STRAND RANCH INTEGRATED BANKING PROJECT

Final Environmental Impact Report

Prepared for:
Rosedale-Rio Bravo Water Storage District

May 2008

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TABLE OF CONTENTS

Strand Ranch Integrated Banking Project FEIR

Appendices

List of Figures

List of Tables

List of Acronyms

AEWSD	Arvin Edison Water Storage District
AGR	agricultural water supply
Amsl	above mean sea level
AQMP	Air Quality Management Plan
BMP	best management practice
BVWSD	Buena Vista Water Storage District
CARB	California Air Resources Board
CCAA	California Clean Air Act
Caltrans	California Department of Transportation
Corps	U.S. Army Corps of Engineers
CCTS	Central California Taxonomic System
CDC	California Department of Conservation
CDFG	California Department of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLWA	Castaic Lake Water Agency

List of Acronyms (cont)

CVP	Central Valley Project
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CH_4	methane
CMP	Congestion Management Program
CNEL	Community Noise Equivalent Level
CO	carbon monoxide
CO_2	carbon dioxide
CO_2E	carbon dioxide equivalents
Cy	cubic yards
DNL	Day-Night Noise Level
DOT	United States Department of Transportation's
DTSC	Department of Toxic Substances Control
dBA	A-weighted decibels
FCAA	Federal Clean Air Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMMP	Farmland Mapping and Monitoring Program
GHG	greenhouse gas
GWR	groundwater recharge
HAZNET	California Hazardous Waste Information System
IND	industrial service supply
IRWD	Irvine Ranch Water District
KMVCD	Kern Mosquito and Vector Control District
KRT	Kern Regional Transit
KWBA	Kern Water Bank Authority
KT & RG	Kern-Tulare and Rag Gulch Water Districts
LCFS	low carbon fuel standard
LUST	leaking underground storage tank
LWMR	limited warm fresh water habitat
MBTA	Federal Migratory Bird Treaty Act
Mmax	maximum moment magnitude
MMRP	Mitigation Monitoring and Reporting Plan
MBHCP	Metropolitan Bakersfield Habitat Conservation Plan
MSHCP	Multi-Species Habitat Conservation Plan
MUN	municipal and domestic water supply
Mw	moment magnitude
MWD	Metropolitan Water District of Southern California
MWDOC	Municipal Water District of Orange County
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NCCP	Natural Communities Conservation Plan Act
NOC	Notice of Completion
NOP	Notice of Preparation
NOx	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NFIP	National Flood Insurance Program

List of Acronyms (cont)

PAH	polycyclic aromatic hydrocarbons
PCB	Polychlorinated Biphenyls
PFCs	perfluorocarbons
RCPG	Regional Comprehensive Plan and Guide
RARE	rare, threatened, or endangered species
RCA	Regional Conservation Authority
RCRA	Resource Conservation and Recovery Act
ROG	reactive organic gases
RRBWSD	Rosedale-Rio Bravo Water Storage District
RTP	Regional Transportation Plan
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendment Reauthorization Act
SCAQMD	South Coast Air Quality Management District
SCAG	Southern California Association of Governments
SIP	State Implementation Plan
SJVAPCD	San Joaquin Valley Air Pollution Control District
SPAWN	spawning, reproduction, and development
SWP	State Water Project
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TACs	Toxic Air Contaminants
TMDL	total maximum daily load
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Services
VMT	average truck miles traveled
Vpd	vehicles per day
Vph	vehicles per hour
WARM	warm freshwater aquatic habitat
WILD	wildlife habitat
WSD	Water Storage District

SUMMARY

S.1 Introduction

The Rosedale-Rio Bravo Water Storage District (RRBWSD or Rosedale) as the Lead Agency, in consultation with Irvine Ranch Water District (IRWD) as a Responsible Agency, has prepared this Final Environmental Impact Report (Final EIR) to provide information about the potential effects on the local and regional environment associated with the Strand Ranch Integrated Banking Project (proposed project). The purpose of the proposed project is twofold: to augment the recharge and extraction capacity of Rosedale's Groundwater Storage, Banking, Exchange, Extraction & Conjunctive Use Program (Conjunctive Use Program); and to provide water supply reliability and redundancy to IRWD and its customers.

The proposed project would be located on the Strand Ranch in western Kern County, California. Strand Ranch is owned by IRWD and consists of approximately 611 acres of agricultural land six miles west of the City of Bakersfield. The proposed project would annex Strand Ranch into Rosedale's service area and integrate Strand Ranch into Rosedale's existing Conjunctive Use Program. Groundwater banking facilities, including recharge basins, conveyance channels, and recovery wells, would be developed to recharge and recover up to 17,500 acre-feet per year (afy) for IRWD.

This Final EIR has been prepared in compliance with the California Environmental Quality Act (CEQA) of 1970 (as amended), codified at California Public Resources Code Sections 21000 et. seq., and the State *CEQA Guidelines* in the Code of Regulations, Title 14, Division 6, Chapter 3. Inquiries about the proposed project should be directed to:

> Rosedale-Rio Bravo Water Storage District
> Attn: Hal Crossley, General Manager
> 849 Allen Road
> P.O. Box 867
> Bakersfield, CA 93302
> (661) 589-6045

S.2 Project Background

Rosedale-Rio Bravo Water Storage District

Rosedale was established in 1959 to develop a groundwater recharge program to offset overdraft conditions in the regional Kern County aquifer. Rosedale, located west of Bakersfield, encompasses 44,150 acres in Kern County, with 28,500 acres developed as irrigated agriculture and about 6,000 acres developed for urban uses. To meet the long term needs of its landowners, Rosedale developed the Groundwater Storage, Banking, Exchange, Extraction & Conjunctive Use Program (Conjunctive Use Program). Rosedale's Conjunctive Use Program includes agreements with six entities that provide for maximum annual recharge of approximately 150,000 afy[1] and a maximum annual recovery of 45,750 afy. Water supplies for the Conjunctive Use Program are supplied by the participating water agencies and include high-flow Kern River water and water from the Central Valley Project (CVP) and State Water Project (SWP). Rosedale certified a Final Master EIR covering the Conjunctive Use Program in July 2001. In addition, Rosedale has certified subsequent CEQA documents for individual project components.

Memorandum of Understanding

In 2004, Rosedale entered into a Memorandum of Understanding (MOU) with the Kern County Water Agency (KCWA) and other Adjoining Entities in the Kern Fan area, which include Semitropic Water Storage District, Buena Vista Water Storage District, Henry Miller Water Storage District, Berrenda Mesa Water Storage District, Kern Water Bank Authority, Improvement District No 4, and West Kern Water District. The MOU provides guidelines for operation and monitoring of Rosedale's Conjunctive Use Program. The proposed project would be subject to and would be consistent with the conditions of the MOU.

The MOU allows for Rosedale to operate its Conjunctive Use Program to achieve maximum water storage and withdrawal benefits, while also avoiding, eliminating, or mitigating adverse impacts to the groundwater basin and to the operation of other groundwater banking programs in the Kern Fan area. As part of the operating objectives defined in the MOU, Rosedale's Conjunctive Use Program includes the following:

- Maintain, or if possible enhance, the quality of the groundwater in its district. For example, Rosedale will attempt to implement recovery operations in such a manner that TDS in recovery waters exceed TDS of recharge waters.
- Control the migration of poor quality water. For example, Rosedale could increase water recharge in areas with favorable groundwater gradients.
- Operate recharge and recovery facilities in such a manner to "prevent, eliminate, or mitigate significant adverse impacts." Mitigation measures to avoid adverse impacts could include but not be limited to the following, if necessary: provide buffer areas between recovery wells and neighboring districts; limit monthly or annual recovery rates; provide redundancy in recovery wells and rotate pumping from recovery wells; provide adequate well spacing; adjust or stop pumping if necessary to reduce impacts; and use recharge water that otherwise is not recharging the Kern Fan area.

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1 Annual recharge could be greater depending on available capacity in Rosedale.

Irvine Ranch Water District

IRWD was established in 1961 as a California Water District pursuant to the California Water District Law (California Water Code, Division 13). IRWD provides potable and recycled water, sewage collection and treatment, and urban runoff treatment to municipal and industrial (M&I), and agricultural customers within an 114,560-acre service area in Orange County, California. Currently, 60 percent of the water IRWD provides for its customers comes from local sources, including groundwater (produced from the groundwater basin managed by Orange County Water District), surface water, and reclaimed water. The remaining 40 percent of IRWD's water supply is imported by the Metropolitan Water District of Southern California (MWD) and purchased by IRWD through the Municipal Water District of Orange County (MWDOC).

IRWD purchased the 611-acre Strand Ranch in Kern County in 2004 for the purpose of developing a water banking program to improve drought year reliability. The 611-acre Strand Ranch property is located in unincorporated Kern County in the northern Kern River Fan area south of Stockdale Highway. Strand Ranch is adjacent to Rosedale's existing boundary and to portions of the Kern Water Bank. Strand Ranch currently is used for agriculture, including production of cotton, wheat, alfalfa, garlic and almonds.

Two existing water conveyance facilities bisect Strand Ranch: the Pioneer Canal and the Cross Valley Canal (CVC). New CVC turnouts are currently under construction. Strand Ranch is under a Williamson Act contract, pursuant to the California Land Conservation Act of 1965. The Williamson Act contract restricts land use activities on Strand Ranch to agricultural uses and other compatible uses as determined by Kern County. Strand Ranch also is located within the Strand Oil Field. Mineral rights on the property are not owned by IRWD.

S.3 Project Objectives

The objectives of the proposed project are as follows:

- Provide additional groundwater recharge, storage, and recovery capacity in the Kern Fan region to augment Rosedale's existing and future programs;
- Integrate IRWD's participation in Rosedale's Conjunctive Use Program through the use of Strand Ranch and other Rosedale facilities to the extent they are not obligated to meet Rosedale's existing banking program contracts;
- Allow the storage of water ~~during wet hydrologic periods~~ subject to the conditions established by the water supplier and availability for recovery and use during dry periods to provide IRWD customers with increased water supply reliability through redundancy and diversification.

S.4 Project Description

Rosedale and IRWD propose to develop groundwater banking facilities on the Strand Ranch for use by both districts. Strand Ranch would be annexed into Rosedale's existing service area. All groundwater banking facilities on the Strand Ranch would be owned by IRWD and operated and maintained by Rosedale for the duration of the proposed project. Facilities would be constructed to recharge and recover up to 17,500 acre-feet per year (afy) for IRWD. When not in use by IRWD, the facilities could also be used by Rosedale to serve its existing commitments. IRWD would be provided a cumulative maximum banking allotment (maximum storage capacity) within Rosedale's Conjunctive Use Program of 50,000 acre-feet (af). The following are the components of the proposed project:

- **Annexation.** Strand Ranch would be annexed into Rosedale's existing service area. Annexation requires approval by the Kern County Local Agency Formation Commission (LAFCO). This EIR evaluates impacts of annexation as part of the project description. Therefore, the Kern County LAFCO may use this EIR to comply with their CEQA review requirements.
- **Recharge Facilities.** Recharge facilities would occupy approximately 502 acres (or 82 percent) of the Strand Ranch property. Recharge facilities would consist of up to 20 recharge basins of varying shape, size, and depth. The basins would be constructed to avoid the Pioneer Canal, the CVC, and the slough that connects the CVC to recharge basins on neighboring property owned by Kern Water Bank. The basins also would avoid developing four three-acre parcels (drill islands) to maintain access to mineral rights. The basins and berms would be reseeded with native grasses to blend the berms into the surrounding landscape and allow for grazing.
- **Recovery Facilities.** Between five and eight groundwater extraction wells would be constructed on the Strand Ranch property. Each well would be designed to pump groundwater at a recovery rate of approximately five cubic feet per second (cfs). In addition, the proposed project provides the flexibility for IRWD and Rosedale to pump from up to three additional wells within the Rosedale service area. These wells would be joint-use wells providing recovery capacity for IRWD and for other obligations by Rosedale. Construction impacts of these wells have already been evaluated pursuant to CEQA as part of Rosedale's Negative Declaration for the Glorious Land Company (GLC) Water Banking and Recovery Program (Rosedale, 2003) (see Appendix C). Only operational impacts of these Rosedale service area wells are discussed in this EIR

  The proposed project would provide the flexibility for IRWD and Rosedale to pump from any combination of Strand Ranch wells and up to three additional wells within the Rosedale service area. Recovery operations from the Strand Ranch wells and project wells in Rosedale would be limited to a combined rate of 36 cfs with the following exception: Rosedale would have the ability to increase the combined rate of recovery to 40 cfs as required to meet mitigation requirements imposed by the MOU. As an example, this could occur in response to a request from a neighboring property to limit recovery operations on Strand Ranch to a certain period of time.
- **Conveyance Facilities.** Two water supply channels would be constructed along the eastern edge of Strand Ranch with connections to the easternmost recharge basins and the CVC. The turnouts connecting the supply channels to the CVC are not part of the

proposed project because they have already been evaluated pursuant to CEQA as part of the Kern County Water Agency Cross Valley Canal Expansion Project EIR and Addendum. Groundwater recovered from the Strand Ranch production wells would be conveyed to the CVC via a new underground pipeline network that would connect to the CVC. Groundwater recovered from the Rosedale production wells also would be conveyed to the CVC through new or existing pipelines, which have already been evaluated pursuant to CEQA as part of Rosedale's Negative Declaration for the GLC Water Banking and Recovery Program. Groundwater pumped in to the CVC would then be available for subsequent "wheeling" to IRWD through the California Aqueduct and MWD distribution system in Orange County.

- **Water Supply.** Recharge water for the proposed project would be secured and acquired by IRWD from various sources, potentially including federal, state, and wet-year local supplies. Sources have not been identified yet, but, similar to Rosedale's existing Conjunctive Use Program, water sources could include State Water Project water, pre-1914 water rights water, the Central Valley Project water, MWD water, and high-flow Kern River water depending on annual availability. Although water sources have not yet been secured, this EIR assesses impacts of purchasing and recharging water from these specific sources.

S.5 Project Alternatives

An EIR must describe a range of reasonable alternatives to the proposed project or alternative project locations that could feasibly attain most of the basic project objectives and would avoid or substantially lessen any of the significant environmental impacts of the proposed project. The alternatives analysis must include the "No Project Alternative" as a point of comparison. The No Project Alternative includes existing conditions and reasonably foreseeable future conditions that would exist if the proposed project were not approved (*CEQA Guidelines* §15126.6). The following alternatives are discussed further in **Chapter 6, Alternatives Analysis**. CEQA also requires that an EIR identify an environmentally superior alternative (*CEQA Guidelines* §15126.6[e][2]).

No Project Alternative

Under the No Project Alternative, Rosedale and IRWD would not implement the proposed project; there would be no construction of recharge, recovery or conveyance facilities. Under the No Project Alternative, IRWD's future water demands would continue to be met through the existing diversity of water supplies: groundwater, surface water, imported water, and recycled water. Future demands would be met in less reliable, redundant, and diverse ways.

Recharge Basin Location Alternative

Under the Recharge Basin Location Alternative, Rosedale and IRWD would identify alternative locations other than Strand Ranch to construct recharge basins. The Strand Ranch would not be annexed into the Rosedale service area. IRWD would purchase other property to be annexed by

Rosedale. Conveyance and extraction facilities would be designed to accommodate the alternative location.

Injection Well Alternative

Under the Injection Well Alternative, Rosedale and IRWD would construct injection wells to recharge water into the groundwater basin rather than construct recharge basins on the surface. The other components of the project including conveyance and extraction facilities would be similar to the proposed project.

Alternatives Rejected from Further Consideration

Additional alternatives considered and rejected from further consideration by IRWD include development of local storage facilities in Orange County, enhanced conservation policies to be implemented during periods of drought, and increased use of recycled water to reduce potable water demands. These alternatives either did not meet the project objectives or were found to result in significant environmental impacts.

S.7 Summary of Impacts

Table S-1, at the end of this chapter, presents a summary of the impacts and mitigation measures identified for the proposed project. The complete impact statements and mitigation measures are presented in **Chapter 3, Environmental Setting, Impacts, and Mitigation Measures**. The level of significance for each impact was determined using significance criteria (thresholds) developed for each category of impacts; these criteria are presented in the appropriate sections of Chapter 3. Significant impacts are those adverse environmental impacts that meet or exceed the significance thresholds; less-than-significant impacts would not exceed the thresholds. **Table S-1** indicates the measures that will be implemented to avoid, minimize, or otherwise reduce significant impacts to a less-than-significant level.

The impacts associated with the proposed project would occur during both construction and operational phases. Most construction impacts would be short term and temporary. These construction related impacts either are considered less than significant or are reduced to less than significant levels with appropriate mitigation measures. Operation of the proposed project would primarily affect hydrology and groundwater. These operational impacts either are considered less than significant or are reduced to less than significant levels with appropriate mitigation measures. The proposed project would not result in any significant and unavoidable impacts.

S.8 Organization of this EIR

The chapters of this Final EIR are as follows:

S. **Summary.** This chapter summarizes the contents of the Final EIR.

1. **Introduction and Project Background.** This chapter discusses the CEQA process and the purpose of the EIR, and background information for the proposed project.
2. **Project Description.** This chapter provides an overview of the proposed project, describes the need for and objectives of the proposed project, and provides detail on the characteristics of the proposed project.
3. **Environmental Setting, Impacts and Mitigation Measures.** This chapter describes the environmental setting and identifies impacts of the proposed project for each of the following environmental resource areas: Aesthetics; Agriculture; Air Quality; Biological Resources; Cultural Resources; Geology, Soils, Seismicity, and Mineral Resources; Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use, Planning and Recreation; Noise; Transportation and Traffic; and Public Services and Utilities. Measures to mitigate the impacts of the proposed project are presented for each resource area where significant potential impacts have been identified.
4. **Cumulative Impacts Analysis.** This chapter describes the potential impacts of the proposed project when considered together with other related projects in the project area.
5. **Growth Inducement Potential.** This chapter summarizes population projections and water demands within the IRWD and Rosedale service areas and describes the potential for the proposed project to induce development.
6. **Alternatives Analysis.** This chapter presents an overview of the alternatives development process and describes the alternatives to the proposed project that were considered.
7. **References.**
8. **Report Preparers.** This chapter identifies those involved in preparing this Final EIR, including persons and organizations consulted.
9. **Introduction to Response to Comments.**
10. **Comments Received on the Draft EIR.** This chapter contains the comment letters received during the public review period for the Draft EIR.
11. **Responses to Comments.** This chapter contains the responses to the comment letters received during the public review period for the Draft EIR.
12. **Revisions Made to the Draft EIR.** This chapter provides a compilation of revisions made to the Draft EIR following the public review period.

TABLE S-1
SUMMARY OF PROJECT IMPACTS AND MITIGATION MEASURES

IMPACT	MITIGATION MEASURE	LEVEL OF SIGNIFICANCE AFTER MITIGATION
Aesthetics Impact 3.1-1: The proposed project would alter the existing visual character of the site. Less than Significant	None required.	Less than significant.
Agricultural Impact 3.2-1: The Proposed Project would convert Prime Farmland and Unique Farmland to non-agricultural use. Less than significant.	None required.	Less than significant.
Air Quality Impact 3.3-1: Construction activities associated with the proposed project could result in short-term pollutant emissions. Less than Significant with Mitigation.	**Mitigation Measure 3.3-1:** During construction activities, the District shall require the construction contractor(s) to implement a dust abatement program that incorporates SJVAPCD-recommended measures including: • All disturbed areas, including storage piles, which are not being actively utilized for construction purposes, shall be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, covered with a tarp or other suitable cover or vegetative ground cover; • All on-site unpaved roads and off-site unpaved access roads shall be effectively stabilized of dust emissions using water or chemical stabilizer/suppressant; • All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by presoaking;	Less than significant.
Air Quality Impact 3.3-2: Operation of the proposed project could result in air emissions from the powering of pumps and from maintenance/repair trips. Less than Significant.	None required.	Less than significant.
Air Quality Impact 3.3-3: Construction of the proposed project would emit greenhouse gases. Less than Significant.	None required.	Less than significant.
Biological Impact 3.4-1: Activities associated with the construction of the proposed project could result in adverse impacts to special-status bird species. Less than Significant with Mitigation.	**Mitigation Measure 3.4-1a:** A pre-construction survey shall be conducted for burrowing owls 14 to 30 days prior to clearing of the site by a qualified biologist in accordance with the most recent CDFG protocol, currently the Staff Report on Burrowing Owl Mitigation (CDFG 1995). Surveys shall cover areas disturbed by construction including a 500-foot buffer (within the Strand Ranch property). The survey would identify adult and juvenile burrowing owls and signs of burrowing owl occupation. This survey shall include two early morning surveys and two evening surveys to ensure that all owl pairs have been located. If occupied burrowing owl habitat is detected on the Strand Ranch site, measures to avoid, minimize, or mitigate impacts shall be incorporated into the project and shall include the following: • Construction exclusion areas shall be established around the occupied burrows in which no	Less than Significant.

TABLE S-1 (CONT.)
SUMMARY OF PROJECT IMPACTS AND MITIGATION MEASURES

IMPACT	MITIGATION MEASURE	LEVEL OF SIGNIFICANCE AFTER MITIGATION
	disturbance shall be allowed to occur while the burrows are occupied. During the non-breeding season (September 1 through January 31), the exclusion zone shall extend 160 feet around the occupied burrows. During the breeding season (February 1 through August 31), exclusion areas shall extend 250 feet around occupied burrows. • Passive relocation of on-site owls may be implemented during the non-breeding season after coordinating with CDFG. Passive relocation shall be accomplished by installing one-way doors on the entrances of burrows located within 160 feet of the project site. The one-way doors shall be left in place for 48 hours to ensure that the owls have left the burrow. • For each burrow affected by project construction, two alternate unoccupied natural or artificial burrows shall be provided outside of the 160-foot buffer zone (CDFG 1995). The alternate burrows shall be monitored daily for one week to confirm that owls have moved and acclimated. • Burrows in the construction area shall be excavated using hand tools under the supervision of a qualified biologist and then refilled to prevent reoccupation. If any burrowing owls are discovered during excavation, the excavation shall cease and the owl(s) be allowed to escape. Excavation shall be completed when the biological monitor confirms that the burrow is empty. • If owls are identified on or adjacent to the site, a qualified biologist shall provide a pre-construction worker education program to contractors and their employees that describes the life history and species protection measures that are in effect to avoid impacts to burrowing owls. **Mitigation Measure 3.4-1b:** The following measures would reduce potential impacts to nesting and migratory birds and raptors to less than significant levels. • Within 15 days of site clearing, a qualified biologist shall conduct a pre-construction, migratory bird and raptor nesting survey. The biologist must be qualified to determine the status and stage of nesting by migratory birds and all locally breeding raptor species without causing intrusive disturbance. This survey shall include species protected under the MBTA including the Swainson's hawk, tricolored blackbird, mountain plover. The survey shall cover all reasonably potential nesting locations for the relevant species on or closely adjacent to the project site. • If an active nest is confirmed by the biologist, no construction activities shall occur within at least 500 feet of the nesting site until the end of the breeding season when the nest has failed or the young have fledged. CDFG will be notified of the identification of active nests and will be consulted regarding resumption of construction activities. • Removed trees that have been documented during pre-construction surveys as supporting Swainson's hawk nests shall be replaced with suitable native nest tree species (i.e., cottonwoods, etc.) within 1/2 mile of the project area and adjacent to suitable foraging habitat.	

