with surrounding pumping wells, reduction in the
volume of daily groundwater extraction from the pilot well, or voluntary water conservation
measures. Implementation of Stage 2 management actions may require action by the Tehama
County BOS.

**Stage 3 Warning** - Stage 3 management actions shall consist of terminating program-related
groundwater pumping and collecting groundwater level recovery data in the surrounding
monitoring wells. Groundwater level recovery data will be collected by the DWR and presented
to the Deer Creek WAC, the DCID Board, the Tehama County EHD, and the Tehama County
AB 3030 TAC for review. The DCID and DWR shall investigate the recovery from Stage 3
noncompliance levels, and develop recommend actions as to further program operation.

**Supporting Data**
When possible, groundwater level and groundwater quality data from surrounding Tehama
County areas will be used to support evaluation of existing conditions in the DCID area.

**GROUNDWATER QUALITY CRITERIA**

Maintaining a minimum level of acceptable water quality from the pilot program pumping well
is the second criteria for program operation. The water quality criteria will require that
groundwater from the program-related production wells will be maintained within the
recommended Maximum Contaminant Level (MCL) established for agricultural use in the
United States by the Food and Agriculture Organization of the United Nations. For some
minerals and nutrients, no agricultural MCL's have been established. In these situations, water
quality from the program-related production wells will be maintained at level that is equal to, or
better than, the existing quality of surface water that is currently being diverted. The water
quality standards for agriculture are listed in Table 1.

The range of acceptable groundwater quality will be reviewed by the Deer Creek WAC and
supported by the DCID Board. Operation of the groundwater pumping program will proceed as
long as there is compliance with the pre-agreed to groundwater quality criteria. The location and frequency of groundwater quality monitoring, the reporting of the data, and management action for noncompliance are presented below and is based on previous water quality monitoring conducted during the 2003 and 2004 pilot well programs which indicated that the quality of water from the lower Tuscan aquifer is of high quality.

**Key Water Quality Monitoring Sites**

Three key water quality monitoring sites will be selected at each of the program-related production well locations. The sites will be located as follows:

- Site 1: Sample and test surface water quality in the distribution system, above the point where groundwater from the program well(s) discharge into the system.
- Site 2: Sample and test the groundwater quality as it discharges from program well(s).
- Site 3: Sample and test the surface water quality in the distribution system below the point where groundwater from the program well(s) discharges into the system.

**Water Quality Sampling and Testing**

The Department of Water Resources will be responsible for field collection and testing of surface and groundwater quality samples. Analytical testing will be conducted at a State of California approved laboratory and will include analysis for minerals, trace metals and nutrients. Minerals analysis will include testing for conductivity, pH, temperature, alkalinity, total dissolved solids, total hardness, boron, calcium, chloride, magnesium, potassium, sodium and sulfate. Trace metal analysis will include testing for aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium and zinc. Nutrient analysis will include testing for ammonia, dissolved orthophosphate, nitrite, nitrate, and total phosphorus.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Aluminum</th>
<th>Arsenic</th>
<th>Boron</th>
<th>ASAR</th>
<th>Cadmium</th>
<th>Chloride</th>
<th>SC</th>
<th>TDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag. MCL (^1) (mg/l)</td>
<td>5.0</td>
<td>0.1</td>
<td>0.7</td>
<td>&lt;3</td>
<td>0.01</td>
<td>106</td>
<td>0.7</td>
<td>450</td>
</tr>
<tr>
<td>Parameter</td>
<td>Manganese</td>
<td>Copper</td>
<td>Nickel</td>
<td>Iron</td>
<td>Selenium</td>
<td>Lead</td>
<td>Zinc</td>
<td></td>
</tr>
<tr>
<td>Ag. MCL (^1) (mg/l)</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.3</td>
<td>0.02</td>
<td>5.0</td>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

1. MCL = Agricultural Maximum Contaminant Level
2. ASAR = Adjusted Sodium Absorption Ratio
3. SC = Specific Capacity measured in micro-mhos/cm
4. TDS = Total Dissolved Solids

**Table 1. Agricultural Water Quality Standards Established by Food and Agriculture Organization of the United Nations.**

**Frequency of Water Quality Monitoring**

Based on the 2003 and 2004 data indicating that the quality of water from the lower Tuscan aquifer was of high quality, sampling for the future program will be collected once from
the three above indicated sites, at each production well location, within 5 days of the start of the test-production well pumping and once within 5 days of the conclusion of the pumping. In addition, field measurements of electrical conductivity will be conducted monthly at similar locations. Following each monitoring period, the DWR will evaluate the surface and groundwater water quality data for compliance with the MCL's for agricultural use as listed in Table 1.

**Compliance Reporting of Water Quality Data**
During program operations, the DWR will provide the analytical results from the water quality testing over the Internet within 10 days of receiving the data from the lab, and within 7 days of the monthly field sampling date. In addition, status reports will be provided to the Deer Creek WAC, the Tehama County EHD, and the Tehama County AB 3030 TAC. Each report will provide a comparison of recently measured water quality data against the agricultural MCL's.

**Response Action for Noncompliance with Water Quality Criteria**
If water quality data exceeds the recommended agricultural standards presented in Table 1, DWR will submit the information to the DCID Board, the EHD and the Tehama County AB 3030 TAC along with recommend actions to improve water quality. The recommended corrective actions will vary depending upon which water quality parameters are exceeding the agricultural MCL. Corrective actions may include, but not be limited to, mixing of poor quality water with water of a higher quality, treatment of the poor quality water or termination of pumping from the pilot well.

**ANNUAL REPORTING**
An annual report will be prepared in the fall at the conclusion of the program-related groundwater pumping. The annual report will summarize the status of groundwater levels and water quality for the DCID project area over the past year, compliance or non-compliance with groundwater management objectives of the pilot water exchange program, evaluation of program operations, and recommendations for improvement.
APPENDIX D

Deer Creek Fish Passage Assessment Plan
For the
Deer Creek Flow Enhancement Program

Prepared by the California Department of Fish and Game
March 29, 2006

The California Department of Fish and Game (DFG) and Deer Creek Irrigation District (DCID) recognize the need for a long-term solution to fish transportation issues in Deer Creek and are working towards a phased development of a Deer Creek Flow Enhancement Program. The intent of the Flow Enhancement Program is to augment fish transportation in Deer Creek by developing a supplemental water supply and implementing water use efficiency improvements. These measures are anticipated to provide between 15 and 18 cfs of flow for spring-run Chinook salmon (SRCS), fall-run Chinook salmon (FRCS) and Steelhead trout. DCID will be reimbursed with supplemental water in the amount equal to that bypassed for fish transportation flow. This Fish Passage Assessment will monitor fish passage conditions over a range of water year types to determine the timing and effectiveness of the Deer Creek Flow Enhancement Program operations.

Background

To date, no flow studies specific to the unique hydrology of Deer Creek have been completed to determine timing and duration of minimum and optimal bypass flows for adult salmon and steelhead migration. For the purposes of initially estimating the annual volume and timing of the Deer Creek Flow Enhancement Program, a preliminary estimate of 50 cfs has been chosen for fish transportation needs. To better refine transportation requirements of adult salmon, the fish flow objectives addressed in this plan are:

1. What is the sustained flow for unimpaired fish passage from the Sacramento River past Stanford Vina Ranch Irrigation Company (SVRIC) Dam?

2. In the absence of unimpaired sustained flow, will a Pulse Flow trigger fish movement?

3. In the absence of unimpaired sustained flow, will a combination of minimum sustained flow and riffle modification pass fish?

4. When and for how long are bypassed flows needed to move fish?

This fish passage assessment will focus on determining the appropriate habitat conditions to insure unimpaired migration. The techniques used to assess these habitat conditions will include salmon occurrence surveys, identification and measurement of critical riffles, identification and mapping of braided channels, and water temperature monitoring.
Measuring Fish Passage

The 4.9 mile section of Deer Creek between SVRIC dam and the confluence with the Sacramento River will be assessed using a combination of stream channel monitoring and salmon occurrence surveys (Figure 1). Spring surveys will be made April, May, and June and will commence once post-diversion flows are $\leq 100\text{cfs}$. Fall surveys will start in mid-October once water temperatures can support spawning salmon and continue for a 2 week period.