TABLE S-1 (CONT.)
SUMMARY OF PROJECT IMPACTS AND MITIGATION MEASURES

IMPACT	MITIGATION MEASURE	LEVEL OF SIGNIFICANCE AFTER MITIGATION
Biological Impact 3.4-2: Activities associated with the construction of the proposed project could result in adverse impacts to the American badger. Less than Significant with Mitigation.	**Mitigation Measure 3.4-2:** A qualified biologist shall conduct focused preconstruction surveys no more than two weeks prior to construction for potential American badger dens. If no potential American badger dens are present, no further mitigation is required. If potential dens are observed, the following measures are required to avoid potential adverse effects to the American badger: • If the qualified biologist determines that potential dens are inactive, the biologist shall excavate these dens by hand with a shovel to prevent badgers from re-using them during construction. • If the qualified biologist determines that potential dens may be active, the entrances of the dens shall be blocked with soil, sticks, and debris for three to five days to discourage use of these dens prior to project disturbance. The den entrances shall be blocked to an incrementally greater degree over the three- to five-day period. After the qualified biologist determines that badgers have stopped using active dens within the project boundary, the dens shall be hand-excavated with a shovel to prevent re-use during construction.	Less than Significant.
Biological Impact 3.4-3: Activities associated with the construction of the proposed project could result in adverse impacts to the San Joaquin kit fox. Less than Significant with Mitigation.	**Mitigation Measure 3.4-3:** IRWD shall conduct a USFWS-approved "early evaluation" of the Strand Ranch to determine if a San Joaquin kit fox survey must be completed. If the evaluation shows that the San Joaquin kit fox does not utilize the property, then no further mitigation shall be required for this endangered species. If the "early evaluation" finds potential for the presence of kit fox, a San Joaquin kit fox survey shall be conducted by a qualified biologist, between May 1 and November 1, in accordance with the USFWS San Joaquin Kit Fox Survey Protocol (1999). Evidence must be provided to the CDFG and USFWS that the San Joaquin Fox Survey Protocol has been conducted. If it is determined that the San Joaquin kit fox has the potential to utilize the property then the following measures are required to avoid potential adverse effects to this species: • IRWD shall design the recharge basins to avoid impacting the slough area if feasible. • IRWD shall initiate discussions with the USFWS to determine appropriate project modifications to protect kit fox, including avoidance, minimization, restoration, preservation, or compensation. • If evidence of active or potentially active San Joaquin kit fox dens is found within the area to be impacted by the proposed project, compensation for the habitat loss shall be determined and provided in consultation with USFWS and CDFG.	Less than significant.
Biological Impact 3.4-4: Activities associated with the construction of the proposed project could result in adverse impacts to the giant kangaroo rat, Tipton kangaroo rat, and San Joaquin pocket mouse. Less than Significant with Mitigation.	**Mitigation Measure 3.4-4a**. IRWD shall design the recharge basins to avoid impacting the edges of the Pioneer Canal and slough area south of the CVC if feasible. During construction, a buffer area shall be established to prevent disturbance to the canal berm and slough area. Exclusion fencing shall be required during construction to ensure that the canal edges are not disturbed. The width of the buffer zone shall be determined by a qualified biologist permitted to trap for the species and agreed upon with CDFG and USFWS. **Mitigation Measure 3.4-4b**. If avoidance measures described above are not feasible, IRWD shall conduct protocol surveys to determine the presence or absence of the giant kangaroo rat, Tipton kangaroo rat, and San Joaquin pocket mouse. Surveys will be conducted in areas of suitable	Less than significant.

TABLE S-1 (CONT.)
SUMMARY OF PROJECT IMPACTS AND MITIGATION MEASURES

IMPACT	MITIGATION MEASURE	LEVEL OF SIGNIFICANCE AFTER MITIGATION
	habitat along the edge of the Pioneer Canal and within the slough area. The survey protocol shall follow the USFWS and CDFG-approved survey protocol for the Morro Bay kangaroo rat (1996). The survey protocol is intended to provide the USFWS and CDFG with sufficient information to assess the presence or absence of state and federally listed species including the giant kangaroo rat, Tipton kangaroo rat, and San Joaquin pocket mouse. The surveys include visual surveys followed by trapping surveys. If no signs of the species are found during the surveys, and no kangaroo rats have been trapped, the survey is considered complete and the property is considered to be unoccupied by the species. If the species is found within the area to be impacted by the proposed project, compensation for the habitat loss shall be determined and provided in consultation with USFWS and CDFG.	
Biological Impact 3.4-5: Activities associated with the construction of the proposed project could result in adverse impacts to the giant garter snake. Less than Significant with Mitigation.	**Mitigation Measure 3.4-5a.** IRWD shall design the recharge basins to avoid impacting the edges of the Pioneer Canal if feasible. During construction, a buffer area would be established to prevent disturbance to the canal berm. Exclusion fencing would be required during construction to ensure that the canal edges were not disturbed. A 200 foot buffer zone from the banks of giant garter snake aquatic habitat would be established as suggested in the *USFWS Guidelines for the Giant Garter Snake (2003)*. **Mitigation Measure 3.4-5b.** If avoidance measures described above are not feasible, IRWD shall conduct pre-construction surveys in would be conducted in accordance with the *USFWS Guidelines for the Giant Garter Snake (2003)* to help determine the absence/presence of the giant garter snake. Surveys require authorization from and consultation with USFWS and CDFG to comply with standard procedures. A take that may result from monitoring development or project construction would require a 10(a)(1)(b) incidental take permit or a Section 7 (FESA) consultation with an incidental take statement. The following measures would help to reduce the impacts to the giant garter snake if determined present. • Avoid construction activities within 200 feet from the banks of giant garter snake aquatic habitat. Confine movement of heavy equipment to existing roadways to minimize habitat disturbance. • Construction activity within habitat shall be conducted between May 1 and October 1. This is the active period for giant garter snakes. Direct mortality is lessened because snakes are expected to actively move and avoid danger. Between October 2 and April 30 contact the Service's Sacramento Fish and Wildlife Office to determine if additional measures are necessary to minimize and avoid take. • Confine clearing to the minimal area necessary to facilitate construction activities. Flag and designate avoided giant garter snake habitat within or adjacent to the project area as Environmentally Sensitive Areas. This area shall be avoided by all construction personnel. • Construction personnel shall receive Service-approved worker environmental awareness training. This training instructs workers to recognize giant garter snakes and their habitat(s). • 24-hours prior to construction activities, the project area shall be surveyed for giant garter	Less than significant.

TABLE S-1 (CONT.)
SUMMARY OF PROJECT IMPACTS AND MITIGATION MEASURES

IMPACT	MITIGATION MEASURE	LEVEL OF SIGNIFICANCE AFTER MITIGATION
	snakes. Survey of the project area shall be repeated if a lapse in construction activity of two weeks or greater has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. Report any sightings and any incidental take to the Service immediately by telephone at (916) 414-6600. • Any dewatered habitat shall remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat. After completion of construction activities, remove any temporary fill and construction debris and, wherever feasible, restore disturbed areas to pre-project conditions. Restoration work may include such activities as replanting species removed from banks or replanting emergent vegetation in the active channel.	
Cultural Impact 3.5-1: Project construction could adversely affect currently unknown cultural resources, including unique archaeological resources. Less than Significant with Mitigation.	**Mitigation Measure 3.5-1:** In the event that prehistoric or historic subsurface cultural resources are discovered during ground-disturbing activities, all work within 50 feet of the resources will be halted and the project proponent will consult with a qualified archaeologist to assess the significance of the find according to CEQA Guidelines Section 15064.5. If any find is determined to be significant, the project proponent and the archaeologist will meet to determine the appropriate avoidance measures or other appropriate mitigation. The project proponent (as applicable) will make the final determination. All significant cultural materials recovered will be, as necessary and at the discretion of the consulting archaeologist, subject to scientific analysis, professional museum curation, and documentation according to current professional standards. In considering any suggested mitigation proposed by the consulting archaeologist in order to mitigate impacts to historical resources or unique archaeological resources, the project proponent will determine whether avoidance is necessary and feasible in light of factors such as the nature of the find, project design, costs, and other considerations. If avoidance is infeasible, other appropriate measures (e.g., data recovery) will be instituted. Work may proceed on other parts of the project site while mitigation for historical resources or unique archaeological resources is being carried out.	Less than significant.
Cultural Impact 3.5-2: Project Construction could adversely affect unidentified paleontological resources. Less than Significant with Mitigation.	**Mitigation Measure 3.5-2:** In the event that paleontological resources are discovered, the project proponent (depending upon the project component) will notify a qualified paleontologist. The paleontologist will document the discovery as needed, evaluate the potential resource, and assess the significance of the find under the criteria set forth in *CEQA Guidelines* Section 15064.5. If fossil or fossil bearing deposits are discovered during construction, excavations within 50 feet of the find will be temporarily halted or diverted until the discovery is examined by a qualified paleontologist (in accordance with Society of Vertebrate Paleontology standards (Society of Vertebrate Paleontology, 1995). The paleontologist will notify the appropriate agencies to determine procedures that would be followed before construction is allowed to resume at the location of the find. If the project proponent determines that avoidance is not feasible, the paleontologist will prepare an excavation plan for mitigating the effect of the project on the qualities that make the resource important. The plan will be submitted to the project proponent for review and approval prior to implementation.	Less than significant.

TABLE S-1 (CONT.)
SUMMARY OF PROJECT IMPACTS AND MITIGATION MEASURES

IMPACT	MITIGATION MEASURE	LEVEL OF SIGNIFICANCE AFTER MITIGATION
Cultural Impact 3.5-3: Project construction could result in damage to previously unidentified human remains. Less than Significant with Mitigation.	**Mitigation Measure 3.5-3:** If human skeletal remains are uncovered during project construction, the project proponent (depending upon the project component) will immediately halt work, contact the Kern County coroner to evaluate the remains, and follow the procedures and protocols set forth in Section 15064.5 (e)(1) of the *CEQA Guidelines*. If the County coroner determines that the remains are Native American, the project proponent will contact the NAHC, in accordance with Health and Safety Code Section 7050.5, subdivision (c), and Public Resources Code 5097.98 (as amended by AB 2641). Per Public Resources Code 5097.98, the landowner shall ensure that the immediate vicinity, according to generally accepted cultural or archaeological standards or practices, where the Native American human remains are located, is not damaged or disturbed by further development activity until the landowner has discussed and conferred, as prescribed in this section (PRC 5097.98), with the most likely descendents regarding their recommendations, if applicable, taking into account the possibility of multiple human remains.	Less than significant.
Geological Impact 3.6-1: The proposed project could expose people or structures to strong seismic ground shaking or liquefaction. Less than Significant.	None required.	Less than significant.
Geological Impact 3.6-2: The proposed project could result in substantial soil erosion or the loss of topsoil. Less than Significant with Mitigation.	**Mitigation Measure 3.6-1:** All topsoil stripped from the ground surface during construction shall be used for construction of the earthen berms and not hauled offsite. Any temporary stockpiles shall be managed through the use of best management practices as outlined in the SWPPP which shall include but not be limited to wetting and/or covering stockpiles to prevent wind erosion.	Less than significant.
Geological Impact 3.6-3: The proposed project could potentially experience subsidence as a result of hydrocompaction from recharge activities or due to groundwater recovery operations. Less than Significant.	None required.	Less than significant.
Geological Impact 3.6-4: The proposed project could block access to oil resources beneath the property. Less than Significant.	None required.	Less than significant.
Hazards and Hazardous Material Impact 3.7-1: Project construction could encounter soils during excavation that have been exposed to contamination. Less than Significant.	~~No mitigation measures are required.~~ **Mitigation Measure 3.7-1:** IRWD shall collect representative samples of soils remaining in place near the former fuel and pesticide storage areas identified in the Phase I Site Assessment. The samples shall be analyzed for total petroleum hydrocarbons and pesticides. IRWD shall remove from the site in accordance with applicable waste disposal regulations, soils identified as containing hazardous quantities of contaminates.	Less than significant.

TABLE S-1 (CONT.) SUMMARY OF PROJECT IMPACTS AND MITIGATION MEASURES

IMPACT	MITIGATION MEASURE	LEVEL OF SIGNIFICANCE AFTER MITIGATION
Hazards and Hazardous Material Impact 3.7-2: Project operation could cause an increase in airborne insect populations. Less than Significant with Mitigation.	**Mitigation Measure 3.7-21:** IRWD and Rosedale shall consult with the Kern County Department of Public Health Services and KMVCD to develop appropriate insect control measures that utilize non-toxic abatement methods.	Less than significant.
Hydrology, Groundwater Resources, and Water Quality Impact 3.8-1: The proposed project would lower groundwater levels at neighboring wells during periods of recovery. Less than Significant.	None required.	Less than significant.
Hydrology, Groundwater Resources, and Water Quality Impact 3.8-2: Groundwater quality could be affected by the addition of recharge water, neighboring contamination plumes, and intermixing of aquifer layers with varying water quality. Less than Significant.	None required.	Less than significant.
Hydrology, Groundwater Resources, and Water Quality Impact 3.8-3: Recharge operations on the proposed project site could result in groundwater mounding that could potentially impact subsurface structures or impair recharge efforts of adjacent groundwater banking operations. Less than Significant with Mitigation.	**Mitigation Measure 3.8-1:** IRWD and Rosedale will agree with the KCWA on a monitoring and operations plan to avoid impacts to CVC facilities as a result of project operations. As part of said monitoring and operations plan IRWD and Rosedale will install and monitor piezometers adjacent to the CVC within the Strand Ranch property. When groundwater approaches 12 feet bgs beneath the CVC, IRWD and Rosedale will consult with geotechnical engineers to determine if conditions might pose a risk to subsurface structures if further recharge operations were to continue. Under such conditions, piezometer data collected on the Strand Ranch as well as information from the geotechnical engineers will be shared with KCWA. If subsurface structures are determined to be at risk from high groundwater, IRWD and Rosedale will temporarily cease recharge activities until water surface elevations no longer pose a risk to subsurface structures.	Less than significant.
Hydrology, Groundwater Resources, and Water Quality Impact 3.8-4: Earthwork activities associated with construction of recharge ponds could expose soils to erosion and sedimentation in runoff. Less than Significant with Mitigation.	**Mitigation Measure 3.8-2:** Rosedale and IRWD shall require that the following BMPs are included in the construction SWPPP: • Establish an erosion control perimeter around active construction and contractor layout areas including silt fencing, jute netting, straw waddles, or other appropriate measures to control sediment from leaving the construction area. • Install containment measures at fueling stations and at fuel and chemical storage sites. • Employ good house-keeping measures including clearing construction debris and waste materials at the end of each day.	Less than significant.
Hydrology, Groundwater Resources, and Water Quality Impact 3.8-5: Failure of the earthern berms that surround the recharge ponds could cause flooding of surrounding areas. Less than Significant.	None required.	Less than significant.

TABLE S-1 (CONT.)
SUMMARY OF PROJECT IMPACTS AND MITIGATION MEASURES

IMPACT	MITIGATION MEASURE	LEVEL OF SIGNIFICANCE AFTER MITIGATION
Hydrology, Groundwater Resources, and Water Quality Impact 3.8-6: The quality of water extracted from the Strand Ranch could exceed thresholds imposed by the conveyance facilities. Less than Significant with Mitigation.	**Mitigation Measure 3.8-3:** IRWD and Rosedale shall ensure that water quality testing is conducted prior to introduction of extracted groundwater into the CVC or California Aqueduct subject to review and approval by the KCWA and DWR.	
Land Use Impact 3.9-1: The proposed project could conflict with applicable land use plans, policies, or regulations, of an agency with jurisdiction over the project. Less than Significant with Mitigation.	**Mitigation Measure 3.9-1:** A General Plan Amendment shall be requested from Kern County to eliminate the mid-section line setback requirements from Strand Ranch.	Less than significant.
Noise Impact 3.10-1: Proposed project construction activities could intermittently and temporarily generate noise levels above existing ambient levels in the project vicinity. Less than Significant.	None required.	Less than significant.
Noise Impact 3.10-2: Proposed project construction activities could expose sensitive receptors to excessive ground-borne vibration levels. Less than Significant.	None required.	Less than significant.
Noise Impact 3.10-3: Operational activities associated with the proposed Project could permanently generate noise levels above existing ambient levels in the project vicinity. Less than Significant.	None required.	Less than significant.
Transportation Impact 3.11-1: The proposed project would add to the traffic in the project area during construction. Less than Significant.	None required.	Less than significant.
Utilities and Public Services Impact 3.12-1: The proposed project would construct infrastructure to enhance water supply reliability. Less than Significant.	None required.	Less than significant.
Utilities and Public Services Impact 3.12-2: The proposed project would require new or expanded water supply resources. Less than Significant.	None required.	Less than significant.

CHAPTER 1
Introduction and Project Background

1.1 Purpose of the EIR

The Rosedale-Rio Bravo Water Storage District (RRBWSD or Rosedale) as the Lead Agency, in consultation with the Irvine Ranch Water District (IRWD) as a Responsible Agency, has prepared this Final Environmental Impact Report (EIR) to provide the public and trustee agencies with information about the potential effects on the local and regional environment associated with the Strand Ranch Integrated Banking Project (proposed project). This Final EIR has been prepared in compliance with the California Environmental Quality Act (CEQA) of 1970 (as amended), codified at California Public Resources Code Sections 21000 et. seq., and the State *CEQA Guidelines* in the Code of Regulations, Title 14, Division 6, Chapter 3.

This Final EIR describes the environmental impacts of the proposed project and suggests mitigation measures to reduce impacts to a less-than-significant level. The impact analyses are based on a variety of sources, including agency consultation, technical studies, and field surveys.

1.2 Intended Use of the EIR

Rosedale and IRWD intend to use this EIR to consider implementation of the proposed project. According to CEQA, when a project is to be carried out by multiple public agencies, one agency is selected to be the lead agency and the other agencies are designated as responsible agencies (*CEQA Guidelines* §15050(a)). The decision-making bodies of the lead agency and responsible agencies are required to consider and certify the EIR prior to acting upon or approving the project (*CEQA Guidelines* §15050(b)). The proposed project is a joint project of both Rosedale and IRWD. For purposes of this EIR, Rosedale is the Lead Agency and IRWD is the Responsible Agency. The Rosedale Board of Directors and the IRWD Board of Directors independently shall consider and certify this EIR prior to approving the proposed project.

1.3 Organization of this EIR

The chapters of this Final EIR are as follows:

S. **Summary.** This chapter summarizes the contents of the Final EIR.

1. **Introduction and Project Background.** This chapter discusses the CEQA process and the purpose of the EIR, and background information for the proposed project.

2. **Project Description.** This chapter provides an overview of the proposed project, describes the need for and objectives of the proposed project, and provides detail on the characteristics of the proposed project.

3. **Environmental Setting, Impacts and Mitigation Measures.** This chapter describes the environmental setting and identifies impacts of the proposed project for each of the following environmental resource areas: Aesthetics; Agriculture; Air Quality; Biological Resources; Cultural Resources; Geology, Soils, Seismicity, and Mineral Resources; Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use, Planning and Recreation; Noise; Transportation and Traffic; and Public Services and Utilities. Measures to mitigate the impacts of the proposed project are presented for each resource area where significant potential impacts have been identified.

4. **Cumulative Impacts Analysis.** This chapter describes the potential impacts of the proposed project when considered together with other related projects in the project area.

5. **Growth Inducement Potential.** This chapter summarizes population projections and water demands within the IRWD and Rosedale service areas and describes the potential for the proposed project to induce development.

6. **Alternatives Analysis.** This chapter presents an overview of the alternatives development process and describes the alternatives to the proposed project that were considered.

7. **References.**

8. **Report Preparers.** This chapter identifies those involved in preparing this Final EIR, including persons and organizations consulted.

9. **Introduction to Response to Comments.**

10. **Comments Received on the Draft EIR.** This chapter contains the comment letters received during the public review period for the Draft EIR.

11. **Responses to Comments.** This chapter contains the responses to the comment letters received during the public review period for the Draft EIR.

12. **Revisions Made to the Draft EIR.** This chapter provides a compilation of revisions made to the Draft EIR following the public review period.

1.4 CEQA Process

1.4.1 Notice of Preparation

In accordance with Sections 15063 and 15082 of *CEQA Guidelines*, Rosedale prepared a Notice of Preparation (NOP) of an EIR (see **Appendix A**). The NOP was circulated to local, state, and federal agencies, and to other interested parties in April 2007. As indicated in the NOP, the EIR addresses a full range of resource analyses. The NOP described the proposed project objectives, the proposed facilities, and the project location.

1.4.2 Public Scoping Meeting

CEQA recommends conducting early coordination with the general public, appropriate public agencies, and local jurisdictions to assist in developing the scope of the environmental document. Pursuant to *CEQA Guidelines* §15083, two public scoping meetings were held to allow agency consultation and public involvement for the Draft EIR, one on April 24, 2007 at IRWD in Irvine, and one on May 8, 2007 at Rosedale in Bakersfield. Public notices were placed in local newspapers informing the general public of the scoping meetings and the availability of the NOP. The purpose of the meetings was to present to the public the proposed project and its potential environmental impacts. Attendees were provided an opportunity to voice comments or concerns regarding potential effects of the proposed project.

Comments received during the scoping meetings are included in the scoping report in **Appendix B**. Written comments were received from the Kern Water Bank Authority, Orange County Water District, and Kern County Planning Department. The verbal and written comments raised questions regarding potential project effects on groundwater levels and water quality and cumulative impacts of the proposed project with respect to all of Rosedale's existing and planned banking obligations and those of neighboring water districts and future development projects within Kern County.

1.4.3 Draft EIR

The Draft EIR was circulated for public review from January 24 through March 10, 2008. During this period, a public meeting was held to provide interested persons with an opportunity to comment orally or in writing on the Draft EIR and the project. The public meeting was held at the Kern County Water Agency on February 20, 2008. Four comment letters were received on the Draft EIR. Chapter 10 includes each comment received during the public review period. Chapter 11 provides responses to each comment received.

1.4.4 Final Environmental Impact Report

Written and oral comments received in response to the Draft EIR have been addressed in Chapter 11. These responses to comments, together with the revised Draft EIR, constitute the Final EIR. The Board of Directors of Rosedale will consider the Final EIR for certification (*CEQA Guidelines* §15090). Once the Final EIR is certified, both Rosedale and IRWD may proceed to consider project approval (*CEQA Guidelines* §15090, §15096(f)).

1.4.5 Mitigation Monitoring and Reporting Program

CEQA requires lead agencies to "adopt a reporting and mitigation monitoring program for the changes to the project which it has adopted or made a condition of project approval in order to mitigate or avoid significant effects on the environment" (CEQA §21081.6, *CEQA Guidelines*

§15097). The Mitigation Monitoring and Reporting Plan (MMRP) was prepared based on the mitigation measures included in the Final EIR and has been included in the Findings to be approved by IRWD and Rosedale Boards of Directors.