Channel characteristics of riffles successfully passing fish will be compared with riffles causing fish stranding. A combination of ground and underwater observation techniques and fish ladder counts will be used to determine the occurrence of adult salmon and evidence of fish stranding. In the spring months riffles will be monitored starting at 100cfs and will continue until water temperatures create a thermal barrier, or adult salmon are no longer observed. Measurement of channel characteristics of critical riffles successfully passing salmon will be used to determine relationships between stream discharge, riffle depth characteristics, and fish occurrence.

Figure 1. Deer Creek Fish Passage Assessment Study Area
Pulse Flows

Upon mutual consent of DCID, DFG and the California Department of Water Resources (DWR), DFG may request that DCID bypass diversions greater than the instantaneous capacity (realized thru Project wills and WUE improvements) for a pulse flow rather than a continuous flow. If additional flows are needed, DCID may provide a pulse flow of up to approximately 30 cfs for a period of one or two days. Actual bypass flow will be based on DFG’s recommendations utilizing concurrent assessment of surface water temperatures and critical riffle transportation flow need. Pulse flows are not recommended in the fall of the year due to the spawning potential downstream of Stanford Vina Ranch Irrigation Company (SVRIC) dam and possible salmon or redd stranding once sustained flows resume.

If adult salmon are observed between SVRIC dam and the confluence of Deer Creek with the Sacramento River, an enhanced one or two day pulse flow may be used to attract salmon upstream of SVRIC Dam if the following conditions occur:

- As maximum daily water temperatures reach 65°F to 70°F as measured at DWR’s Deer Vina Dam (DVD) gage below SVRIC dam
- Critical riffles reach the minimum critical passage depths

Likewise, if juvenile salmon and steelhead are observed in lower reaches of Deer Creek in the end of June when bypassed flows may no longer be requested for adult fish passage, a pulse flow may be requested to trigger outmigration.

Lower Deer Creek is considered a migration corridor for immigrating SRCS and these fish are not utilizing this area for holding habitat or long-term resting pools. Consequently a pulse flow of up to 2 days should provide adequate time for fish to migrate past diversion dams. Studies in other rivers show that SRCS migrate upstream at rates between 6-18 miles/day early in the migration season and maximum rates of 31 miles/day later in the migration season. Applying these migration rate criteria to Deer Creek, (assuming unimpeded flows over critical riffles and no thermal inhibitors), yields passage rates of 4 to 19 hours to pass the lower dam and 6 to 29 hours to pass the upper dam. As shown in Table 1, a 1-2 day pulse flow (24-48 hours) should facilitate movement upstream of water diversions.

<table>
<thead>
<tr>
<th>Distance from confluence:</th>
<th>Travel Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SVRIC Dam (4.9 miles)</td>
</tr>
<tr>
<td>Early season rates</td>
<td>6.2 mi/day</td>
</tr>
<tr>
<td></td>
<td>18.3 mi/day</td>
</tr>
<tr>
<td>Late season rate</td>
<td>31 mi/day</td>
</tr>
</tbody>
</table>

Table 1. Estimated migration rates for adult salmon in Deer Creek between the confluence and DCID upper dam.
Before and after pulse flow events, visual observations (including ground surveys, underwater surveys and fish ladder counts) will be used to evaluate the effectiveness of pulses of water in triggering adult and juvenile fish movement, including evaluation of diurnal timing of pulse release and experimental ramp down rates.

**Riffle Modification**

In some instances, a riffle or braided channel may require more flow for unimpaired passage than is available to be bypassed. If fish surveys find evidence of adult salmon stranding caused by a barrier condition and extra flows are not available for a pulse flow event, the potential of mechanically modifying a riffle to afford fish passage will be evaluated. Each riffle modification proposal and post-project evaluation will include measurements of streambed elevation, water depth and stream velocity. All proposed modifications will be discussed with affected landowners. Although it is not the intent of this program to annually modify riffles as a substitute for providing adequate passage flows for salmon, it is recognized that concurrent with changing channel conditions, bypass needs for unimpeded passage may also change. A program that occasionally modifies a critical passage area will assist with providing salmon access into Deer Creek in situations when extra bypass flow is not available.