1.5 Project Background

1.5.1 Rosedale-Rio Bravo Water Storage District

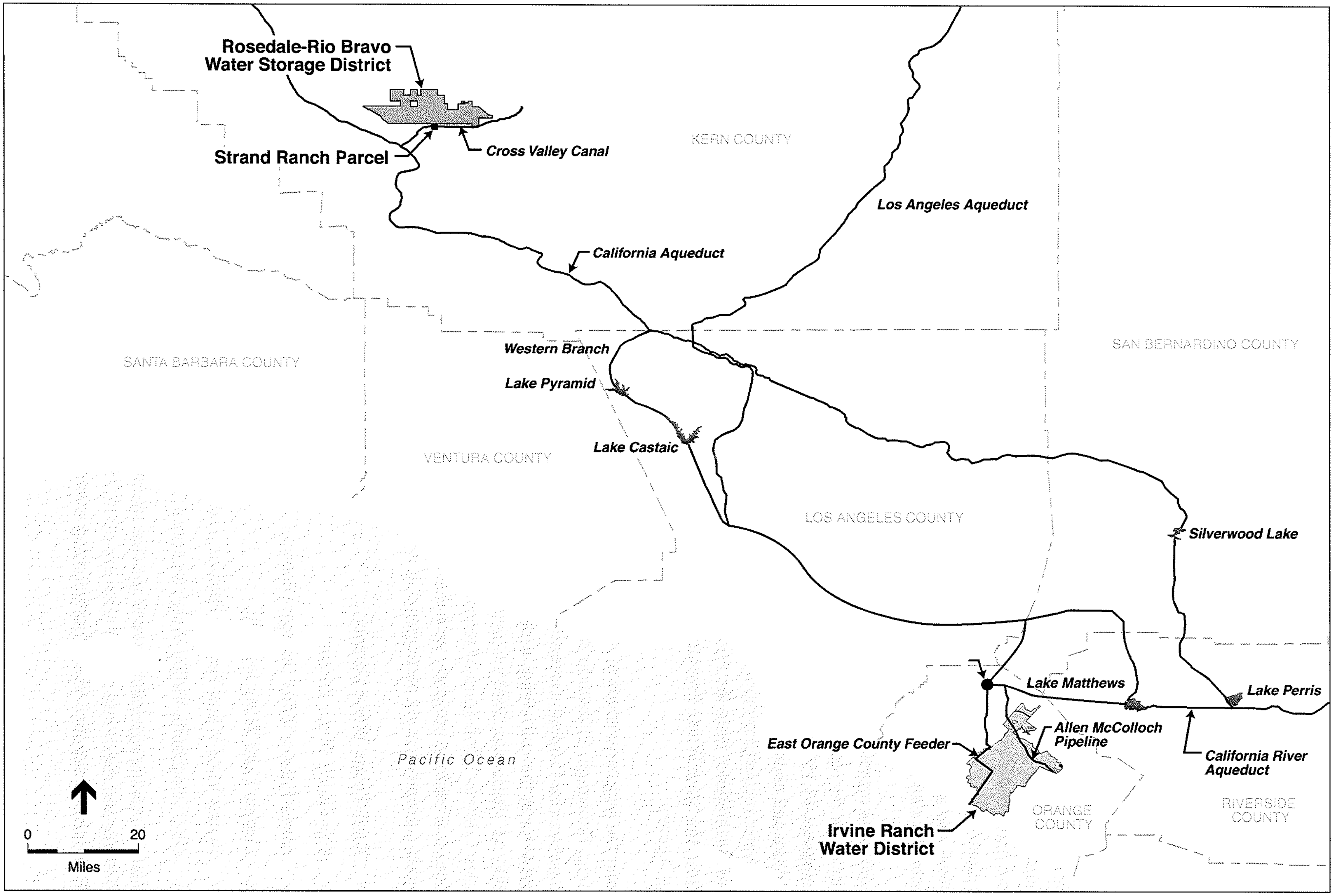
The water districts of Kern County are leaders in the development of groundwater banking programs in California. Portions of Kern County are characterized by hydrogeologic conditions that are particularly suitable for groundwater recharge operations. Kern County is also strategically located in central California near federal, state, and local water supply conveyance facilities. The groundwater banking programs of Kern County benefit local customers and water districts and also provide water storage for districts in northern and southern California.

Rosedale was established in 1959 to develop a groundwater recharge program to offset overdraft conditions in the regional Kern County aquifer. Rosedale, located west of Bakersfield, encompasses 44,150 acres in Kern County (**Figure 1-1**), with 28,500 acres developed as irrigated agriculture and about 6,000 acres developed for urban uses. Rosedale receives water for its groundwater recharge program from the Kern River through water service agreements with the City of Bakersfield, from the Friant-Kern Canal of the Central Valley Project (CVP) as available, and from the State Water Project (SWP) through a water supply contract with the Kern County Water Agency.

To meet the long term needs of its landowners, Rosedale developed the Groundwater Storage, Banking, Exchange, Extraction & Conjunctive Use Program (Conjunctive Use Program). The Conjunctive Use Program currently manages approximately 210,000 acre feet (AF) of stored groundwater in the underlying aquifer, which has an estimated total storage capacity in excess of 930,000 AF (Rosedale, 2001). Currently, the infrastructure for the Conjunctive Use Program includes 1,000 to 1,200 acres of recharge basins and seven recovery wells. The Conjunctive Use Program is a banking program, such that all recharge must occur in advance of extraction. Rosedale currently has six participants in its Conjunctive Use Program:

- Kern-Tulare Water District,
- Rag Gulch Water District,
- Arvin-Edison Water Storage District,
- Castaic Lake Water Agency,
- Buena Vista Water Storage District, and
- GLC (Coachella Valley Water District).

Rosedale's existing agreements are to provide maximum annual recharge of approximately 150,000 afy and maximum annual recovery of 45,750 afy. Water supplies for the Conjunctive Use Program are supplied by the participating water agencies and include high-flow Kern River



SOURCE: Kern County, 2007; ESA, 2007.

Irvine Ranch Water District . 205426

Figure 1-1
Project Location
Strand Ranch

water and water from the CVP and SWP. Rosedale certified a Final Master EIR covering the Conjunctive Use Program in July 2001. In addition, Rosedale has certified subsequent CEQA documents for individual project components. See **Appendix C** for a summary of CEQA documentation related to Rosedale's Conjunctive Use Program.

1.5.2 Irvine Ranch Water District

IRWD was established in 1961 as a California Water District pursuant to the California Water District Law (California Water Code, Division 13). IRWD provides potable and recycled water, sewage collection and treatment, and urban runoff treatment to municipal and industrial (M&I), and agricultural customers within an 114,560-acre service area in Orange County, California (Figure 1-1). Currently, 60 percent of the water IRWD provides for its customers comes from local sources, including groundwater (produced from the groundwater basin managed by Orange County Water District), surface water, and reclaimed water. The remaining 40 percent of IRWD's water supply is imported by the Metropolitan Water District of Southern California (Metropolitan or MWD) and purchased by IRWD through the Municipal Water District of Orange County (MWDOC).

IRWD's *Water Resources Master Plan* (January, 2003) reports that water supplies exceed water demand through 2030. In 2010, projected build-out demand is 106,339 afy, while projected supply is 159,504 afy (IRWD, January, 2003). By the year 2030, it is projected that demand will be 136,206 afy, while projected supply is expected to be 174,904 afy (IRWD, January, 2003). Although projected water supplies exceed demand, the reliability of future imported supplies decreases during periods of drought. During consecutive dry years, the difference between supply and demand narrows. IRWD purchased the 611-acre Strand Ranch in Kern County in 2004 for the purpose of developing a water banking program to enhance drought-year reliability and provide water supply redundancy in a cost-effective manner. Water purchased by IRWD and stored at Strand Ranch during wet hydrologic periods would be used as a supplemental water supply during dry hydrologic periods when water imported by MWD is reduced and more costly.

Strand Ranch

The 611-acre Strand Ranch property is located in unincorporated Kern County in the northern Kern Fan area south of Stockdale Highway. Strand Ranch is adjacent to Rosedale's existing boundary and to portions of the Kern Water Bank. Strand Ranch currently is used for agriculture. In May 2007, crop production on Strand Ranch included cotton, wheat, alfalfa, garlic and almonds. Existing structures on Strand Ranch include a farm residence, storage shed, aboveground diesel tank, farm chemical storage trailer, and an irrigation piping system. There are seven agricultural wells located on the project site referred to as Well Numbers 1 through 7. Two of the wells (Nos. 5 and 7) are inoperable.

Two existing water conveyance facilities bisect Strand Ranch: the Pioneer Canal and the Cross Valley Canal (CVC). The Pioneer Canal is controlled by the Kern Water Bank Authority (KWBA), which holds a permanent easement across Strand Ranch. The KWBA uses the Pioneer Canal for water deliveries to its recharge basins to the west and south of Strand Ranch. The CVC is operated by Kern County Water Agency for the benefit of the CVC participants that utilize the canal for delivery of their water supplies, including contractual delivery of SWP water.

In the middle-western portion of the Strand Ranch site there is a slough that connects the CVC to neighboring recharge basins located on property owned by KWBA to the west and south of Strand Ranch. The slough is an old borrow pit and canal that have been used intermittently by KWBA for delivery of water supplies from the CVC. Continued future use of the slough by KWBA is subject to agreement by IRWD.

Strand Ranch is under a Williamson Act contract, pursuant to the California Land Conservation Act of 1965. Strand Ranch has been under a Williamson Act Land Use Contract since November 27, 1974. The Williamson Act contract applies to Assessor's Parcel Numbers 160-010-03, 160-010-07, 160-010-02-01, and 160-010-06. The Williamson Act contract restricts land use activities on Strand Ranch to agricultural uses and other compatible uses as determined by Kern County.

Strand Ranch is located within the Strand Oil Field. Mineral rights on the property are not owned by IRWD. As a condition of the property deed, IRWD is obligated to maintain four 3-acre oil well pads such that the mineral rights owners can access subsurface oil resources in the future.

1.5.3 Interim Recharge Project

In 2006, IRWD and Rosedale constructed the Interim Recharge Project on Strand Ranch, a pilot recharge project consisting of three recharge basins covering 125 acres in the southwest corner of the property. A Notice of Determination of Negative Declaration for this project was filed on May 10, 2006. The purposes of the Interim Recharge Project were to test and confirm the percolation rates of the soils on Strand Ranch and to correct overdraft conditions due to groundwater extraction from agricultural wells on site.

Currently, Strand Ranch is not part of a water storage district. The water extracted from agricultural wells by previous land owners was not actively replenished and thus contributed to overdraft conditions in the underlying groundwater basin. Since IRWD acquired Strand Ranch in 2004, the site has continued to be leased for agricultural production. As part of the Interim Recharge Project, IRWD recharged water to correct overdraft conditions starting from the date IRWD acquired the Strand Ranch property through May 2008. The volume of water required to replenish the groundwater extracted for agriculture was determined based on actual consumptive use of irrigated acreage on Strand Ranch. A total of 2,983 af was recharged into the basin between July 2006 and December 2006. The average recharge rate for the Interim Recharge Project was 0.17 af per day per acre. Upon implementation of the proposed project, the Interim Recharge Project facilities will be replaced with those described in **Chapter 2, Project Description**.

CHAPTER 2
Project Description

2.1 Overview and Project Location

The Strand Ranch Integrated Banking Project (proposed project) would annex the Strand Ranch into Rosedale's service area and integrate the Strand Ranch into Rosedale's existing Conjunctive Use Program. Rosedale manages a groundwater recharge, storage, and recovery program within its district boundaries for land owners and other water districts, both within and outside of its district boundaries. Strand Ranch is owned by IRWD and is immediately adjacent to Rosedale's existing district boundary (**Figure 2-1**).

Strand Ranch consists of approximately 611 acres of agricultural land located in western Kern County approximately six miles west of the City of Bakersfield and ten miles south of the City of Shafter. Strand Ranch is approximately 2.5 miles north of the Kern River, 10 miles southwest of the Friant-Kern Canal, and six miles east of the California Aqueduct. The Cross Valley Canal and the Pioneer Canal bisect Strand Ranch on an east-west axis.

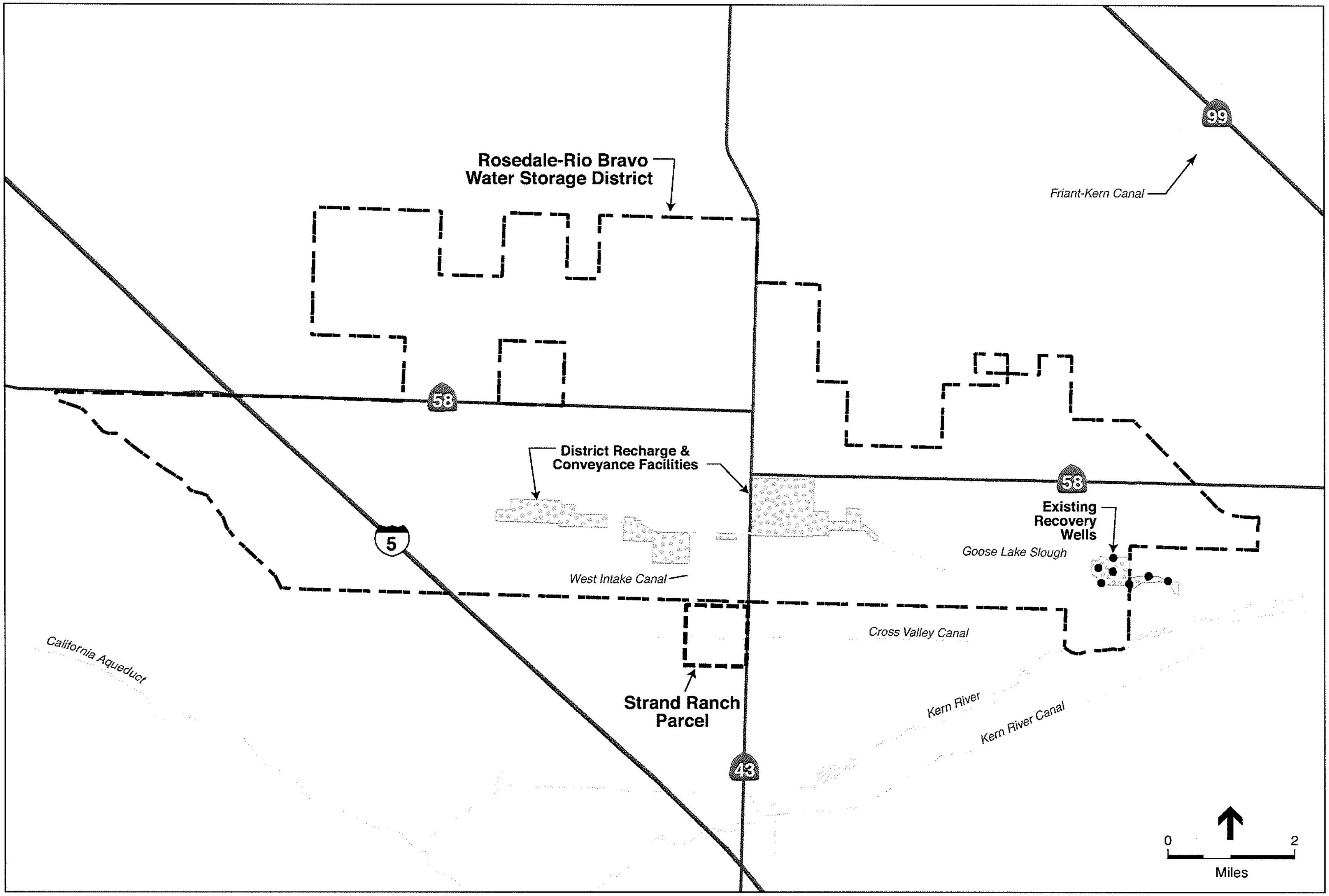
2.2 Project Objectives

The objectives of the proposed project are as follows:

- Provide additional groundwater recharge, storage, and recovery capacity in the Kern Fan region to augment Rosedale's existing and future programs;
- Integrate IRWD's participation in Rosedale's Conjunctive Use Program through the use of Strand Ranch and other Rosedale facilities to the extent they are not obligated to meet Rosedale's existing banking program contracts,
- Allow the storage of water ~~during wet hydrologic periods~~ subject to the conditions established by the water supplier and availability for recovery and use during dry periods to provide IRWD customers with increased water supply reliability through redundancy and diversification.

2.3 Purpose and Need for the Project

The proposed project would augment the recharge and extraction capacity of the Rosedale Conjunctive Use Program and provide greater operational flexibility. In addition, the proposed project would enhance water supply reliability for IRWD by providing contingency storage to augment supplies during dry-year periods when other supply sources may be limited or not available.



SOURCE: Kern County, 2007; ESA, 2007.

Irvine Ranch Water District . 205426

Figure 2-1
Project Site and
Existing Facilities

Utilizing existing underground storage capacity of the Kern County aquifer avoids the need to construct extensive surface water storage facilities elsewhere to perform the same function. In addition, the project helps protect the basin from overdraft by annexing Strand Ranch into Rosedale and ~~eliminating~~ reducing the extraction of groundwater for agricultural production. Strand Ranch currently is not part of a water storage district, and thus water extracted for agricultural irrigation is not replenished.

The proposed project is consistent with Department of Water Resources (DWR) water management goals. In the *California Water Plan Update 2005*, DWR recognizes the benefits from conjunctive water management, which include improving water supply reliability, reducing groundwater overdraft and land subsidence, and protecting water quality and environmental conditions (DWR, 2005).

IRWD Recovery Scenarios

In the event of an interruptible or short-term water shortage, IRWD recognizes the need for additional storage to provide for improved reliability and redundancy in its supplies. The proposed project is intended to assist IRWD in meeting demands during periods of drought or catastrophic supply interruption and would improve the reliability and redundancy of its water supplies. It is expected that banked supplies would be conveyed to IRWD when needed, potentially during times when imported and/or local supplies are interrupted or curtailed. Since the amount of water available to IRWD would be less than the amount recharged due to the requirement to account for "losses," the groundwater basin would experience a net benefit from the project.

Situations under which IRWD might recover banked water include, but are not limited to, the following. This list is not intended to be exhaustive but rather intended to give a general understanding of the types of situations that might require dependence on banked water.

- **Agricultural Interruptible Supplies.** IRWD receives imported water for both urban and agricultural users. IRWD's agricultural contract with MWD is currently "interruptible" and drought therefore may affect the reliability of agricultural deliveries. The proposed project would benefit IRWD's agricultural customers by reducing the potential for interruption of supply when MWD calls for interruption of imported supplies to agriculture.
- **Catastrophic Supply Interruption.** According to analyses in MWD's current Regional Urban Water Management Plan (2005), extensive levee failures in the Sacramento-San Joaquin Bay-Delta (Delta) could result in a reduction in firm deliveries to its member agencies by as much as 10%. The proposed project would benefit IRWD's customers by providing water supply reliability and redundancy to reduce the potential for interruption of supply under such extreme catastrophic scenarios.
- **MWD Allocation.** In November 2007, MWD reported to its Board that there is "uncertainty about future pumping operations from the State Water Project due to fishery protection measures in the [Delta]. This uncertainty has raised the possibility that MWD may not have access to the supplies necessary to meet total firm demands at some point in

the future and may have to allocate shortages in supplies to the member agencies." The proposed project would benefit IRWD's customers by providing water supply reliability and redundancy to reduce the potential for interruption of supply under such fishery protection scenarios.

2.4 Rosedale's Existing Conjunctive Use Program and Facilities

Rosedale's Conjunctive Use Program currently includes partnerships with six water agencies under five separate agreements. The water agencies and terms of the agreements are summarized in **Table 2-1**.

TABLE 2-1
ROSEDALE CONJUNCTIVE USE PROGRAM PARTNERSHIP AGREEMENTS

Banking Partner	Type	Annual Recharge (af)	Maximum Return Obligation (afy)	Maximum Storage (af)	Banked Water Source
Arvin-Edison WSD (draft terms)	2:1 Banking	30,000	10,000	90,000	CVP
Kern-Tulare/Rag Gulch WD	2:1 Banking	20,000	7,500	50,000	varies
GLC/Castaic Lake Water Agency*	Banking	20,000	20,000	100,000	varies
Buena Vista WSD	Banking	80,000	8,250	200,000	Kern River
TOTAL			45,750		

SOURCE: Rosedale-Rio Bravo Water Storage District.

* The maximum recovery obligation for GLC is 9,500 afy but unused capacity of these and other existing facilities may be used by Castaic Lake Water Agency for return of banked water up to 20,000 afy.

Rosedale's maximum annual groundwater recovery obligation for its existing partnership agreements is 45,750 afy. Rosedale's existing facilities that support the Conjunctive Use Program include 1,200 acres of canals and recharge basins. Seven recovery wells have been constructed as part of the Kern Tulare/Rag Gulch and Arvin-Edison programs. Figure 2-1 shows the general locations of these facilities.

Rosedale conducted a district-wide water balance analysis in 2006 that summarized the water demands within its service area including water banking commitments. **Table 2-2** summarizes the operations for all banking programs. **Appendix D** provides detailed results of the analysis for each banking partner.

2.4.1 Memorandum of Understanding

In 2004, Rosedale entered into a Memorandum of Understanding (MOU) with the Kern County Water Agency (KCWA) and other Adjoining Entities in the Kern Fan area, which include Semitropic Water Storage District, Buena Vista Water Storage District, Henry Miller Water Storage District, Berrenda Mesa Water Storage District, Kern Water Bank Authority, Improvement District No 4, and West Kern Water District. The MOU provides guidelines for operation and monitoring of Rosedale's Conjunctive Use Program. The MOU is included in **Appendix E**. The proposed project would be subject to and would be consistent with the conditions of the MOU.

TABLE 2-2
TOTAL BANKING PROGRAM OPERATIONS SINCE 2004 (AF)

Year	Total Delivered	For Partners Total to Bank	Total Returned	Bank Balance
2003				39,771
2004	313	279	17,938	22,112
2005	214,003	136,011	3,929	154,175
2006	68,352	56,633	417	210,391

SOURCES: Rosedale Rio-Bravo Water Storage District

The MOU allows for Rosedale to operate its Conjunctive Use Program to achieve maximum water storage and withdrawal benefits, while also avoiding, eliminating, or mitigating adverse impacts to the groundwater basin and to the operation of other groundwater banking programs in the Kern Fan area. As part of the operating objectives defined in the MOU, Rosedale's Conjunctive Use Program includes the following:

- Maintain, or if possible enhance, the quality of the groundwater in its district. For example, Rosedale will attempt to implement recovery operations in such a manner that TDS in recovery waters exceed TDS of recharge waters.
- Control the migration of poor quality water. For example, Rosedale could increase water recharge in areas with favorable groundwater gradients.
- Operate recharge and recovery facilities in such a manner to "prevent, eliminate, or mitigate significant adverse impacts." Mitigation measures to avoid adverse impacts could include but not be limited to the following, if necessary provide buffer areas between recovery wells and neighboring districts; limit monthly or annual recovery rates; provide redundancy in recovery wells and rotate pumping from recovery wells; provide adequate well spacing; adjust or stop pumping if necessary to reduce impacts; and use recharge water that otherwise is not recharging the Kern Fan area.

The MOU also establishes a Monitoring Committee, which includes Rosedale and all Adjoining Entities. The Monitoring Committee is collectively responsible for monitoring groundwater levels and water quality in the Kern Fan area and evaluating the impact of Rosedale's Conjunctive Use Program on each of the Adjoining Entities. The Monitoring Committee can recommend that Rosedale modify operation of its Conjunctive Use Program if monitoring data "indicate that excessive mounding or withdrawal is occurring or is likely to occur in an area of interest." Any disputes to the Monitoring Committee's recommendations are subject to resolution through binding arbitration.

The MOU stipulates that modifications to Rosedale's Conjunctive Use Program would be subject to environmental review pursuant to CEQA and would require review by the Monitoring Committee. The proposed project would be integrated into Rosedale's existing Conjunctive Use Program, and this EIR will satisfy the CEQA requirements as indicated in the MOU.

2.5 Description of Proposed Project

Rosedale and IRWD propose to develop groundwater banking facilities on the Strand Ranch for use by both districts. Facilities would be constructed to recharge and recover up to 17,500 acre-feet per year (afy) for IRWD. When not in use by IRWD, the facilities could also be used by Rosedale to serve its existing commitments. IRWD would be provided a cumulative maximum banking allotment (maximum storage capacity) within Rosedale's Conjunctive Use Program of 50,000 af. All groundwater banking facilities on the Strand Ranch would be owned by IRWD and operated and maintained by Rosedale for the duration of the proposed project. The following sections describe the proposed facilities.

2.5.1 Annexation

As part of the proposed project, Strand Ranch would be annexed into Rosedale's service area and assimilated into its Conjunctive Use Program. Rosedale would assume control of operation and maintenance for all facilities on Strand Ranch for the duration of the proposed project. IRWD would maintain ownership of the Strand Ranch and its facilities.

Annexation requires approval by the Local Agency Formation Commission (LAFCO). The LAFCO was created by the Legislature in 1963 to discourage urban sprawl and encourage the orderly formation and development of local government agencies. There is a LAFCO in each county in California except for San Francisco. The LAFCO is responsible for reviewing and approving proposals for changes in the boundaries of cities and special districts in the county, including annexations to or detachments from cities and districts. Annexation of Strand Ranch by Rosedale would be approved by the Kern County LAFCO. This EIR evaluates impacts of annexation as part of the project description. Therefore, the LAFCO may use this EIR to comply with its CEQA review requirements.

2.5.2 Recharge Facilities

Recharge facilities, including basins and berms, would occupy approximately 502 acres (or 82 percent) of the Strand Ranch property. Recharge facilities would consist of up to 20 recharge basins of varying shape, size, and depth. The proposed preliminary layout of the basins is shown in **Figure 2-2**. The actual configuration of basins within the Strand Ranch could vary. The basins would be constructed to avoid the Pioneer Canal, the CVC, and the slough, which is a canal and a borrow pit that connects the CVC to recharge basins on neighboring property owned by KWBA. The basins also would avoid developing four three-acre parcels (drill islands) to maintain access to mineral rights. The basins would be set back 55~~110~~ feet from ~~the perimeter roadways (or~~ section lines~~)~~ around Strand Ranch as required by Kern County. Basins would be formed by excavating and contouring existing soils and using excavated soils to form earthen berm walls. Basin depths would average four to five feet, and basin berms would extend up to six feet above ground level.

Note: Well Locations TBD

SOURCE: GlobeXplorer; Boyle, 2007.

Irvine Ranch Water District . 205426

Figure 2-2
Strand Ranch Recharge Facilities

Maximum water depth in each basin would be approximately three feet; there would be a minimum of one foot of freeboard when the basins are filled to capacity. The basins would be designed in compliance with the California Building Code (CBC) to account for seismic hazards. The basins and berms would be reseeded to blend the berms into the surrounding landscape and to allow agricultural land uses to continue, such as organic farming or grazing.

Dirt roads would run along the perimeter of and in between all basins to provide access to facilities during operation and maintenance activities. Dirt roads would be approximately 20 feet wide, occupying approximately 32 acres (or five percent) of the Strand Ranch property.

Basin elevation would generally slope downward from northeast to southwest. The maximum bottom elevation of the basins would range from 323 feet above mean sea level (AMSL) in the northeast corner of Strand Ranch to 317 feet AMSL in the southwest corner of Strand Ranch. Recharge water would enter the eastern basins through turnout structures from the new water supply channels. The basins would be connected by transfer gates to allow recharge water to flow by gravity among basins, flowing generally from east to west, using the elevation gradient.

2.5.3 Water Supplies

Recharge water for the proposed project would be secured and acquired by IRWD from various sources, potentially including federal, state, and local supplies. Sources have not been identified yet but, similar to Rosedale's existing Conjunctive Use Program, water sources could include Metropolitan Water District of Southern California (MWD), the State Water Project, pre-1914 water rights, the Central Valley Project, and high-flow Kern River water depending on annual availability. Source water for the proposed project does not represent a new water supply; rather, IRWD would secure entitlements to excess water otherwise not being used ~~during wet hydrologic periods~~ subject to the conditions established by the water supplier and availability. It is the intent of this EIR to evaluate impacts of recharging water from the sources described below, such that no new analysis would be necessary to comply with CEQA for the purchase and recharge of water. Should water from other sources not suggested below be acquired for recharge, additional analysis may be required subject to the discretion of Rosedale and IRWD.

Metropolitan Water District

IRWD currently receives water supplies from MWD. Water is provided to IRWD through Municipal Water District of Orange County, the regional wholesale member agency of MWD. MWD sells water under a variety of terms and conditions and at different prices reflecting these conditions. For example water can be delivered to IRWD as either treated potable water or untreated raw water. Water may also be delivered as full service (firm) water or as discounted (surplus or interruptible) water for agricultural use or groundwater replenishment. MWD has also entered into a variety of cooperative delivery and storage conjunctive use arrangements with many of its member agencies who have groundwater storage assets.

IRWD could take delivery of this purchased water from MWD at Strand Ranch for storage and later conveyance to IRWD. Delivery would be made from the California Aqueduct via the CVC to the Strand Ranch. The delivery would be subject to supply and conveyance capacity availability and approval by MWD and KCWA for CVC conveyance capacity. IRWD could also purchase surplus water supplies when available from MWD for delivery at Strand Ranch.

State Water Project

DWR delivers water to 29 SWP contractors including 21 south of the Sacramento River Delta that are served from the California Aqueduct. SWP contractors can order water up to their entitlement under a given allocation set by DWR, even if the water is not needed in that year, and this excess water can be stored outside the contractor's place of service for future use. Under certain guidelines, DWR allows for the exchange of stored water. These arrangements would require coordination and approval through DWR, KCWA and MWD. SWP water available for recharge at Strand Ranch would be acquired and recharged only under conditions where no State Water Contractor would be adversely impacted.

Additionally, during wet hydrologic years, DWR may declare Article 21 water available, which is uncontrolled water that cannot be stored in State reservoirs. Article 21 supplies are available in short duration, and, if conveyance capacity exists, could be purchased and stored for future use. IRWD could purchase excess Article 21 water through a SWP Contractor for delivery to Strand Ranch when such water is available.

Pre-1914 Water Rights

Pre-1914 surface water rights are held by water districts and parties throughout California. Pre-1914 water rights are allowed for export and transfer to third parties as long as existing water users are not harmed. Much of this supply is available through reductions in use by fallowing or is surplus to the existing agency's needs during a period and can be transferred.

Central Valley Project

The Bureau of Reclamation makes excess non-storable Central Valley Project (CVP) water, (Section 215 flood water) available during wet years. If conveyance is available, this surplus CVP water could be delivered to Strand Ranch from the Friant-Kern Canal through the CVC.

High-Flow Kern River

Unregulated Kern River flows are high flow waters available during wet years when the U.S. Army Corps of Engineers (USACE) declares a high flow condition on the Kern River and conducts mandatory release of water from Isabella Reservoir. The Kern River Water Master is the administrative agency that records the amount of water released daily by the USACE from the Isabella Reservoir into the Kern River.[1] During periods of very high flow including periods of flooding, releases from the Isabella Reservoir may be available for diversion. Rosedale currently

1 Kern County Planning Department, Draft Kern River Valley Specific Plan, available on-line at: http://www.co.kern.ca.us/planning/pdfs/KRVSP/Chp1Introduction2.pdf. Accessed on September 17, 2007.

receives Kern River water when it is available for groundwater recharge through water service agreements with the City of Bakersfield. The reference to "high flow" Kern River water that may be available for IRWD under this project is intended to refer to Kern River water which is or becomes available to Rosedale after the demands of all Kern River interests have been met and the remaining water (1) is offered to all takers willing to sign a "Notice/Order"; or (2) is offered to the Kern River/California Aqueduct Intertie for disposal; or (3) is expected to flood farm acreage in the Buena Vista Lake; or (4) is expected to be delivered into the Kern River Flood Channel for disposal out-of-county. Only under these "high flow" conditions, the terms of the proposed project allow for Rosedale to utilize the Strand Ranch facilities for banking and recharge of high-flow water and for IRWD to receive one acre-foot for every five acre-feet banked. The availability of Kern River high-flow water as a water supply for the proposed project would be determined by hydrological conditions and the approval of the Kern River Water Master. Kern River high-flow water could be conveyed to Strand Ranch through the CVC. Existing rights and entitlements of others would not be affected.

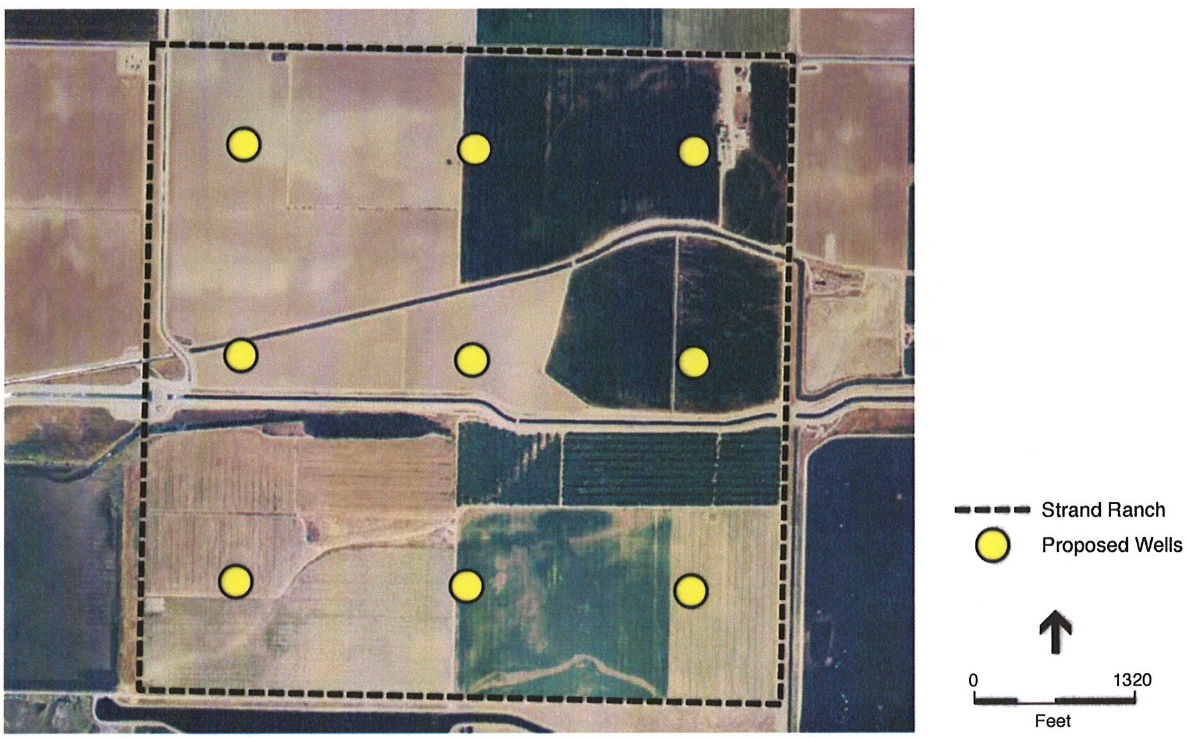
2.5.4 Recovery Facilities

The proposed project recovery facilities would be designed to limit impacts to wells pumping on adjacent properties. To recover up to 17,500 afy for IRWD, between five and eight wells would be constructed on the Strand Ranch. The wells would have 1/4 to 1/3 mile (1,320 to 1,760 feet) normal spacing. The wells would be located at a minimum of an 880-foot setback from the adjacent southern property line where the closest neighboring wells are located. **Figure 2-3** identifies potential well locations on Strand Ranch under each spacing scenario. Final specific locations would be determined in relation to final placement of recharge basins. In addition, the proposed project provides the flexibility for IRWD and Rosedale to pump from up to three additional wells within the Rosedale service area as shown on **Figure 2-4**. These wells would be joint-use wells providing recovery capacity for IRWD and for other obligations by Rosedale. Construction impacts of these wells have already been evaluated pursuant to CEQA as part of Rosedale's Negative Declaration for the GLC Water Banking and Recovery Program (Rosedale, 2003) (see Appendix C). Operational impacts to neighboring wells due to pumping at these Rosedale service area wells are discussed in this EIR. The proposed project would provide the flexibility to combine the use of the Strand Ranch wells and the Rosedale wells to meet pumping obligations within the imposed limits described in Section 2.8.1 below.

Each well would be designed to pump groundwater at a recovery rate of approximately five cubic feet per second (cfs). Actual recovery rates for each well may be slightly more or less based on aquifer conditions at each well site. If higher rates are achieved for the first few wells installed, fewer wells may be needed. Conversely, if 36 cfs is not achievable with eight wells, additional wells may be needed.

All production wells would be large-diameter (18 to 24 inches) steel-cased wells with completion intervals between depths of 250 to 750 feet below ground surface (bgs). Wellheads would consist of riser pipes, discharge pipes, wellhead motors, submersible pumps, and other appurtenances.

Potential ~~Proposed~~ Well Location with 1/4 mile spacing



Potential ~~Proposed~~ Well Location with 1/3 mile spacing

SOURCE: GlobeXplorer; ESA, 2007.

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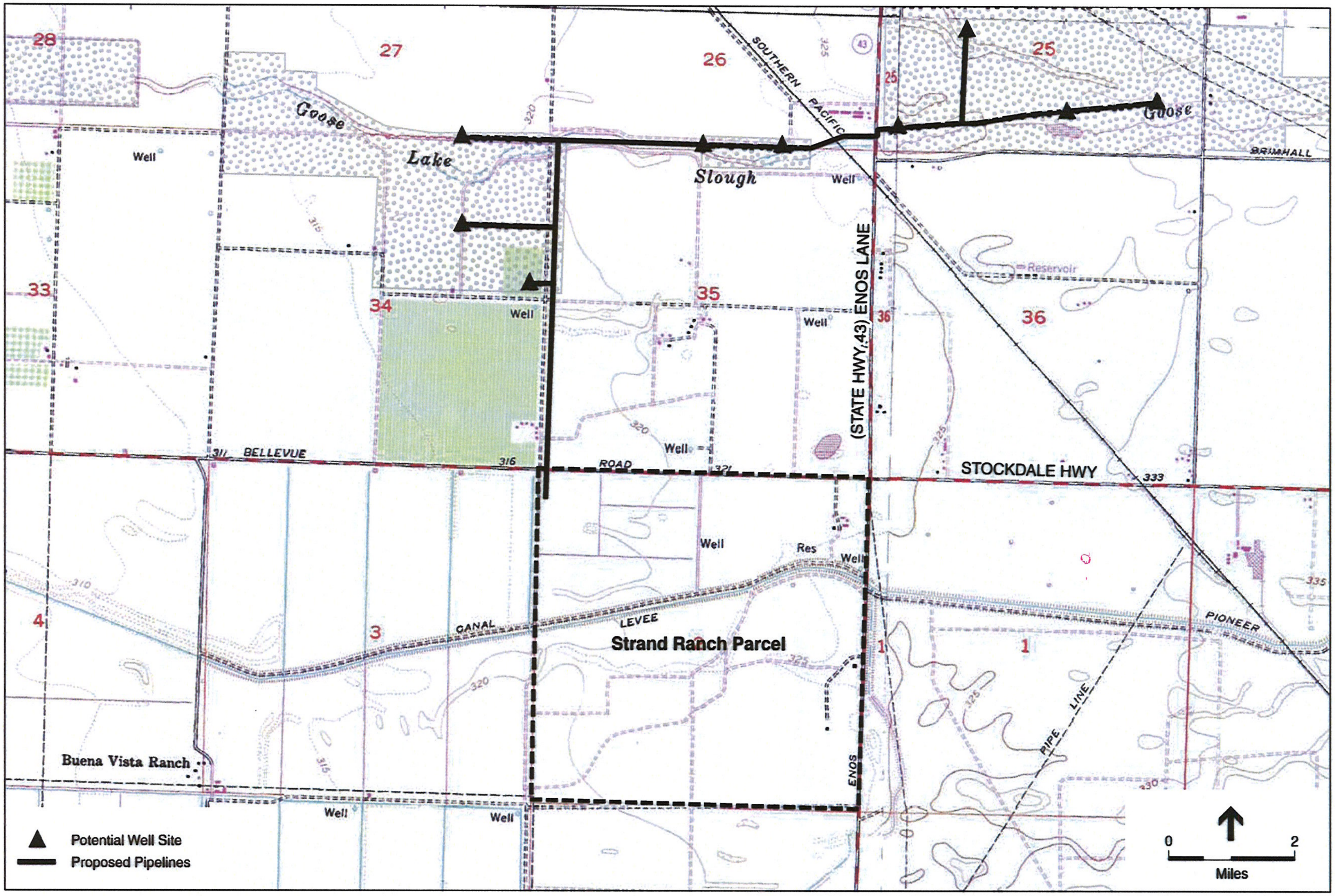
Figure 2-3
Strand Ranch Recovery Facilities



SOURCE: Boyle Engineering Corporation, 2007.

Irvine Ranch Water District . 205426

Figure 2-4
Rosedale Recovery Facilities

All production wells will be completed within a single zone, shallow or deep. The project does not propose any multi-zone production wells.

Wellheads would be protected by lockable, roofed, metal-mesh pumphouses that are approximately four feet in height and constructed on 12-foot square concrete pads. The five operable existing agricultural wells on the Strand Ranch property could be used as monitoring wells.

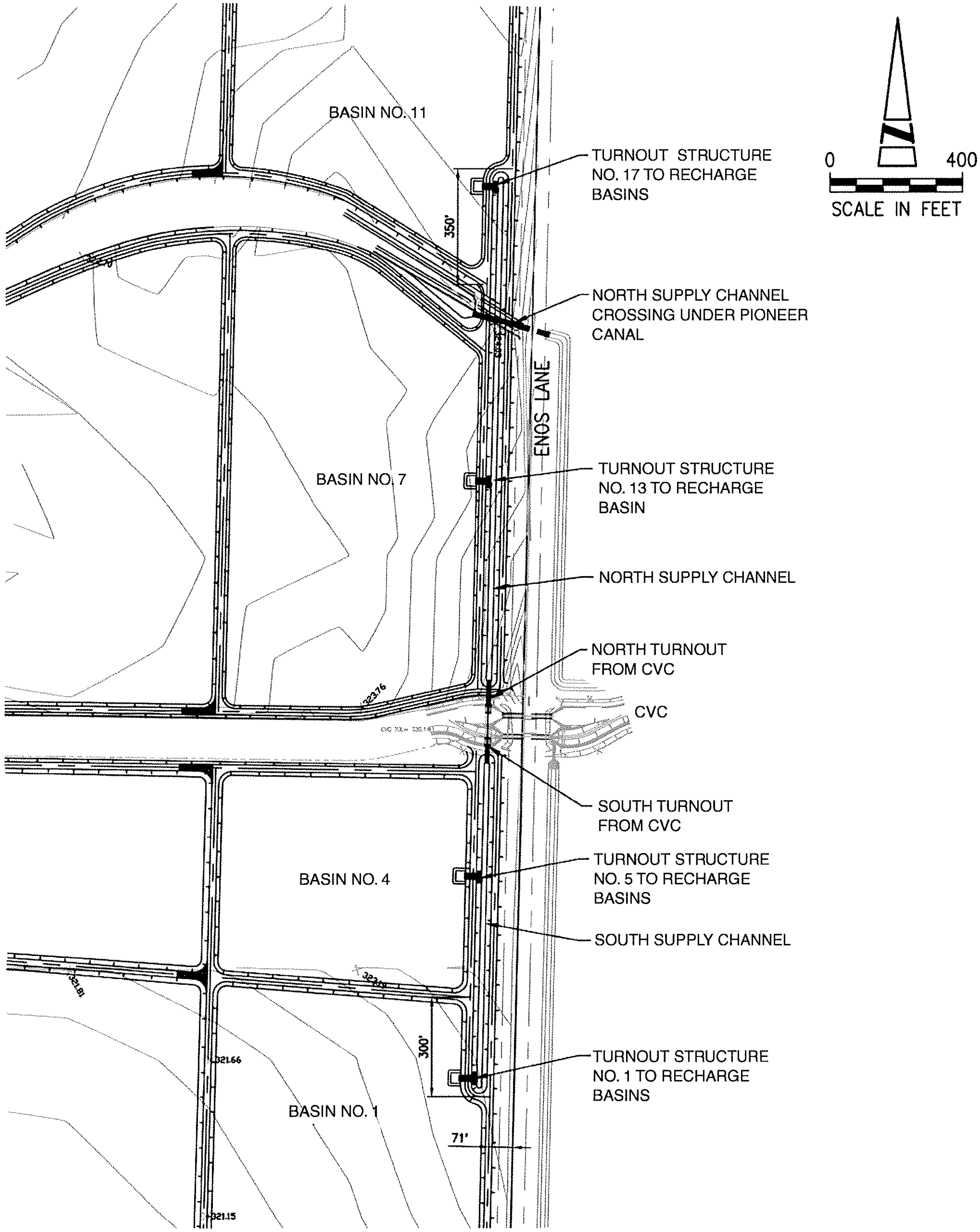
Alternatively, Rosedale could agree to an exchange of its SWP entitlement, or other water supplies available to Rosedale, to MWD and transfer that same portion of IRWD's banked water to Rosedale's account and thereby eliminate the need for any direct extraction and conveyance.

2.5.5 Conveyance Facilities

Water would be conveyed to Strand Ranch via the CVC. Two water supply channels would be constructed along the eastern edge of Strand Ranch, one north and one south of the CVC (Figure 2-2). These supply channels would occupy approximately four acres of Strand Ranch. Turnouts would be used to connect each water supply channel to the easternmost recharge basins north and south of the CVC (**Figure 2-5**). The north supply channel would cross under the Pioneer Canal through a culvert to avoid disturbance of the Pioneer Canal. The north and south supply channels would be connected to the CVC with turnouts as showed in Figure 2-5. These turnouts are not part of the proposed project because they have already been evaluated pursuant to CEQA as part of the Kern County Water Agency Cross Valley Canal Expansion Project EIR and Addendum (Kern County Water Agency, 2004b). These turnouts are not evaluated further in this EIR.