**Water Temperature Standards**

Since adult Chinook salmon are less tolerant of thermal stress than juvenile salmon, temperature tolerance criteria for adult Chinook will be used for setting temperature standard for all life-stages of salmonids in lower Deer Creek. These temperature standards will be used in determining the effects of flow reduction and flow augmentation, the duration of fish migration, the cessation of bypass flows in early summer and the beginning of bypass flows in the fall.

In order to determine upper optimal temperature ranges and maximum temperature tolerance levels for immigrating SRCS, a literature review was made of temperature studies on Chinook salmon. The following table represents a generalized temperature tolerance regime for adult Chinook salmon.

<table>
<thead>
<tr>
<th>Tolerance Levels</th>
<th>Maximum daily average of 7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper optimal temperature range</td>
<td>57.7°F to 62.2°F</td>
</tr>
<tr>
<td>Acute (short-term) exposure</td>
<td>68°F to 69.8°F (single daily maximum)</td>
</tr>
<tr>
<td>Upper migration limit</td>
<td>70°F</td>
</tr>
<tr>
<td>Resuming migration</td>
<td>66°F</td>
</tr>
<tr>
<td>Lethal</td>
<td>( \geq 72°F )</td>
</tr>
<tr>
<td>Upper limit for spawning FRCS</td>
<td>57.5°F</td>
</tr>
</tbody>
</table>

**Table 2. Adult Chinook salmon immigration temperature tolerances.**
For the purposes of establishing temperature tolerance criteria for immigrating Deer Creek SRCS, the following **maximum daily water temperatures** will be used:

- Prolonged exposure to 70°F or greater will be considered lethal
- Salmon will presume to migrate up to 70°F. At 70°F will salmon presumably halt migration and resume movement when temperatures cool to ≤66°F.

Water temperature will be measured pre-diversion at the United States Geological Surveys’ (USGS) Deer Vina Dam (DCV) stream gage and post-diversion at the DVD gage. Portable water temperature monitors will be installed between DCID and SVRIC diversions.

A weekly rolling average of maximum daily water temperatures in conjunction with monitoring for salmon occurrence will be used to predict when SRCS migration has ceased in early summer and when FRCS will begin migration in the fall. Using a combination of established USGS temperature gages and portable temperature monitors, when the 7-day arithmetic average of the daily maximum temperature values exceeds 70°F, it will be assumed that SRCS migration has ceased for the season. When this criteria has been reached DFG will notify DCID and DWR. Conversely, bypass flows will be requested for FRCS when the 7-day average of the daily maximum water temperature declines below 57.5°F. A fall flow release will be arranged by mutual consent of DCID, DFG, and DWR. Once fall flows commence, they must be maintained for the duration of salmon spawning and egg incubation.

**Time Line**

The following chart shows the anticipated timeline for data collection and assessment for this program.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Years 1 - 10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Apr</td>
</tr>
<tr>
<td>Water temperature monitoring</td>
<td>✓</td>
</tr>
<tr>
<td>Channel and riffle assessment</td>
<td>✓</td>
</tr>
<tr>
<td>Salmonid occurrence surveys</td>
<td>✓</td>
</tr>
<tr>
<td>Develop long-term monitoring plan</td>
<td>Jan-Mar of 3rd year</td>
</tr>
</tbody>
</table>
For field assessment during years 1-3, DFG will employ 2 PSMFC Technicians for a total of 3 months in April, May, June and a 2 week period in October and November. In years 4-10, Technicians will be used a total of 1.5 months during the same time periods. Total cost for 10 years of assessment will be $247,000. Table 3 shows the annual cost and total budget for these 10 years of monitoring. DFG will supply an in-kind funding match to this program by providing an Associate Biologist for project management and reporting, transportation costs to Deer Creek, and stream survey equipment. The total value of DFG’s 10-year in-kind match will be $201,500. Table 4 shows the total DFG funding match for the 10 years of the program. The entire 10-year cost of this Fish Passage Assessment is $448,500.