Groundwater recovered from the production wells on Strand Ranch would be conveyed to the CVC through new recovery pipelines that would be below ground running along the dirt roads and recharge basins, with exact locations subject to final well and basin placement. The recovery pipelines would connect to the CVC in at least two locations, one on the north side and one on the south side of the canal. Groundwater pumped into the CVC would be introduced into the California Aqueduct and would then be available for subsequent "wheeling" to IRWD through the California Aqueduct and the MWD distribution system in Orange County. Before introduction of pumped groundwater into the California Aqueduct, IRWD and Rosedale would comply with DWR's provisions for introduction of local water into the California Aqueduct and the then current water quality criteria in effect at the time of delivery. MWD would access water from the California Aqueduct at Lake Perris where it would be conveyed to MWD's Diemer Filtration Plant located north of Yorba Linda. The two major pipelines that deliver water from the filtration plant to the IRWD service area are the Allen McColloch Pipeline and the East Orange County Feeder No. 2 (see Figure 1-1).

Groundwater recovered from the proposed Rosedale production wells also would be conveyed to the CVC through new or existing pipelines for subsequent wheeling through the California Aqueduct or Friant-Kern Canal (see Figure 2-1). The new recovery pipelines would connect to the CVC through Rosedale's existing west in-take channel near the northwest corner of Strand Ranch



SOURCE: Boyle Engineering Corporation, 2006.

Irvine Ranch Water District . 205426

Figure 2-5
Strand Ranch Conveyance Facilities

(see Figure 2-1). These recovery pipelines have already been evaluated pursuant to CEQA as part of Rosedale's Negative Declaration for the GLC Water Banking and Recovery Program (Rosedale, 2003) (see Appendix C).

2.6 Construction

Construction of the proposed project would include the following phases: site clearing and demolition; excavation and backfill; construction of basins, conveyance channels and pipelines, and recovery facilities; and site restoration. Up to twenty five workers would be required on-site at one time to implement each construction phase. The staging areas, including construction parking, would be located on-site within the boundaries of Strand Ranch and Rosedale.

Prior to construction of project facilities, existing structures on Strand Ranch would be demolished, including the farm residence, storage shed, aboveground diesel tank, farm chemical storage trailer, and irrigation piping system. (See **Chapter 1**, **Introduction and Background**, for a description of existing conditions at Strand Ranch.) The Pioneer Canal, CVC, slough, and drill islands would be avoided during construction of recharge basins, recovery facilities, and on-site conveyance canals and pipelines. Demolition debris would be removed from the project site and transported to an appropriate landfill facility that accepts construction waste material.

Recharge basins would be constructed by excavating and contouring each basin up to five feet deep. The excavated soils would be used to form earthen berm walls to contain each basin. The basins would be connected by welded steel transfer structures with varying numbers of 42-inch diameter corrugated metal pipe (CMP) culverts. After construction is complete, recharge basins would be reseeded with native grasses.

The north and south supply channels would be constructed by excavating to a depth of approximately five feet below existing ground surface. The supply channels would be earthen channels, and turnout structures between the supply channels and recharge basins would consist of 42-inch CMP culverts. A culvert under the Pioneer Canal would be constructed to allow the north supply channel to cross the Pioneer Canal without impacting or disturbing it.

The recovery wells would be constructed with a standard drill rig. Well components would be installed and the immediate area graded for construction of the concrete pad. The aboveground wellheads and pumphouses would be installed and connected to nearby electric junction boxes. The recovery wells would be connected to a conveyance system of underground pipelines to deliver pumped groundwater to the CVC. Installation of the recovery well conveyance system would require trenching to a depth of about seven feet below existing ground surface.

The recharge basins and supply channels would be designed in an effort to balance earthwork on site, such that all excavated soils are redistributed and utilized to construct the project facilities, requiring no imported materials and leaving no excess materials. If excess soils are produced, they would be either sold or transported to an appropriate landfill facility.

2.6.1 Construction Equipment

Construction at Strand Ranch would involve site clearing, demolition, grading and excavation, site contouring, structural development, well drilling, and site restoration. Heavy construction could include the following equipment, to be determined by the construction contractor:

- Back hoes
- Front-end loaders
- 10-wheel dump trucks
- Cranes
- Compactor
- Water trucks
- Flat-back delivery truck
- Earth movers
- Bulldozers
- Excavators
- Drill rig

2.7 Project Construction Schedule

Construction of the proposed project is anticipated to begin in summer of 2008 and continue for approximately one year. The Strand Ranch site could be ready to receive water for recharge by summer of 2009, subject to variation of the construction schedule.

2.8 Operation and Maintenance of Facilities

2.8.1 Project Operation

Recharge Facilities

Rosedale would operate the recharge basins on Strand Ranch in a manner similar to the existing basins in Rosedale's Conjunctive Use Program. The recharge basins would be filled when water supplies become available, which could be highly variable from year to year, as evidenced by fluctuations in water deliveries to Rosedale's Conjunctive Use Program in the recent past. For example, in 2002, there were no water deliveries for banking in Rosedale's existing program, while in 2005, banking water deliveries totaled approximately 214,000 af (RRBWSD, 2007b). In years when water is available, it is estimated that active recharge operations would occur for three to four months. During times when high-flow Kern River water is available, or periods when IRWD is not utilizing the Strand Ranch recharge basins, or when IRWD has reached its maximum annual recharge of 17,500 af, Rosedale would be able to use the basins to recharge water for its own needs or for its other program partners.

The recharge basins and berms would be used for grazing for a minimum of eight months per year, in accordance with the Williamson Act contract for Strand Ranch and Kern County's Agricultural Standard Uniform Rules for agricultural preserves. Rosedale currently holds grazing leases for its existing recharge basins. Rosedale would either modify its existing grazing leases to include Strand Ranch or would develop a new grazing lease for Strand Ranch.

Recovery Facilities

The project would provide the flexibility for IRWD and Rosedale to pump from any combination of Strand Ranch wells and up to three additional wells within the Rosedale service area. Recovery operations from the Strand Ranch wells and project wells in Rosedale would be limited to a combined rate of 36 cfs with the following exception: Rosedale would have the ability to increase the combined rate of recovery to 40 cfs as required to meet mitigation requirements imposed by the MOU. As an example, this could occur in response to a request from a neighboring property to limit recovery operations on Strand Ranch to a certain period of time.

The proposed wells on Strand Ranch could be used by Rosedale when not needed by IRWD. Production from these wells for any purpose by IRWD and Rosedale would not exceed 17,500 afy. Extraction on the Strand Ranch by IRWD would also be limited to the amount previously recharged on the site by IRWD less losses as specified in the MOU. Extraction on the Strand Ranch by Rosedale would also be limited to the amount previously recharged by Rosedale in its service area less losses as specified in the MOU. Extraction from the proposed wells within the Rosedale service area for purposes other than IRWD would not exceed the amount previously recharged in the Rosedale service area to meet Rosedale's other obligations.

Conveyance Facilities

Water recovered from the proposed production wells would be conveyed via the CVC to the California Aqueduct and Friant-Kern Canal, for subsequent wheeling to IRWD and Rosedale's other program partners.

2.8.2 Maintenance

The recharge and recovery facilities would require maintenance similar to the existing basins in Rosedale. Rosedale would be responsible for the maintenance of all proposed facilities for the duration of the proposed project. Weed and pest control operations would be conducted as necessary, utilizing products approved for aquatic use in order to protect and preserve groundwater quality. Periodic earthwork operations would be required to maintain levees, enhance soil permeability, and remove vegetative growth.

2.9 Project Approvals

As Lead Agency, Rosedale may use this EIR to approve the proposed project, make Findings regarding identified impacts, and if necessary, adopt a Statement of Overriding Considerations regarding these impacts. The Rosedale Board of Directors has the authority to certify this EIR. This EIR evaluates the proposed project at the project level. The components of the proposed project, evaluated at the project level, would proceed upon certification of this EIR by the Rosedale Board. In addition, as a Responsible Agency, IRWD would have discretionary approval over the construction of facilities and operation of the project under the terms of a proposed cooperative agreement to be developed as stipulated in the banking project terms between

Rosedale and IRWD. IRWD would also consider the EIR prior to approving discretionary actions associated with implementing the project. Other approvals required may include the following:

- Regional Water Quality Control Board: Storm Water Pollution Prevention Plans (SWPPP)
- Department of Water Resources: approval for use of the California Aqueduct to convey water
- Kern County: approval for development within the Metropolitan Bakersfield Habitat Conservation Plan (MBHCP) area
- Kern County: approval of a General Plan Amendment to remove reservation of section and mid-section lines for use as arterial roads
- Kern County Water Agency: approval for use and modifications required to the Cross Valley Canal and a point-of-delivery agreement among DWR, KCWA, and other SWP contractors
- Kern County LAFCO: approval of annexation of Strand Ranch to Rosedale
- Metropolitan Water District of Southern California: approval to exchange and convey water

2.10 Alternatives

An EIR must describe a range of reasonable alternatives to the proposed project or alternative project locations that could feasibly attain most of the basic project objectives and would avoid or substantially lessen any of the significant environmental impacts to the proposed project. The alternatives analysis must include the "No Project Alternative" as a point of comparison. The No Project Alternative includes existing conditions and reasonably foreseeable future conditions that would exist if the proposed project were not approved (*CEQA Guidelines* §15126.6). CEQA also requires that an EIR identify an environmentally superior alternative (*CEQA Guidelines* §15126.6[e][2]). Alternatives examined are discussed below.

2.10.1 No Project Alternative

Under the No Project Alternative, Rosedale and IRWD would not implement the proposed project; there would be no construction of recharge, recovery or conveyance facilities. Under the No Project Alternative, IRWD's future water demands would continue to be met through the existing diversity of water supplies: groundwater, surface water, imported water, and recycled water. Without the proposed project, IRWD's water supply would be less reliable, redundant, and diverse. IRWD would be more vulnerable to water supply disruptions caused by drought or other catastrophic water supply interruptions due to infrastructure failures, Delta water supply reductions, or reductions in other imported water deliveries from MWD. During such water supply disruptions, IRWD may need to impose water restrictions under its Water Shortage Contingency Plan, which include mandatory demand reduction measures (UWMP, 2005).

Under the No Project Alternative, Rosedale would not have access to the recharge and recovery facilities proposed for Strand Ranch. Rosedale would be limited to the recharge capacity of its existing recharge basins.

2.10.2 Recharge Basin Location Alternative

Under the Recharge Basin Location Alternative, Rosedale and IRWD would identify alternative locations other than Strand Ranch to construct recharge basins. The Strand Ranch would not be annexed into the Rosedale service area. IRWD would purchase other property to be annexed by Rosedale. Conveyance and extraction facilities would be designed to accommodate the alternative location.

2.10.3 Injection Well Alternative

Under the Injection Well Alternative, Rosedale and IRWD would construct injection wells to recharge water into the groundwater basin rather than construct recharge basins on the surface. The other components of the project including conveyance and extraction facilities would be similar to the proposed project.

2.10.4 Alternatives Rejected from Further Consideration

Additional alternatives considered and rejected from further consideration by IRWD include development of local storage facilities in Orange County, enhanced conservation policies to be implemented during periods of drought, and increased use of recycled water to reduce potable water demands. These alternatives either did not meet the project objectives or were found to result in significant environmental impacts.

CHAPTER 3

Environmental Setting, Impacts, and Mitigation Measures

In compliance with Section 15126 of the California Environmental Quality Act (CEQA) *Guidelines*, **Chapter 3** provides an analysis of the environmental effects of the Strand Ranch Integrated Banking Project (proposed project) with respect to existing conditions at the time the Notice of Preparation (NOP) was published (**Appendix A**). The following environmental issue areas are assessed in this chapter:

- Aesthetics;
- Agriculture;
- Air Quality;
- Biological Resources;
- Cultural Resources;
- Geology, Soils and Mineral Resources;
- Hazards and Hazardous Materials;
- Hydrology, Groundwater Resources and Water Quality;
- Land Use, Planning and Recreation;
- Noise;
- Transportation and Traffic;
- Utilities and Public Services.

Each environmental issue area includes the following subsections:

- Environmental Setting;
- Regulatory Framework;
- Impacts and Mitigation Measures.

3.1 Aesthetics

3.1.1 Introduction

The purpose of this section is to analyze the potential aesthetics impacts that could occur with project implementation. The analysis identifies and evaluates key visual resources in the project area and determines the degree of visual impacts that could occur from proposed project implementation. The analysis also describes the potential aesthetic effects of the project on the existing landscape and built environment, focusing on the project's effects on scenic resources.

3.1.2 Environmental Setting

Regional Visual Setting

Regional views for the unincorporated area of Kern County are characterized by flat plains with low-density communities, water conveyance infrastructure, oil extraction facilities, and agricultural land. The nighttime lighting environment mainly consists of vehicle headlights and scattered street lighting from commercial, recreational, and residential development.

Project Site

The project site is located in a rural area. Surrounding land uses primarily consist of agriculture, road-side commercial zones, and low-density rural residential communities. The project site is used for agricultural production. Immediately adjacent land uses include agriculture and groundwater recharge basins. **Figure 3.1-1** provides views of the project site. The project site borders State Route 43. The project site is generally flat, as is the surrounding area. Current views from the project site are expansive areas of agricultural production. The project site is adjacent to land that is characterized by irrigated agricultural fields in active cultivation and recharge basins.

Views in all directions are dominated by flat expanses of agricultural land and oil recovery structures. Looking southwest, distant views of the Elk Hills are visible from the project site on clear days.

None of the roadways abutting the project site are considered scenic. Eligible State Scenic Highways within Kern County include State Route 58 (SR-58) between Mojave and Boron (70 miles from the project site), SR-41 (55 miles), SR-14, and State Highway 395 beginning north of Mojave and continuing to the Inyo County Line (65.84 miles), none of which are in the vicinity of the project site. The Kern County General Plan does not identify any scenic resources in the project vicinity.


Photo 1: View of Strand Ranch from northeast corner, looking southwest.


Photo 2: View of Strand Ranch from intersection of CVC and Highway 43, looking west.

SOURCE: ESA, 2007

Figure 3.1-1
Project Site Photos

3.1.3 Regulatory Framework

State

State Scenic Highway Program

The State Scenic Highway Program, created by the California Legislature in 1963, was established to preserve and protect scenic highway corridors from change that would diminish the aesthetic value of lands adjacent to highways. A highway is designated under this program when a local jurisdiction adopts a scenic corridor protection program, applies to the California Department of Transportation (Caltrans) for scenic highway approval, and receives notification from Caltrans that the highway has been designated as a Scenic Highway. When a city or county nominates an eligible scenic highway for official designation, it defines the scenic corridor, which is land generally adjacent to and visible to a motorist on the highway. Although there are eligible state scenic highways in Kern County, none are officially designated at this time.

Local

Kern County General Plan (June 2004)

The Kern County General Plan discusses specific goals and policies related to aesthetics and visual quality for areas within the Kern County area or its Sphere of Influence. The Kern County General Plan also has a Scenic Route Corridors Element that has been adopted. The following General Plan policies for visual resources and aesthetics are relevant to the proposed project:

1.10.7 Light and Glare

Policy 47: Ensure that light and glare from discretionary new development projects are minimized in rural as well as urban areas.

Policy 48: Encourage the use of low-glare lighting to minimize nighttime glare affects on neighboring properties.

1.10.8 Smart Growth

Policy 49: Discretionary development projects should be encouraged to incorporate innovative or "smart growth" land use planning techniques as design features, as follows:

- Aesthetically pleasing and unifying design features that promote a visually pleasing environment.

Scenic Route Corridors

Policy 1: Kern County should consider designating local scenic highway routes, where appropriate, throughout the County.

Metropolitan Bakersfield General Plan Update EIR (June 2002)

The Metropolitan Bakersfield General Plan Update EIR discusses specific issues related to aesthetics and visual quality for areas within the Metropolitan Bakersfield area or its Sphere of Influence. The General Plan EIR also contains a specific section that discusses the existing scenic resources located in the area. Although no scenic resources are located within the project vicinity, the General Plan EIR mentions the following scenic resources within the Metropolitan Bakersfield area:

- Kern River Corridor,
- the area east of Lake Ming north of the Kern River Corridor,
- the area along Highway 178 south of the Kern River Corridor
- the area near and surrounding Lake Ming,
- the area located north of Alfred Harrell Highway at the western end of Kern County River Park
- the scenic vantage points along Comanche Drive, south of Highway 178
- the east-west portion of Alfred Harrell Highway, south of Lake Ming
- the north-south portion of Alfred Harrell Highway, north of Highway 178, and
- The Highway 178, west of Alfred Harrell Highway.

Metropolitan Bakersfield General Plan (December 2002)

The Metropolitan Bakersfield General Plan discusses specific goals or policies related to aesthetics and visual quality for areas within the Metropolitan Bakersfield area or its Sphere of Influence. The General Plan also contains a specific section that discusses the existing scenic resources located in the area. The following General Plan policies for visual resources and aesthetics are relevant to the proposed project:

Policy 1: Promote the establishment, maintenance, and protection of the planning area's open space resources, including the following:

(a) Conservation of natural resources

- Kern River Corridor
- Management of hillsides

(b) Managed production of resources

- Agriculture
- Oil production

(c) Outdoor Recreation

- Parks
- Kern River Corridor

Policy 7: Consider the use of groundwater recharge lands for recreation, habitat, and alternate resource uses.

3.1.4 Project Impacts and Mitigation Measures

Significance Criteria

The *CEQA Guidelines* Appendix G provides guidance for assessing the significance of potential environmental impacts. Relative to aesthetic resources, a project will normally have a significant effect on the environment if it will:

- Have a substantial adverse effect on a scenic vista;
- Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway;
- Substantially degrade the existing visual character or quality of the site and its surroundings; or
- Create a new source of substantial light or glare, which would adversely affect day or nighttime views in the area.

Impacts Discussion

The Strand Ranch is not located within a designated scenic vista or scenic highway corridor, so no impacts to these scenic resources would result from the project. Furthermore, the project would eliminate lights currently in place on the farm buildings, reducing the potential for light and glare to be generated at the property. No additional lights or structures that would create glare are proposed.

Impact 3.1-1: The proposed project would alter the existing visual character of the site. Less than Significant

The proposed project would occur in an area dominated by agricultural land uses. Groundwater recharge projects, similar to the proposed project, have been implemented on neighboring properties to the south. The property is currently used for agriculture and contains several almond orchards. The proposed project would replace the orchards and crop fields with 20 recharge basins of varying shape, size, and depth, and up to eight recovery wells. The basins would be formed by excavating and contouring each basin to the desired depth and using excavated soils to form an earthen berm wall. The berms would be up to six feet in height and would be reseeded with native grasses to blend the berms into the surrounding landscape and make them available for grazing. The recovery wells would have aboveground wellheads protected by metal-mesh pumphouses that would be approximately four feet in height.

The proposed project would modify immediate views of the property by removing the orchard and farming structures. However, the recharge basins would be consistent with similar recharge facilities south of the project site. The character of the site would be similar to surrounding land uses. Pumphouses and wells are already present and in use on Strand Ranch and surrounding properties for agricultural irrigation and groundwater banking. The orchards and other crops would be replaced by graded recharge basins characterized by native grasses that are flooded for portions of the year and used for grazing otherwise. There are no land uses in the area that would be adversely affected by this local view disruption. The recharge basins and pumphouses would not affect long range views from surrounding properties. The visual character of the site and surroundings would not be substantially degraded by converting the land use on Strand Ranch from agriculture to groundwater recharge and annexing the property into Rosedale. Construction of recharge basins and pumphouses would not result in significant impacts to local or regional aesthetics.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

3.2 Agricultural Resources

This section describes the environmental setting for agricultural resources, summarizes the applicable regulatory framework, and identifies impacts to agricultural resources that could occur as a result of implementation of the proposed project.

3.2.1 Setting

Existing Conditions

Regional

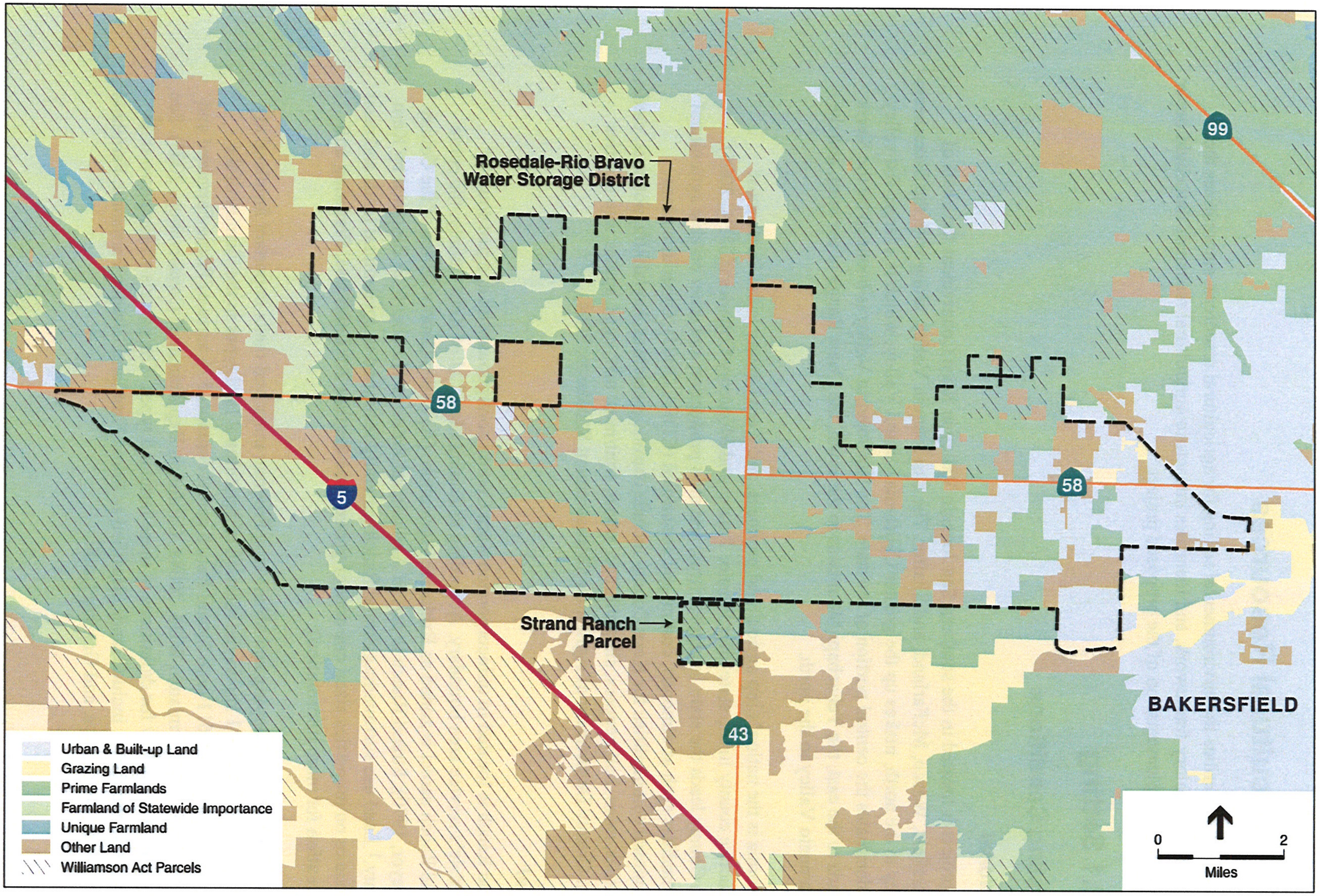
The project is located in the southern San Joaquin Valley in Kern County near the cities of Bakersfield, Wasco, McFarland, and Shafter. The San Joaquin Valley, along with the Sacramento Valley to the north, makes up the greater California Central Valley, which is a large, flat valley that dominates the central portion of the state. The San Joaquin Valley is bounded by the Sierra Nevada to the east, the Tehachapi Mountains to the south, the Coast Range to the west, and the Sacramento Valley to the north.