<table>
<thead>
<tr>
<th>PSMFC Labor</th>
<th>Start Up</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Years 4-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Labor/Benefits (2 PSMFC technicians)</td>
<td>$27,000</td>
<td>$27,000</td>
<td>$27,000</td>
<td>$15,000 annually</td>
</tr>
<tr>
<td>2. Supplies/Reporting/PSMFC Project Management</td>
<td>$10,000</td>
<td>$8,000</td>
<td>$8,000</td>
<td>$5,000 annually</td>
</tr>
<tr>
<td>subtotal</td>
<td>$37,000</td>
<td>$35,000</td>
<td>$35,000</td>
<td>$20,000 annually</td>
</tr>
<tr>
<td>Project Total</td>
<td></td>
<td></td>
<td></td>
<td>$247,000</td>
</tr>
</tbody>
</table>

Table 3. 10-year budget for Fish Passage Assessment component of Deer Creek Flow Enhancement Program.

<table>
<thead>
<tr>
<th>DFG Labor</th>
<th>Years 1-3</th>
<th>Years 4-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DFG Project Management</td>
<td>$25,000</td>
<td>$12,500 annually</td>
</tr>
<tr>
<td>2. Field supplies and Transportation</td>
<td>$6,000</td>
<td>$3,000 annually</td>
</tr>
<tr>
<td>subtotal</td>
<td>$31,000 annually</td>
<td>$15,500 annually</td>
</tr>
<tr>
<td>In Kind Match Project Total</td>
<td></td>
<td>$201,500</td>
</tr>
</tbody>
</table>

Table 4. DFG in-kind match for 10-year Fish Passage Assessment component of Deer Creek Flow Enhancement Program.

Reporting

A fish assessment template for anadromous fish instream flow needs in lower Deer Creek will be prepared after the initial three years of the program. This template will include:

a. Recommendations for minimum in-stream flows needed for unimpaired passage of adult salmon between the Sacramento River and SVRIC Dam.

b. Recommendations on the seasonal duration of bypass flow periods based on maximum daily water temperatures and fish occurrence surveys.

c. Minimum riffle depth criterion and recommended channel profiles to pass fish at recommended minimum flows.

d. Criteria for critical riffle modification.
e. Criteria for the timing, frequency and duration of pulse flows.
f. Anticipate frequency of this program based on assessment results and historical hydrographs.
g. Sampling protocol and revised projected budget for years 4-10 of the Deer Creek Fish Passage Assessment Plan.

Stream Access Permission

The additional flow provided by this Environmental Flow Program will be bypassed at the DCID dam. Flow conditions between DCID and SVRIC diversions do not impede fish passage. It is the post-diversion flow section of Deer Creek, downstream of both DCID and SCRIC diversions, which will benefit from this bypassed flow. DFG has not obtained permission for land access between SVRIC dam and Deer Creeks’ confluence for the purposes of this Assessment Plan. Likewise, permission has not been obtained for potential riffle modification activities. If access permission cannot be obtained at the onset of this program, objectives will not be completed as outlined.

Other fish monitoring in the Watershed

Additional monitoring by DFG in Deer Creek which may benefit this Assessment Plan includes annual SRCS and FRCS population counts and juvenile salmon outmigrant monitoring. Adult SRCS and FRCS population numbers will be used in this assessment to compare annual escapement levels with unimpaired passage flows. (Although, using salmon escapement numbers to justify program effectiveness cannot be verified with the proposed sampling methodologies.) The rotary screw trap monitoring will be used in this assessment to predict the occurrence of juvenile Chinook and Steelhead trout in lower Deer Creek during the months of May, June and late October. These monitoring activities are funded through existing DFG contracts.
APPENDIX C

PARCEL MAPS
OF THE PRODUCTION WELL AREA
PARCEL MAP OF PRODUCTION WELL AREA – COPY 2
APPENDIX D

HYDROGRAPHS
KEY MONITORING WELLS
Figure 1. Key Well: 24N/01W-05J03.

Figure 2. Key Well: 24N/01W-05J01.
Figure 3. Key Well: 24N/01W-05G01.

Figure 4. Key Well: 24N/01W-05K01.
Figure 5. Key Well: 24N/01W-05Q03.
APPENDIX E

HYDROGRAPHS
DEEP MONITORING WELLS
Figure 1. Lower Tuscan Well: 24N/01W-05J04.

Figure 2. Lower Tuscan Well: 24N/01W-05Q04.
Figure 3. Lower Tuscan Well: 24N/01W-34N03.

Figure 4. Lower Tuscan Well: 24N/02W-01L02.
Figure 5. Lower Tuscan Well: 24N/02W-12P02.