California is the nation's top agricultural producer, and Kern County is the fourth most productive county in the state after Fresno, Tulare, and Monterey Counties (CDFA, 2005). Kern County leads the state in grape, citrus, and milk production and other notable agricultural commodities such as almonds, cotton, and cottonseed (CDFA, 2005). Other important agricultural commodities for Kern County include carrots, pistachios, hay/alfalfa, potatoes, cattle, tomatoes, roses, bell peppers, silage/forage, wheat, fruit/nuts, turf, eggs, apples, and cherries (Kern County Department of Agriculture/Measurement Standards, 2004).

Local

Strand Ranch is located in unincorporated Kern County contiguous with and just south of Rosedale's service area boundary. According to Zoning Map 121 of Kern County, the entire Strand Ranch parcel is zoned as Exclusive Agriculture (A) (Kern County Office of the County Surveyor, 1970). Strand Ranch is part of Agricultural Preserve Number 9, as designed by Kern County.[1] Land use surrounding Strand Ranch generally is limited to agricultural lands and rural residences on properties sized one acre or greater (see **Section 3.9 Land Use, Planning and Recreation** for more information).

The state Farmland Mapping and Monitoring Program maps and ranks important farmland in California. **Figure 3.2-1** shows the location of agricultural land types in the vicinity of the proposed project. The 611-acre Strand Ranch parcel contains 576 acres of Prime Farmland and 35 acres of Unique Farmland (WDS, 2004a; California Department of Conservation, 2005). See Subsection 3.2.2 below for definitions of these farmland types. The parcels within a two-mile radius of Strand Ranch include lands classified as Prime Farmland, Unique Farmland, Farmland of Statewide Importance, and Grazing Land.



SOURCE: State of California Department of Conservation Division of Land Resource Protection, 2004.

Irvine Ranch Water District . 205426

Figure 3.2-1
Agricultural Lands

The California Land Conservation Act (Williamson Act) is designed to preserve agricultural and open space lands by discouraging their premature and unnecessary conversion to urban uses. The entirety of Strand Ranch is contracted as an agricultural preserve under the Williamson Act (CDC, 2005). **Figure 3.2-1** shows farmland resources enrolled under the Williamson Act in the vicinity of the project area. Various parcels within two miles of Strand Ranch also are contracted as agricultural preserves under the Williamson Act.

3.2.2 Regulatory Framework

State

California Farmland Mapping and Monitoring Program

The California Department of Conservation (CDC), under the Division of Land Resource Protection, has established the Farmland Mapping and Monitoring Program (FMMP). The FMMP monitors the conversion of the state's farmland to and from agricultural use. The map series identifies eight classifications and uses a minimum mapping unit size of 10 acres. The FMMP also produces a biannual report on the amount of land converted from agricultural to non-agricultural use. The FMMP maintains an inventory of state agricultural land and updates its "Important Farmland Series Maps" every two years (CDC, 2007). Important farmlands are divided into the following five categories based on their suitability for agriculture.

- **Prime Farmland.** Prime Farmland is land with the best combination of physical and chemical characteristics able to sustain long-term production of agricultural crops. This land has produced irrigated crops at some time within the four years prior to the mapping date.
- **Farmland of Statewide Importance.** Farmland of Statewide Importance is land that meets the criteria for Prime Farmland but with minor shortcomings such as greater slopes or lesser soil moisture capacity.
- **Unique Farmland.** Unique Farmland has even lesser quality soils and produces the state's leading agricultural crops. This land is usually irrigated but also includes non-irrigated orchards and vineyards.
- **Farmland of Local Importance.** Farmland of Local Importance is land that is important to the local agricultural economy as determined by each county's board of supervisors and a local advisory committee.
- **Grazing Land.** Grazing Land is land on which the existing vegetation is suited to the grazing of livestock.

Williamson Act

The California Land Conservation Act of 1965, also known as the Williamson Act, is designed to preserve agricultural and open space lands by discouraging their premature and unnecessary conversion to urban uses. Williamson Act contracts, also known as agricultural preserves, create an arrangement whereby private landowners contract with counties and cities to voluntarily restrict their land to agricultural and compatible open-space uses. The vehicle for these agreements is a rolling term 10-year contract.[2] In return, restricted parcels are assessed for tax purposes at a rate consistent with their actual use, rather then potential market value. To cancel a Williamson Act contract, either the local government or the landowner can initiate the nonrenewal process. A "notice of nonrenewal" starts a 9-year nonrenewal period. During the nonrenewal process, the annual tax assessment gradually increases. At the end of the 9-year nonrenewal period, the contract is terminated. Contracts renew automatically every year unless the nonrenewal process is initiated. Williamson Act contracts can be divided into the following categories: Prime Agricultural Land, Non-Prime Agricultural Land, Open Space Easement, Built Up Land, and Agricultural Land in Non-Renewal.

The Williamson Act states that a board or council by resolution shall adopt rules governing the administration of agricultural preserves. The rules of each agricultural preserve specify the uses allowed. Generally, any commercial agricultural use will be permitted within any agricultural preserve. In addition, local governments may identify compatible uses permitted with a use permit. As described below, the Kern County Planning Department has adopted its own rules governing agricultural preserves and compatible uses.

Local

Kern County Agricultural Preserve Standard Uniform Rules

The Kern County Planning Department has adopted *Agricultural Preserve Standard Uniform Rules*, which identify land uses that are compatible within agricultural preserves established under the Williamson Act (Kern County Planning Department, 2007). The rules are designed to restrict land uses to those compatible with agriculture, including crop cultivation, livestock breeding, grazing operations, and dairies. In addition, some non-agricultural land uses are considered compatible, including public utilities facilities (e.g., gas, electric, communication, water) and groundwater recharge facilities as follows:

- Water recharge facilities, as defined in Section 51201(b), Public Resources Code, when either:
    - The affected land will continue to be used for commercial agricultural purposes for a minimum of eight (8) months out of each twelve (12) month period; or,
    - The Land Use Contract is amended by the Board of Supervisors to allow water recharge as the primary purpose of an "open space" contract, as provided for in Section 51201, Public Resources Code. (Kern County Planning Department, 2007).

Kern County General Plan

The *Kern County General Plan* (County General Plan) states that agriculture is vital to the future of Kern County and sets the goals, policies, and procedures of protecting important agricultural lands for future use and to prevent conversion of prime farmland to other uses (Kern County

2 Information about the basic provisions of Williamson Act contracts can be found on the California Department of Conservation, Division of Land Resource Protection web site: http://www.consrv.ca.gov/DLRP/lca/basic_contract_provisions/index.htm, accessed June 22, 2007.

Planning Department, 2004a). Currently Strand Ranch is designated as Intensive Agriculture (Map Code 8.1) by the County General Plan (Kern County Planning Department, 2004a). According to the County General Plan, permitted uses under this designation include water storage and groundwater recharge acres and facilities (Kern County Planning Department, 2004a). Within the Land Use, Open Space, and Conservation Element Resource Section of the County General Plan, there are goals, policies, and implementation measures that are applicable to the proposed project regarding agricultural resources:

- **Goal 1:** To contain new development within an area large enough to meet generous projections of foreseeable need, but in locations which will not impair the economic strength derived from the petroleum, agriculture, rangeland, or mineral resources, or diminish the other amenities which exist in the County.
- **Goal 2:** Protect areas of important mineral, petroleum, and agricultural resource potential for future use.
- **Goal 5:** Conserve prime agriculture lands from premature conversion.
- **Policy 7:** Areas designated for agricultural use, which include Class I and II and other enhanced agricultural soils with surface delivery water systems, should be protected from incompatible residential, commercial, and industrial subdivision and development activities.
- **Policy 10:** To encourage effective groundwater resource management for the long-term economic benefit of the County the following shall be considered:
    - Promote groundwater recharge activities in various zone districts.
    - Support the development of future sources of additional surface water and groundwater, including conjunctive use, recycled water, conservation, additional storage of surface water and groundwater and desalination.
- **Implementation Measure C:** The County Planning Department will seek review and comment from the County Engineering and Survey Services Department on the implementation of the National Pollution Discharge Elimination System for all discretionary projects.
- **Implementation Measure F:** Prime agricultural lands, according to the Kern County Interim-Important Farmland 2000 map produced by the Department of Conservation, which have Class I or II soils and a surface delivery water system shall be conserved through the use of agricultural zoning with minimum parcel size provisions.

Metropolitan Bakersfield General Plan

The Strand Ranch parcel is also located within the area governed by the *Metropolitan Bakersfield General Plan* (Bakersfield General Plan) (City of Bakersfield and Kern County, 2002). Within the Conservation Element Soils and Agriculture Section of the Bakersfield General Plan, there is a goal, policies, and an implementation measure that are applicable to the proposed project regarding agricultural resources:

- **<u>Goal 1</u>:** Provide for the planned management, conservation, and wise utilization of agricultural land in the planning area.
- **<u>Policy 3</u>:** Protect areas designated for agricultural use, which include Class I and II agricultural soils having surface delivery water systems, from the encroachment of residential and commercial subdivision development activities.
- **<u>Policy 14</u>:** When considering proposals to convert designated agricultural lands to non-agricultural use, the decision-making body of the City or County shall evaluate the following factors to determine the appropriateness of the proposal:
  - Soil Quality;
  - Availability of irrigation water;
  - Proximity to non-agricultural uses;
  - Proximity of intensive parcelization;
  - Effect on properties subject to "Williamson Act" land use contracts;
  - Ability to be provided with urban services (sewer, water, roads, etc.);
  - Ability to affect the application of agricultural chemicals on nearby agricultural properties;
  - Ability to create a precedent-setting situation that leads to the premature conversion of prime agricultural lands;
  - Demonstrated project need; and
  - Necessity of buffers as lower densities, setbacks, etc.
- **<u>Implementation 2</u>:** Evaluate discretionary projects for their impact on agricultural resources.

3.2.3 Project Impacts and Mitigation Measures

Significance Criteria

Based on the *CEQA Guidelines,* a project may be deemed to have a significant effect on the environment with respect to agricultural resources if it would:

- Convert Prime Farmland, or Farmland of Statewide Importance, as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use;
- Conflict with existing zoning for agricultural use, or a Williamson Act contract; and/or
- Involve other changes in the existing environment which, due to their location or nature, could result in the conversion of Farmland, to non-agricultural use.

Impacts Discussion

The Strand Ranch is zoned as Exclusive Agriculture, which includes groundwater recharge facilities as a permitted use (County Zoning Ordinance, Section 19.12.020 (F)). The entire Strand Ranch is within a County-designated agricultural preserve and considered Prime Agricultural Land under an existing Williamson Act contract. The proposed project would convert 502 acres of existing farmland to recharge facilities that would be made available for organic farming or livestock grazing for a minimum of eight months per year. The remaining 36 acres affected by the proposed project would convert existing farmland to non-agricultural use to support the recharge facilities.

Converting farmland covered under a Williamson Act contract to non-compatible uses would require submittal of a Notice of Nonrenewal that initiates a nine-year period prior to the cancellation of the contract. However, Kern County's *Agricultural Preserve Standard Uniform Rules* states that groundwater recharge operations are compatible land uses on agricultural preserves if the preserve is used for commercial agriculture for at least eight months out of a twelve month period (Kern County Planning Department, 2007). Organic farming and livestock grazing are considered compatible agricultural uses. Therefore, the proposed project would be considered compatible with the existing Williamson Act contract for the Strand Ranch. IRWD would not be required to initiate the nonrenewal process.

The proposed recovery wells, supply channels, and dirt roadways would occupy 36 acres (seven percent) of the 538 acres affected by the proposed project. The conversion of farmland for ancillary infrastructure would be considered less than significant by Kern County.[3] No impact to the Williamson Act contract would result from the proposed project.

Impact 3.2-1: The proposed project would convert Prime Farmland and Unique Farmland to non-agricultural use. Less than Significant.

The proposed project would affect 538 acres of the 611 acres that comprise Strand Ranch. No new buildings would be constructed on the property. The proposed project is compatible with land use on surrounding properties, which is primarily agriculture and groundwater recharge.

The proposed recharge basins and berms would affect 502 acres of existing farmland, or approximately 93 percent of the area affected by the proposed project. The basins and berms would be reseeded with native grasses and vegetation and would be made available for organic farming or livestock grazing for at least eight months each year. Kern County's *Agricultural Preserve Standard Uniform Rules* for uses of agricultural preserves considers farming or grazing for a minimum of eight months per year to be compatible agricultural uses for groundwater recharge facilities. Therefore, implementation of the proposed project would not result in the conversion of Prime and Unique Farmland to non-agricultural use.

The proposed project would support agricultural resources in the region through groundwater recharge. The proposed project would be compatible with the goals and policies of the

[3] Lorelie Oviatt, Kern County Planning Department. Personal Communication. September 24, 2007.

Kern County General Plan for protecting agricultural resources through the beneficial use of percolation basins and would reduce the potential for Strand Ranch to be converted to residential, commercial, and industrial uses. The proposed project would not indirectly induce further loss of farmland in the project area, as is typical of projects that convert agricultural lands to residential or commercial land uses.

The proposed project also would support agriculture in the Kern Fan area by preventing future overdraft conditions in the underlying groundwater basin. Currently, Strand Ranch is not part of a water storage district. Water has been extracted from agricultural wells on Strand Ranch by previous land owners but not actively replenished. As described in **Chapter 1, Introduction**, IRWD has corrected any overdraft conditions due to historical groundwater extraction on Strand Ranch with its Interim Recharge Project. The proposed project would annex Strand Ranch into Rosedale's service area and eliminate agricultural extractions that in the past have contributed to overdraft of the groundwater basin. Implementing a banking program requires that water be recharged and stored prior to extraction. The proposed project would result in less than significant impacts to agricultural land uses.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

3.3 Air Quality

This section addresses the impacts of the proposed project on ambient air quality and the exposure of people, especially sensitive individuals, to unhealthful pollutant concentrations, including the type and quantity of emissions that would be generated by the construction and operation of the proposed project. The analysis of project emissions focuses on whether the project would cause an exceedance of a State or National ambient air quality standard or an exceedance of a threshold set forth by the San Joaquin Valley Air Pollution Control District (SJVAPCD).

3.3.1 Setting

Regional Climate

The project site lies within the San Joaquin Valley Air Basin (Basin), a flat area bordered on the east by the Sierra Nevada Mountains; on the west by the Coast Ranges; and to the south by the Tehachapi Mountains. The region's topographic features restrict air movement through and out of the Basin. As a result, the Basin is highly susceptible to pollutant accumulation over time (SJVAPCD, 2002). Frequent transport of pollutants into the Basin from upwind sources also contributes to poor air quality.

Wind speed and direction play an important role in dispersion and transport of air pollutants. During the summer, winds usually originate out of the north end of the San Joaquin Valley and flow in a south-southeasterly direction through the San Joaquin Valley, through Tehachapi Pass, and into the neighboring Southeast Desert Air Basin. During the winter, light winds occasionally originate from the south end of the San Joaquin Valley and flow in a north-northwesterly direction.

The Basin has an "inland Mediterranean" climate that is characterized by warm, dry summers and cooler winters. Summer high temperatures often exceed 100 degrees Fahrenheit, averaging from the low 90s in the northern part of the valley to the high 90s in the south. The daily summer temperature variation can be as high as 30 degrees Fahrenheit or more. Winters are for the most part mild and humid. Average high temperatures during the winter are in the 50s, while the average daily low temperature is about 45 degrees Fahrenheit. For Kern County in particular, the average maximum temperature reaches the upper 90s in the summer months and around 56 degrees during winter, while the average minimum temperature ranges from about 65 degrees in the summer to 35 degrees in the winter (Western Regional Climate Center, 2005). Precipitation within the San Joaquin Valley is confined primarily to winter months with some also occurring in late summer and fall. Precipitation within the San Joaquin Valley also decreases from north to south. Kern County receives approximately 6.81 inches precipitation annually with the most rainfall occurring during the winter (Western Regional Climate Center, 2005).

The vertical dispersion of air pollutants in the San Joaquin Valley is limited by the presence of persistent temperature inversions. Air temperatures usually decrease with an increase in altitude. A reversal of this atmospheric state, where the air temperature increases with height, is termed an *inversion*. Air above and below an inversion does not mix because of differences in air density. Inversions in the San Joaquin Valley can restrict air pollutant dispersal.

San Joaquin County's major air quality problems occur from late spring through early winter. From May to October high ozone levels are a recurring problem due to the region's intense heat and sunlight. Pollution problems also occur from October through January due to frequent strong temperature inversions, which trap pollutants near the earth's surface. These stagnant air conditions can last for weeks at a time. During these periods, carbon monoxide (CO) levels rise. The presence of visibility-reducing particulates is a problem for much of the year. Dust from spring winds and agricultural operations, including agricultural burning, account for most of the area's particulates.

Local Air Quality Conditions

The SJVAPCD maintains a network of air quality monitoring stations located throughout the Basin. The monitoring stations record concentrations of various pollutants including: Ozone; CO; nitrogen dioxide (NO_2); sulfur dioxide (SO_2); particulate matter less than 10 microns in diameter (PM-10); particulate matter less than 2.5 microns in diameter (PM-2.5); lead (Pb); and sulfates (SO_4). **Table 3.3-1** summarizes the State and Federal standards as well as the health effects and sources of the criteria pollutants.

The SJVAPCD operates a regional monitoring network that measures the ambient concentrations of the six criteria pollutants. Existing and probable future levels of air quality in the project area can generally be inferred from ambient air quality measurements conducted by the SJVAPCD. The station closest to and most representative of air quality conditions at the project site is at 578 Walker Street in Shafter. This monitoring site is approximately ten miles south of the Strand Ranch property. The nearest monitoring station for PM-10 and PM-2.5 is located in Bakersfield at 5558 California Avenue, approximately 29 miles southeast of the Strand Ranch property. As PM is a localized pollutant, data from the California Avenue station would not be representative of concentrations in the Strand Ranch project area. Besides, the California Avenue station is located within an urban area unlike the project area, which is rural in nature. **Table 3.3-2** shows a five-year summary of air pollutant (concentration) data for ozone and includes a comparison to the State and national air quality standards.

As shown in Table 3.3-2, both the 1-hour ozone State standard and 8-hour national standard were exceeded multiple times from 2002 to 2006. Though the 8-hour ozone standard did not become effective until early 2006, monitored concentrations exceeded the 8-hour ozone standard multiple times from 2002 to 2006.

Sensitive Receptors

Some people are especially sensitive to air pollution emissions and should be given special consideration when evaluating air quality impacts from projects. Sensitive receptors are facilities that house or attract children, the elderly, and people with illnesses or others who are especially

TABLE 3.3-1
AMBIENT AIR QUALITY STANDARDS FOR CRITERIA POLLUTANTS

Pollutant	Averaging Time	California Standard	Federal Standard	Pollutant Health and Atmospheric Effects	Major Pollutant Sources
Ozone (O_3)	1 hour 8 hours	0.09 ppm 0.07 pp	--- 0.08 ppm	High concentrations can directly affect lungs, causing irritation. Long-term exposure may cause damage to lung tissue.	Motor vehicles.
Carbon Monoxide (CO)	1 hour 8 hours	20 ppm 9 ppm	35 ppm 9 ppm	Classified as a chemical asphyxiant, CO interferes with the transfer of fresh oxygen to the blood and deprives sensitive tissues of oxygen.	Internal combustion engines, primarily gasoline-powered motor vehicles.
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean 1 hour	0.03 ppm 0.18 ppm	0.053 ppm ---	Irritating to eyes and respiratory tract. Colors atmosphere reddish-brown.	Motor vehicles, petroleum refining operations, industrial sources, aircraft, ships, and railroads.
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean 3 hour 1 hours 24 hours	--- --- 0.25 ppm 0.04 ppm	0.03 ppm 0.50 ppm --- 0.14 ppm	Irritates upper respiratory tract; injurious to lung tissue. Can yellow the leaves of plants, destructive to marble, iron, and steel. Limits visibility and reduces sunlight.	Fuel combustion, chemical plants, sulfur recovery plants, and metal processing.
Suspended Particulate Matter (PM-10)	Annual Arithmetic Mean 24 hours	20 μg/m³ 50 μg/m³	--- 150 μg/m³	May irritate eyes and respiratory tract, decreases in lung capacity, cancer and increased mortality. Produces haze and limits visibility.	Dust and fume-producing industrial and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g. wind-raised dust and ocean sprays).
Fine Particulate Matter (PM-2.5)	Annual Arithmetic Mean 24 hours	12 μg/m³ ---	15 μg/m³ 35 μg/m³	May irritate eyes and respiratory tract, decreases in lung capacity, cancer and increased mortality. Produces haze and limits visibility.	Dust and fume-producing industrial and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g. wind-raised dust and ocean sprays).
Lead (P_b)	Monthly Quarterly	1.5 μg/m³ ---	--- 1.5 μg/m³	Disturbs gastrointestinal system, and causes anemia, kidney disease, and neuromuscular and neurologic dysfunction (in severe cases).	Present source: lead smelters, battery manufacturing & recycling facilities. Past source: combustion of leaded gasoline.
Sulfates (SO_4)	24 hours	25 μg/m³	---	Decrease in ventilatory functions; aggravation of asthmatic symptoms; aggravation of cardio-pulmonary disease; vegetation damage; degradation of visibility; property damage.	Industrial processes.

ppm parts per million
μg/m³ micorgrams per cubic meter

SOURCE: CARB, 2007.

TABLE 3.3-2
PROJECT AREA AIR POLLUTANT SUMMARY, 2000-2006

Pollutant	Standard	2002	2003	2004	2005	2006
Ozone (O_3)						
Highest 1-hr average, ppm	0.09	0.112	0.121	0.1	0.104	0.106
Number of Days above State standard		22	18	3	14	20
Highest 8-hr average, ppm	0.08	0.1	0.104	0.092	0.096	0.099
Number of Days above National Standard		25	15	3	15	23

NOTE: Underlined values indicate an excess of applicable standard.
ppm - parts per million.
$\mu g/m^3$ - micrograms per cubic meter.

SOURCE: CARB, *Air Quality Data Summaries*, 2006.

sensitive to the effects of air pollutants. Hospitals, schools, convalescent facilities, and residential areas are examples of sensitive receptors (SJVAPCD, 2002). The project site is located in a rural area characterized by agriculture uses. There are few sensitive land uses in the vicinity of the proposed project. There is a cluster of residences and a pet boarding facility on Stockdale Highway, just east of Enos Lane. There are no schools, churches, hospitals, police or fire stations, within a three mile radius of Strand Ranch. The closest school is Rio Bravo Greely School, which is approximately 4.5 miles north of Strand Ranch. The closest church is Rosedale Baptist Church, which is approximately 3 miles northeast of Strand Ranch. The closest police and emergency services are in the City of Bakersfield, over 10 miles west of Strand Ranch.

3.3.2 Regulatory Framework

Federal

The Federal Clean Air Act (CAA) is a comprehensive Federal law that regulates air emissions from area, stationary, and mobile sources. This law authorizes the United States Environmental Protection Agency (USEPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. The CAA was passed in 1963, and has since undergone five major amendment cycles. The latest major amendment cycle was completed in 1990, with prior major amendments having occurred in 1966, 1970, and 1977.

The USEPA identifies six "criteria pollutants" as indicators of air quality and has established for each of them a maximum concentration level (i.e., NAAQS) above which adverse effects on human health may occur. These six criteria pollutants are CO, ozone, SO_2, NO_2, inhalable particulate matter (PM-10 and PM-2.5), and lead. Federal standards for these criteria pollutants are displayed in Table 3.3-1. The CAA also requires that air basins or portions thereof, be classified as either "attainment" or "nonattainment" for each criteria air pollutant, based on whether or not the NAAQS have been achieved, specifies future dates for achieving compliance with the NAAQS and mandates that states submit and implement a State Implementation Plan (SIP) for nonattainment areas. These plans must include pollution control measures that demonstrate how the standards will be met.

The San Joaquin Valley Air Basin has been designated a federal non-attainment area for eight-hour ozone, PM-10, and PM-2.5.

State

Criteria Pollutants

In 1988, the State legislature passed the California CAA, which established California's air quality goals, planning mechanisms, regulatory strategies, and standards of progress for the first time. The California CAA provides the State with a comprehensive framework for air quality planning regulation and sets State air quality standards. The California Ambient Air Quality Standards (CAAQS) incorporate additional standards for most of the criteria pollutants and has set standards for other pollutants recognized by the State. In general, the State standards are more health protective than the Federal standards. California has also set standards for PM-2.5, sulfates, hydrogen sulfide, vinyl chloride, and visibility-reducing particles. State standards are displayed in **Table 3.3-1.** The California CAA also requires that air basins or portions thereof, be classified as either "attainment" or "nonattainment" for each criteria air pollutant, based on whether or not the CAAQS have been achieved and requires the development and implementation of regional air quality plans to bring nonattainment areas into compliance.

The San Joaquin Valley Air Basin does meet the California standards for sulfates, hydrogen sulfide, and vinyl chloride. The entire San Joaquin Valley Air Basin fails to meet the State standards for one-hour ozone and PM-10. The Fresno urban area is the only part of the Basin not in attainment for CO. The Basin is unclassified with respect to the recent 8-hour State ozone standard and PM-2.5 standard.

Greenhouse Gases

In 2005, in recognition of California's vulnerability to the effects of climate change, Governor Schwarzenegger established Executive Order S-3-05, which sets forth a series of target dates by which statewide emission of greenhouse gas would be progressively reduced, as follows:

- By 2010, reduce greenhouse gas emissions to 2000 levels;
- By 2020, reduce greenhouse gas emissions to 1990 levels; and
- By 2050, reduce greenhouse gas emissions to 80 percent below 1990 levels.

In 2006, California passed the California Global Warming Solutions Act of 2006 (Assembly Bill No. 32; California Health and Safety Code Division 25.5, Sections 38500, et seq., or AB 32), which requires the CARB to design and implement emission limits, regulations, and other measures, such that feasible and cost-effective statewide greenhouse gas emissions are reduced to 1990 levels by 2020 (representing an approximate 25 percent reduction in emissions). The 2020 target reductions are currently estimated to be 174 million metric tons of carbon dioxide (CO_2) equivalents ($MMTCO_2E$).

In June 2007 CARB directed staff to pursue 37 early actions for reducing greenhouse gas emissions under the California Global Warming Solutions Act of 2006 (AB 32). CARB directed staff to further evaluate early action recommendations made at the June 2007 meeting, and to report back to CARB within six months. Based on its initial analysis, CARB staff is recommending the expansion of the early action list to a total of 44 measures.

In addition to identifying early actions to reduce greenhouse gases, the CARB is also developing the greenhouse gas mandatory reporting regulation that is required by January 1, 2008 pursuant to requirements of AB32. The regulations are expected to require reporting for certain types of facilities that make up the bulk of the stationary source emissions in California. Currently, the draft regulation language identifies major facilities as those that generate more than 25,000 metric tons of CO_2 per year (CO_2/yr). This reporting limit is consistent with European Union reporting. Cement plants, oil refineries, electric generating facilities/providers, co-generation facilities, and hydrogen plants and other stationary combustion sources that emit more than 25,000 MT CO_2/yr, make up 94 percent of the point source CO_2 emissions in California (CARB, 2007d).

Local

San Joaquin Valley Air Pollution Control District

The SJVAPCD is the primary local agency responsible for protecting human health and property from the harmful effects of air pollution in the Basin and has jurisdiction over most stationary source air quality matters in the Basin. The SJVAPCD jurisdiction includes all of Merced, San Joaquin, Stanislaus, Madera, Fresno, Kings and Tulare Counties and the valley portion of Kern County. The Basin includes roughly 24,843 square miles.

The SJVAPCD is responsible for developing attainment plans for the Basin for inclusion in California's SIP, as well as establishing and enforcing air pollution control rules and regulations. The attainment plans must demonstrate compliance with Federal and State ambient air quality standards and must first be approved by the CARB before inclusion into the SIP. The SJVAPCD regulates, permits, and inspects stationary sources of air pollution. These sources include but are not limited to industrial facilities, gasoline stations, auto body shops, municipal solid waste landfills, and dry cleaners. While the state is responsible for emission standards and controlling tailpipe emissions from motor vehicles, the SJVAPCD is required to regulate emissions associated with stationary sources such as agricultural burning and industrial operations. The SJVAPCD also works with eight local transportation planning agencies to implement transportation control measures and to recommend mitigation measures for new growth and development designed to reduce the number of cars on the road. The SJVAPCD promotes the use of cleaner fuels and funds a number of public and private agency projects that provide innovative approaches to reducing air pollution from motor vehicles.

As noted above, federal and state air quality laws require regions designated as nonattainment to prepare plans that either demonstrates how the region will attain the standard or that demonstrate reasonable improvements in air quality conditions. A series of air quality plans has been developed for the Basin. The SJVAPCD previously developed 1-hour ozone documents. However, the USEPA repealed the 1-hour ozone standard and the federal documents no longer apply to the

Basin. The following describes the most current federal and state air quality plans as they apply to the project site:

- *Extreme Ozone Attainment Demonstration Plan* - This Extreme Ozone Attainment Demonstration Plan (OADP) sets forth the emission reductions and timeline for attaining the federal 1-hour ozone ambient air quality standards in the San Joaquin Valley Air Basin (SJVAB) by November 15, 2010.
- *2007 Ozone Plan for the Federal 8-Hour Ozone Standard* - Effective June 15, 2004, EPA designated the SJVAB nonattainment and classified it as serious nonattainment for the federal 8-hr ozone standard with a target attainment date of June 15, 2013.The District Governing Board adopted the 2007 Ozone Plan on April 30, 2007. This far-reaching plan, with innovative measures and a "dual path" strategy, assures expeditious attainment of the federal 8-hour ozone standard for all Valley residents. The plan is due to EPA by June 15, 2007.
- *California Clean Air Act Triennial Progress Report and Plan Revision 1997–1999.* This plan identifies the Basin as both a source and receptor of transported ozone and concludes that attainment of the state ozone standard will not occur until upwind areas, such as the San Francisco Bay Area and the Sacramento Valley Air Basins, substantially reduce their emissions of ozone precursors (SJVAPCD, 2001).
- *California Clean Air Act Annual Progress Report 2000* (adopted February 27, 2001). Section 40924(a) of the California Health and Safety Code requires each air district to submit an annual report to the CARB that summarizes its progress in meeting the schedules for developing, adopting, and implementing the air pollution control measures in the Air Quality Attainment Plan (AQAP).
- *2006 PM-10 Attainment Demonstration Plan.* This plan is a continuation of the SJVAPCD's strategy for achieving the NAAQS for PM-10. It is the SIP revision required as approval of the *2003 PM-10 Attainment Demonstration Plan.* In addition to meting the requirements of the CAA and containing measures needed to attain the NAAQS at the earliest possible date, this SIP revision is to include an evaluation of the modeling from the California Regional Particulate Air Quality Study and the latest technical information, including inventory and monitoring data.
- *PM-2.5 Attainment Demonstration Plan.* The USEPA has designated the Basin a nonattainment area for PM-2.5. This plan, not yet adopted, would demonstrate how the Basin would meet the Federal PM-2.5 standard. The *PM-2.5 Attainment Demonstration Plan* is due to the USEPA by April 2008.

The SJVAPCD's primary means of implementing the above air quality plans is by adopting and enforcing rules and regulations. Regulation VIII consists of a series of dust control rules intended to implement the *PM_{10} Attainment Demonstration Plan*. The *PM_{10} Attainment Demonstration Plan* emphasizes fugitive dust reduction as a means of achieving attainment of the federal standards for PM_{10}. The rule specifically addresses the following activities:

Rule 8021: Construction, demolition, excavation, extraction and other earthmoving activities;

Rule 8031: Handling and storage of bulk materials;

Rule 8041: Trackout/carryout of dirt and other materials onto paved public roads;

Rule 8051: Open areas;

Rule 8061: Construction and use of paved and unpaved roads;

Rule 8071: Use of unpaved vehicle and/or equipment traffic areas; and

Rule 2010: Permits required.

The SJVAPCD limits emissions of, and public exposure to, toxic air contaminants through a number of programs to include the risk reduction program. District Policies 1905, *Risk Management Policy for Permitting New and Modified Sources* and 1910, *Toxic Best Available Control Technology for New and Modified Diesel Internal Combustion Engines*, provide guidelines on permitting sources that emit toxic air contaminants (also referred to interchangeably by the District as hazardous air pollutants).

Kern County General Plan

The *Kern County General Plan* Land Use/ Conservation /Open Space chapter contains the County's Air Quality Element (Kern County Planning Department, 2004a). The following objectives and policies that would be relevant to the Project:

- **Policy 1.10.2.19:** In considering discretionary projects for which an Environmental Impact Report must be prepared pursuant to the California Environmental Quality Act, the appropriate decision making body, as part of its deliberations, will ensure that:
  - All feasible mitigation to reduce significant adverse air quality impacts have been adopted; and
  - The benefits of the proposed project outweigh any unavoidable significant adverse effects on air quality found to exist after inclusion of all feasible mitigation. This finding shall be made in a statement of overriding considerations and shall be supported by factual evidence to the extent that such a statement is required pursuant to the California Environmental Quality Act.
- **Policy 1.10.2.20:** The County shall include fugitive dust control measures as a requirement for discretionary projects and as required by the adopted rules and regulations of the San Joaquin Valley Unified Air Pollution Control District and the Kern County Air Pollution Control District on ministerial permits.
- **Policy 1.10.2.21:** The County shall support air districts' efforts to reduce PM-10 and PM-2.5 emissions.
- **Policy 1.10.2.22:** Kern County shall continue to work with the San Joaquin Valley Unified Air Pollution Control District and the Kern County Air Pollution Control District toward air quality attainment with Federal, State, and local standards.
- **Policy 1.10.2.23:** The County shall continue to implement the local government control measures in coordination with the Kern Council of Governments and the San Joaquin Valley Unified Air Pollution Control District.

3.3.3 Project Impacts and Mitigation Measures

Significance Criteria

Generally, according to Appendix G of the *CEQA Guidelines*, a project would have a significant effect on the environment with respect to air quality if it would:

- conflict with or obstruct implementation of applicable air quality plans;
- violate any air quality standard or contribute substantially to an existing or projected air quality violation;
- result in a cumulatively considerable net increase of any nonattainment pollutant;
- expose sensitive receptors to substantial pollutant concentrations; or
- create objectionable odors affecting a substantial number of people.

The SJVAPCD has established specific thresholds of significance for construction, operational, and cumulative impacts. For construction impacts, the pollutant of greatest concern is PM-10. The SJVAPCD recommends that significance be based on a consideration of the control measures to be implemented during project construction (SJVAPCD, 2002). Compliance with Regulation VIII, Rule 8011, and implementation of appropriate mitigation measures to control PM-10 emissions are considered to be sufficient to render a project's construction-related impacts less than significant. The SJVAPCD *Guide for Assessing and Mitigating Air Quality Impacts* (GAMAQI) contains a list of feasible control measures for construction-related PM-10 emissions.

The SJVAPCD's GAMAQI also includes significance criteria for evaluating operational-phase emissions from direct and indirect sources associated with a project. Stationary sources (such as generators) that comply, or that would comply, with SJVAPCD Rules and Regulations are generally not considered to have a significant air quality impact. For this analysis, project operations would be considered to have a significant effect on the air quality if it would exceed the following thresholds:

- Cause a net increase in pollutant emissions of ROG or NO_X exceeding 10 tons per year.
- Cause a violation of state CO concentration standards. The level of significance of CO emissions from mobiles sources is determined by modeling the ambient concentration under project conditions and comparing the resultant 1- and 8-hour concentrations to the respective state CO standards of 20.0 and 9.0 parts per million.
- Cause "visible dust emissions"[1] due to onsite operations and thereby violate SJVAPCD Regulation VIII.

In addition, pursuant to recent developments in the control of greenhouse gas emissions in the State of California, the project would have a significant impact if it would conflict with implementation of state goals for reducing greenhouse gas emissions.

1 Visible dust is defined by the SJVAPCD as "visible dust of such opacity as to obscure an observer's view to a degree equal to or greater than an opacity of 40 percent, for a period or periods aggregating more than three minutes in any one hour."

Lastly, any proposed project that would individually have a significant air quality impact would also be considered to have a significant cumulative air quality impact. Impacts of local pollutants are cumulatively significant when analysis shows that the combined emissions from the project and other existing and planned projects will exceed air quality standards.

Impacts Discussion

Impact 3.3-1: Construction activities associated with the proposed project could result in short-term pollutant emissions. Less than Significant with Mitigation.

The proposed project would include the development of facilities for groundwater recharge, recovery, and conveyance at Strand Ranch and the operation of such facilities to provide groundwater storage for use by Rosedale and IRWD. The project would include the construction of 20 recharge basins of various capacities; dirt access roads; new conveyance facilities such as on-site supply channels, turnouts, pipelines, and pumping facilities; and production wells to pump groundwater.

Construction of the project has the potential to create air quality impacts through the use of heavy-duty construction equipment and through vehicle trips generated from construction workers traveling to and from the project site. In addition, fugitive dust emissions would result from site preparation and excavation activities. Mobile source emissions, primarily ROG and NO_X, would result from the use of construction equipment such as bulldozers, wheeled loaders, and cranes. Fugitive dust emissions would result from a variety of site preparation activities and vehicle travel on paved and unpaved surfaces. Construction equipment exhaust also would include some PM-10 emissions.

The SJVAPCD considers PM-10 to be the pollutant of greatest concern.[2] The SJVAPCD's approach to CEQA analyses of construction PM-10 impacts is to require implementation of effective and comprehensive control measures rather than to require detailed quantification of emissions. PM-10 emitted during construction can vary greatly depending on the level of activity, the specific operations taking place, the equipment being operated, local soils, weather conditions, and other factors, making quantification difficult. Despite this variability in emissions, there are a number of feasible control measures that can be reasonably implemented to substantially reduce PM-10 emissions from construction. The SJVAPCD has set forth control measures in Regulation VIII, Rule 8011. Implementation of **Mitigation Measure 3.3-1** would reduce the potentially significant PM-10 impact to a less-than-significant level.

The SJVAPCD recognizes that construction equipment emits ozone precursors, but indicates that such emissions are included in the emission inventory that serves as the basis for regional air quality plans. In addition, the proposed project would not include a very large or very intense construction activity and, thus, would not emit significant amounts of CO and ozone precursors.

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[2] The SJVAPCD recognizes that construction equipment also emits CO and ozone precursor emissions. However, the SJVAPCD has determined that these emissions may cause a significant air quality impact only in the cases of very large or very intense construction projects.

Therefore, construction emissions are not expected to impede attainment or maintenance of ozone standards in the Basin. As such, construction emissions would be less than significant.

Mitigation Measures

Mitigation Measure 3.3-1: During construction activities, the District shall require the construction contractor(s) to implement a dust abatement program that incorporates SJVAPCD-recommended measures including:

- All disturbed areas, including storage piles, which are not being actively utilized for construction purposes, shall be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, covered with a tarp or other suitable cover or vegetative ground cover;
- All on-site unpaved roads and off-site unpaved access roads shall be effectively stabilized of dust emissions using water or chemical stabilizer/suppressant;
- All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by presoaking;

Significance after Mitigation: Less than Significant.

Impact 3.3-2: Operation of the proposed project could result in air emissions from the powering of pumps and from maintenance/repair trips. Less than Significant.

The proposed project would add recharge basins, water supply channels, recovery wells and pumphouses, recovery water pipelines, and turnouts. The majority of project operational activity would be passive and would include the movement of water through pipes. Potential emission sources resulting from project implementation include emissions from the recovery well pumps and emissions associated with maintenance/repair trips.

The recovery well pumps would be powered by the existing electrical grid and would not generate local emissions. Emissions would be generated at distant power plant where the power is created. The proposed project would not require significant electrical capacity and would not be responsible for a substantial amount of emissions at the power source. In addition, power plant emissions are subject to the rules and regulations of the air district in which they are located and are subject to their own CEQA review.

Once constructed, the proposed facilities would require routine maintenance and inspection trips. Maintenance activities would be periodic and would not result in an increase in traffic in the project area. The effect of project-related traffic on local carbon monoxide concentrations along roadways and at intersections would also be negligible.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Impact 3.3-3: Construction of the proposed project would emit greenhouse gases. Less than Significant.

The California Global Warming Solutions Act of 2006 (AB 32) establishes a goal in California of reducing GHG emissions in California to 1990 levels by 2020. Presently, standards or methods of achieving this goal have not been established by the state. The California Air Resources Board has been directed by the Governor's office to develop procedures to implement the goal.

Standards for determining the significance of an individual project's GHG emissions have not been established. Quantitative thresholds of significance have not been established. In any case, project specific emissions would not be expected to individually have an impact on global climate change (AEP, 2007). For the purposes of this analysis, the primary concern would be whether the project would be in conflict with the state goals for reducing GHG emissions.

The project would require the temporary use of construction equipment that would emit CO_2. Construction fleets would be required to comply with CARB-imposed emissions standards when they are issued. Compliance with CARB regulations would ensure that construction projects conform to emissions reduction strategies. Due to the temporary nature of construction, and the relatively small amounts of CO_2 emitted, the project would not significantly contribute to climate change or conflict with state-wide efforts to reduce greenhouse gas emissions.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

3.4 Biological Resources

This section describes the environmental setting for biological resources, the applicable regulatory framework, potential impacts of the proposed project, and mitigation measures to reduce those impacts to a level of less than significant.

3.4.1 Setting

Methodology

The determination of biological resources present at Strand Ranch was made from the following site surveys, reports and data sources:

- Reconnaissance-level site surveys conducted by ESA biologist, Michele Budish on May 18, 2007. The purpose of the survey was to assess habitat quality and the potential to support biological resources at the project site. ESA surveys included random search methods and detailed observational surveys in the Pioneer Canal and slough (south of the Cross Valley Canal);
- Paul Pruett and Associates (PPA) surveys of the biological resources at Strand Ranch in September and December 2003 (PPA, 2003) and the slough area in June and October 2006 (PPA 2006). The purpose of the surveys was to assess habitat quality and the potential to support biological resources at the project site. PPA surveys consisted of line transects and random search methods;
- California Native Plant Society's (CNPS's) Inventory of Rare and Endangered Plants of California (Skinner and Palvik, 2004);
- California Natural Diversity Database (CNDDB) records search for the Tupman quadrangle and eight adjacent quadrangles (Buttonwillow, Rio Bravo, Rosedale, Stevens, Millux, Mouth of Kern, Taft, and East Elk Hills) (CDFG 2006);
- List of federal endangered and threatened species that may be affected by projects in Kern County (USFWS, 2006); and
- ESA Biological Resources file information and existing literature (see citations).

Descriptions of plant communities at Strand Ranch follow the California Department of Fish and Game (CDFG) plant classification system (CDFG, 2002). This classification system is similar in structure to the previous CDFG classification systems (i.e., Holland, 1986), but is based on Sawyer and Keeler-Wolf (1995) plant classification system. This classification system is a hierarchal treatment of vegetation communities/wildlife habitats that describes natural communities, naturalized communities, invasive plant associations, and human-influenced/urban landscapes. The vegetation generally correlates with wildlife habitat types.

Regional Setting

The project area is located in the San Joaquin Valley and in Kern County near the cities of Bakersfield, Wasco, McFarland and Shafter and within the Pacific Flyway.[1] This area is also located within the California Floristic Province (CA-FP), Great Central Valley (GV) Region, San Joaquin Valley (SnJV) Subregion (Hickman, 1993). The CA-FP is the largest geographic unit in California and comprises much of the state west of the dry regions of the Great Basin (GB) and Desert (D) Provinces in northern and southern California, respectively (Hickman, 1993). The GV Region is entirely contained with in the CA-FP, is roughly the same area as the California Central Valley, and was once comprised of grassland (California prairie), marshes, extensive riparian woodlands, and islands of valley-oak savanna, but is now predominantly agricultural (Hickman, 1993). The GV Region is divided into two subregions: the Sacramento Valley (ScV) Subregion to the north and the SnJV Subregion to the south (Hickman, 1993). The SnJV Subregion is the larger subregion and is hotter and drier than the ScV Subregion with desert elements in the south (Hickman, 1993). Land use within the vicinity of Strand Ranch is primarily agriculture.

The climate of the project area is characterized by hot, dry summers with daytime temperatures frequently above 100 degrees Fahrenheit (PPA, 2003). The winter months are cool and foggy with temperatures seldom below freezing and, on average, there are between 250 and 300 frost-free days per year (PPA, 2003). Average rainfall is less than 10 inches per year with the heaviest rains occurring between January and March (Munz and Keck, 1973).

Local Setting

Strand Ranch is farmed for cotton, wheat, alfalfa, garlic and a small portion of the project site contains an almond orchard. There is no undisturbed native habitat on Strand Ranch (PPA, 2003). The southern portions of Strand Ranch were fallow in 2007. Undisturbed, open land borders the southwest boundary of Strand Ranch. This open land is part of the Kern Water Bank Authority Conservation Bank and is located immediately adjacent to the Strand Ranch property. Two canals bisect Strand Ranch. The Cross Valley Canal (CVC) and Pioneer Canal extend through the middle portion of the property on an east-west axis. The Pioneer Canal is located north of the CVC and the two canals are separated by wheat fields. The CVC is a paved canal with consistent water flow. The Pioneer Canal is unpaved and consists of dirt, sandy soils, saturated soils, riparian vegetation, native vegetation, non-native vegetation and wildlife. The Pioneer Canal is dry during summer months, however the presence of recently deceased fish in May 2007 indicates this canal does have a steady flow of water at times (ESA, 2007). Two pools of water observed in the Pioneer Canal support a frog population.

There is an 18-acre slough immediately south of the CVC. The slough is a canal and borrow pit and contains some riparian vegetation (willows). The structure of the slough bed is mostly dried mud with some vegetation. Freshwater clams are embedded throughout the slough bed and numerous birds forage and nest in the area. Birds, such as the killdeer, nest their eggs in the

1 The Pacific Flyway is an established air route of waterfowl and other birds migrating between wintering grounds in Central and South America and nesting grounds in Pacific Coast and provinces of North America.

crevices of the mud flats. The outer berm of the Pioneer Canal and the slough area provide some non-agricultural habitat within the Strand Ranch. **Figure 3.4-1** identifies the location of the Pioneer Canal and sough area. **Figure 3.4-2** provides photos of these areas.

Habitat Types

The following assessment of habitat types at Strand Ranch is based on the site surveys performed by ESA and PPA (see 3.4.1 Setting, Methodology above for more information). Three habitat types (agricultural land, riparian scrub, and developed/ruderal land) are present on the site as described below.

Agricultural Land

The majority of Strand Ranch, and surrounding parcels, is agricultural land, which includes orchards, row crops, and fallow land.

Disturbed Riparian Scrub

The CVC slough contains disturbed riparian vegetation. Plant species found in the slough during ESA's 2007 survey include willows (*Salix* sp.). Another smaller irrigation sump/reservoir exists in approximately the middle of the northwestern border of Strand Ranch near Stockdale Highway (PPA, 2006); this area also contains disturbed riparian habitat. Plant species found in this area during ESA's 2007 survey include willows and mulefat (*Baccharis* sp.). The Pioneer Canal also supports disturbed riparian vegetation, such as willows and mulefat (*Baccharis salicifolia*) (ESA, 2007).

Developed/Ruderal Land

A residence with outbuildings and equipment lot exists in the northeastern corner of Strand Ranch (PPA, 2003). The area appears to be frequently grubbed, consists primarily of bare soil denuded of vegetation, and native habitat is not present. Dirt roads providing vehicle access within the site are generally bordered by weeds and disturbed ruderal vegetation. In addition, the outer edges of the Pioneer Canal, CVC and slough contained sandy, friable soils and ruderal vegetation. Ruderal vegetation is also located along small irrigation canals immediately adjacent to agricultural areas and these areas are dominated by weedy, non-native species.

Critical Habitat

Proposed and designated Critical Habitats for the following species were checked in reference to the project site: California condor, least Bell's vireo, southwestern willow flycatcher, western snowy plover and giant kangaroo rat. According to the U.S. Fish and Wildlife Service (USFWS), the project site does not lie within any proposed or designated Critical Habitat at this time.

Wildlife Species in the Project Area

In 2003, 10 mammals, 15 birds, and one reptile species were observed or evidence of these species was found at Strand Ranch. In 2006, nine mammals, 12 birds, and one reptile species were observed or evidence of these species was found at Strand Ranch. **Table 3.4-1** lists these species

SOURCE: GlobeXplorer; ESA, 2007.

Irvine Ranch Water District . 205426

Figure 3.4-1
Location of Pioneer Canal and Slough Area

Slough on Strand Ranch

Slough on Strand Ranch

Riparian Vegetation in the Pioneer Canal

Riparian Vegetation in the Pioneer Canal

SOURCE: ESA, 2007

Irvine Ranch Water District . 205426

Figure 3.4-2
Strand Ranch Slough and Riparian Vegetation

TABLE 3.4-1
WILDLIFE AT STRAND RANCH - PPA SURVEY RESULTS

Species	Evidence and Year for Occurrence
Mammals	
Canis vulgaris (domestic dog)	Sighted* / Scat & Track**
Canis latrans (coyote)	Scat* / Scat **
Procyon lotor (raccoon)	Tracks*
Dipodomys sp. (kangaroo rat)	Burrow & Carcass **
Dipodomys heermanni (Heermans' kangaroo rat)	Burrow*
Felis domesticus (Domestic cat)	Sighted**
Lepus californicus (black-tailed jackrabbit)	Sighted* / Sighted**
Peromyscus maniculatus (deer mouse)	Sighted*
Spermophilus beecheyi (California ground squirrel)	Sighted* / Sighted**
Sylvilagus auduboni (Audubon's cottontail)	Sighted* /Sighted**
Taxidea taxus (American badger)	Sighted*
Thomomys bottae (pocket gopher)	Burrow* / Burrow**
Vulpes macrotis mutica (San Joaquin kit fox)	Scat & Track**
Birds	
Agelaius phoeniceus (red-winged blackbird)	Sighted*
Agelaius tricolor (tricolored blackbird)	Sighted*
Anas platyrhynchos (mallard)	Sighted*/ Sighted**
Ardea elba (great egret)	Sighted*
Athene cunicularia (burrowing owl)	Sighted*
Buteo jamaicensis (red-tailed hawk)	Sighted*/ Sighted**
Buteo swainsonii (Swainson's hawk)	Sighted*
Callipepla californica (California quail)	Sighted*
Carpodacus mexicanus (house finch)	Sighted*/ Sighted**
Cathartes aura (turkey vulture)	Sighted*
Charadrius vociferus (killdeer)	Sighted*/ Sighted**
Columbia livia (pigeon)	Sighted*
Circus cyaneus (northern harrier)	Sighted*
Corvus corax (common raven)	Sighted*/ Sighted**
Egretta thula (snowy egret)	Sighted*
Eremophila alpestris (horned lark)	Sighted*/ Sighted**
Euphagus cyanocephalus (Brewer's blackbird)	Sighted*/ Sighted**
Falco sparverius (American kestrel)	Sighted*/ Sighted**
Melospiza melodia (song sparrow)	Sighted*
Mimus polyglottis (mockingbird)	Sighted*/ Sighted**
Passer domesticus (house sparrow)	Sighted*
Petrochelidon pyrrhonota (cliff swallow)	Sighted*
Sturnella neglecta (western meadowlark)	Sighted*/ Sighted**
Sturnus vulgaris (European starling)	Sighted*
Turdus migratorius (robin)	Sighted*
Tyrannus verticalis (western kingbird)	Sighted*/ Sighted**
Tyto alba (barn owl)	Sighted*
Zenaida macroura (mourning dove)	Sighted*/ Sighted**
Zonotrichia leucophrys (white-crowned sparrow)	Sighted*
Reptile	
Sceloporus occidentalis (western fence lizard)	Sighted*
Uta stansburiana (side-blotched lizard)	Sighted*/ Sighted**
Amphibians	
Rana catesbiana (bullfrog)	Sighted*

SOURCE: PPA 2003 & 2006
*denotes year 2003; **denotes year 2006

and the evidence for their occurrence at the project site. In 2007, six mammals, 16 birds, one amphibian, and one reptile species were observed or evidence of these species was found at Strand Ranch (ESA, 2007). **Table 3.4-2** lists these species and the evidence for their occurrence at the project site.

The American badger (*Taxidea taxus*) is the only wildlife species observed on the site that is listed as a special-status species. This species is listed as a Species of Special Concern by CDFG. Raptor species, such as the red-tailed hawk (*Buteo jamaicensis*) and the American kestrel (*Falco sparverius*), migratory birds such as mallards (*Anas platyrhynchos*), and other nesting birds were also observed on site. These species are afforded certain protection under the Migratory Bird Treaty Act (MBTA) and Section 3503 of the California Fish and Game Code (see 3.4.2 Regulatory Framework below for more information).

Agricultural areas on Strand Ranch may provide occasional habitat for transient mammals, reptiles, and amphibians, and have value to birds. Small mammals, such as rabbits and rodents, forage on the leaves and grasses and, in turn, may attract small predators, such as hawks or feral cats. Burrowing owls (*Athene cunicularia)*, a California Species of Special Concern, may inhabit the burrows of California ground squirrels (*Spermophilus beecheyi)* or other small mammals in the agricultural fields and Pioneer Canal. Small mammals and some birds also may utilize fallow agricultural areas and areas previously cleared that currently exhibit initial shrub re-establishment for limited cover and foraging purposes. During ESA's 2007 survey, frogs were located (via sound) throughout the irrigation ditches in the crop rows. Fish carcasses, identified as the common carp (*Cyprinus carpio*), and freshwater clams were found scattered and embedded throughout the slough and Pioneer Canal. The fish possibly entered the canal from the Kern River during periods of high flow and were trapped in the canal as it drained. An array of birds and frogs were also observed using the Pioneer Canal.

Regional Species and Habitats of Concern

Natural Communities

The California Natural Diversity Database (CNDDB) tracks the occurrence of what the CDFG terms "Terrestrial Natural Communities" that are "considered rare and worthy of consideration by CNDDB" (CDFG, 2002a). A total of five such communities are known to occur in the vicinity of Strand Ranch. These communities are Great Valley Cottonwood Riparian Forest, Great Valley Mesquite Scrub, Valley Sacaton Grassland, Valley Saltbush Scrub, and Valley Sink Scrub. Based on biological reconnaissance surveys conducted by ESA in May 2007 and PPA in 2003 and 2006, these communities are confirmed absent from Strand Ranch.

Raptor Foraging and Nesting

Southern California holds a diversity of birds of prey (raptors), and many of these species are in decline. For most of the declining species, foraging requirements include extensive open, undisturbed or only lightly disturbed areas, especially grasslands. This type of habitat has declined severely in the region, affecting many species but especially raptors. A few species, such

TABLE 3.4-2
WILDLIFE AT STRAND RANCH, 2007

Species	Evidence for Occurrence
Mammals	
Canis latrans (coyote)	Tracks
Procyon lotor (raccoon)	Tracks
Citellus beecheyi (Beechey ground squirrel)	Sighted
Dipodomys sp. (Kangaroo rat sp.)	Burrow
Lepus californicus (black-tailed jackrabbit)	Sighted
Thomomys bottae (pocket gopher)	Burrow
Birds	
Agelaius phoeniceus (red winged blackbird)	Sighted
Anas platyrhynchos (mallard)	Sighted
Buteo jamaicensis (red-tailed hawk)	Sighted
Carpodacus mexicanus (house finch)	Sighted
Charadrius vociferus (killdeer)	Sighted
Corvus corax (common raven)	Sighted
Euphagus cyanocephalus (Brewer's blackbird)	Sighted
Falco sparverius (American kestrel)	Sighted
Junco hyemalis (dark eyed junco)	Sighted
Melospiza melodia (song sparrow)	Sighted
Mimus polyglottis (mockingbird)	Sighted
Quiscalus mexicanus (great-tailed grackle)	Sighted
Stelgidopteryx serripennis (northern rough winged swallow)	Sighted
Sturnella neglecta (western meadowlark)	Sighted
Tyrannus verticalis (western kingbird)	Sighted
Zenaida macroura (mourning dove)	Sighted
Reptiles	
Uta stansburiana (side-blotched lizard)	Sighted
Amphibians	
Lithobates catesbeianus (American bullfrog)	Sighted
Fish	
Cyprinus carpio (common carp)	Sighted
Mollusks	
Freshwater Clams; species unknown	Sighted

as red-tailed hawk and American kestrel observed at Strand Ranch, are somewhat adaptable to low level human disturbance and can be readily observed adjacent to neighborhoods and other types of development. These species still require appropriate foraging habitat and low levels of disturbance in the vicinity of nesting sites. However, habituation of some types of noise and disturbances does occur with the introduction of "new" forms of disturbance during nesting sometimes causing nest abandonment and failure. Given the existing open area and habitat conditions at the site, it is likely that appreciable raptor foraging occurs.

Wildlife Movement

Habitat linkages provide a connection between two or more habitat areas that are often larger or superior in quality to the linkage. Such linkages can be quite small or constricted, but can be vital to the long-term health of connected habitats. Linkage values are often addressed in terms of "gene flow" between populations, with movement taking potentially many generations. The Pioneer Canal and CVC slough provide opportunities for wildlife movement. In addition, Strand Ranch connects to an adjacent area of open space, the Kern Water Bank Authority Conservation Bank, along the southwestern border of the property, and thus linkage value is judged good.

Habitat Conservation Plans/Natural Community Conservation Plans

Strand Ranch is partially within the *Metropolitan Bakersfield Habitat Conservation Plan*[2] (MBHCP) as shown in **Figure 3.4-3**. The MBHCP is described below in Section 3.4.2 Regulatory Framework. Strand Ranch is not part of any Natural Community Conservation Plans (NCCPs).

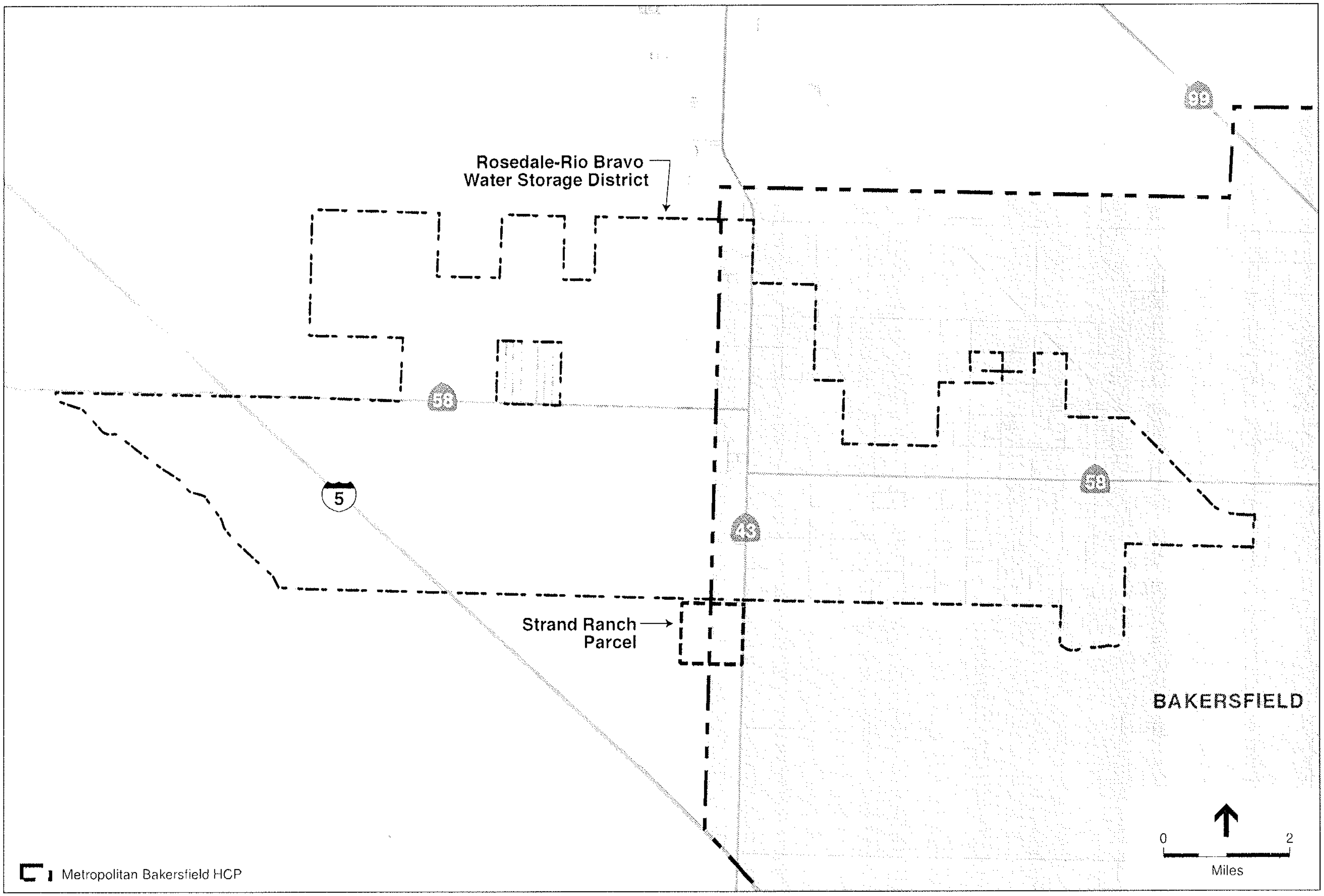
Special-Status Species

Special-Status Species Definition

Special-status species are those plants and animals that, because of their recognized rarity or vulnerability to various causes of habitat loss or population decline, are recognized by federal, state, or other agencies. Some of these species receive specific protection that is defined by federal or state endangered species legislation. Others have been designated as "sensitive" on the basis of adopted policies and expertise of state resource agencies or organizations with acknowledged expertise, or policies adopted by local governmental agencies such as counties, cities, and special districts to meet local conservation objectives. These species are referred to collectively as "special-status species" in this report, following a convention that has developed in practice but has no official sanction. Special-status species include:

- Species listed or proposed for listing as threatened or endangered, or are candidates for possible future listing as threatened or endangered, under FESA or CESA;
- Species that meet the definitions of rare or endangered under the California Environmental Quality Act (CEQA) (*CEQA Guidelines* Section 15380);
- Plants listed as rare under the California Native Plant Protection Act (CDFG Code 1900 *et seq.*);
- Plants considered by the California Native Plant Society (CNPS) to be rare, threatened, or endangered (List 1B and 2 plants) in California (Skinner and Palvik, 2004);
- Plants listed by the CNPS as plants in which more information is needed to determine their status and plants of limited distribution (List 3 and 4 plants) (Skinner and Palvik, 2004);
- Animals species of special concern to CDFG; and/or
- Animals fully protected in California (CDFG Code Sections 3511, 4700, and 5050).

[2] A Phone conversation with Michael Hollier and Cheryl Casdorph of the Kern County Planning Department (May 15, 2007 and November 1, 2007) confirmed that four of the five parcels, (essentially the entire eastern half of the property) lie within the MBHCP.



SOURCE: Kern County, 2007. ESA. 2007.

Irvine Ranch Water District . 205426

Figure 3.4-3
Metropolitan Bakersfield HCP

A list of special-status plant and animal species that have the potential to occur within the vicinity of the project site was compiled based on data in the CNDDB (CDFG, 2006), CNPS literature (Skinner and Pavlik, 2004), and a U.S. Fish and Wildlife Service (USFWS) listing of federally listed and proposed species in Kern County (USFWS, 2006). **Table 3.4-3** lists the special-status species that have may have a potential to occur in the vicinity of Strand Ranch; their listing status with USFWS, CDFG, and CNPS; their likelihood of occurrence; and comments about habitat and why or why not each species is likely to occur at the project site. Nine of these species were further evaluated due to their likelihood of occurrence within the Strand Ranch Parcel, these species are noted below.

American badger. The American badger is a California Species of Special Concern. The range of the American badger includes most of the State, with the exception of the northwestern forests. Badgers occupy a variety of habitats, including grasslands, savannas, and mountain meadows where soils are suitable for digging for their preferred prey, large rodents such as ground squirrels, gophers, and kangaroo rats. Badger activity was identified on the project site during PPA surveys. This species was observed on the property by PPA in 2003 and may occur on the project site.

Burrowing owl. This small, ground-dwelling owl lives in ground squirrel and other mammal burrows that it appropriates and enlarges for its purposes. It typically is found in short-grass grasslands, open scrub habitats, and a variety of open, human-altered environments, such as golf courses, airport runways and agricultural fields. This owl is active at twilight, feeding on insects, amphibians, reptiles and small mammals. Burrowing owls have shown significant declines throughout California in recent years due principally to the conversion of grassland and pasturelands to agricultural and urban uses, and to poisoning programs to control California ground squirrels. This former federal Species of Concern and California Species of Special Concern was observed on burrows within the proposed project boundaries by PPA in 2006 and may occur in the project site along agricultural edges, as well as along the Pioneer Canal and CVC slough.

Giant garter snake. The giant garter snake is a federal and state threatened species. This species preferred habitat includes mammal burrows, crevices and surface objects, normally found in the immediate vicinity of permanent or semi-permanent sources of water. The giant garter snake forages primarily along marshes and sloughs from mid-March through October. Its diet consists of fish and amphibians. Its most current food source is reportedly introduced species, such as bullfrogs and carp, since native prey in the region is no longer available. The giant garter snake may occur along the Pioneer Canal and CVC slough area and when seasonal waters are abundant.[3]

Giant kangaroo rat. The giant kangaroo rat *(Dipodomys ingens)* is a California and federally listed endangered species whose habitat has been reduced and degraded, primarily by agricultural cultivation. Giant kangaroo rats prefer annual grassland on gentle slopes of generally less than 10°, with friable, sandy-loam soils. However, most remaining populations are on poorer, marginal habitats which include shrub communities on a variety of soil types and on slopes up to about 22°. The historical distribution of giant kangaroo rats includes the Kern County.

[3] California Wildlife Habitat Relationship system, CDFG, 2005.

TABLE 3.4-3
SPECIAL-STATUS SPECIES AND HABITAT WITH POTENTIAL TO OCCUR WITHIN THE PROPOSED PROJECT AREA AND GREATER KERN COUNTY

Species/Natural Communities	Listing Status (USFWS/CDFG/ CNPS)	Likelihood of Occurrence	Comments
Wildlife and Birds			
Actinemys marmorata pallida Southwestern pond turtle	--/SSC/--	Very Low	Ponds and small lakes with abundant vegetation. Also seen in marshes, slow-moving streams, reservoirs, and occasionally in brackish water.
Agelaius tricolor Tricolored blackbird	--/SSC/--	Low	Tricolored blackbirds have three basic requirements for selecting their breeding colony sites: open, accessible water; a protected nesting substrate, including either flooded, thorny, or spiny vegetation; and a suitable foraging space providing adequate insect prey within a few miles of the nesting colony. Open water canals and agriculture at Strand Ranch can support this species. This species was observed foraging over the property in 2006.
Ammospermophilus nelsoni Nelson's antelope squirrel	--/ST/--	Low	In the southern and western San Joaquin Valley, San Joaquin antelope squirrels are associated with open, gently sloping land with shrubs. Typical vegetation includes saltbushes and ephedra and sparsely vegetated, loamy soils. Species last sighted in 2002 in the Tupman, Mouth of Kern and Taft quads.
Athene cunicularia Burrowing owl	--/SSC/--	High	Found in open, dry grasslands, agricultural and range lands, and desert habitats often associated with burrowing animals, particularly prairie dogs, ground squirrels and badgers. This was observed on burrows on the property in 2006.
Buteo swainsoni Swainson's hawk	--/ST/--	Low	Inhabit a wide variety of open habitats, ranging from prairie and shrublands to desert and intensive agricultural systems. Two Swainson's hawks were seen foraging over the property in 2206. In addition, potential raptor nest exists in a old cottonwood on the south portion of the property.
Charadrius alexandrinus nivosus Western snowy plover	FT/SSC/--	Very Low	Also will nest beside or near tidal waters, and includes all nesting colonies on the mainland coast, peninsulas, offshore islands, adjacent bays and estuaries from southern Washington to southern Baja California, Mexico Historic records suggest that nesting western snowy plovers were once more widely distributed in coastal California. Species last sighted in 1912 in the vicinity of the project area.
Charadrius montanus Mountain plover	--/SSC/--	Low	Favored habitats include prairie dog towns, areas heavily grazed by domestic livestock or wild herbivores, bare ground areas near artificial watering structures, recently burned or mowed areas. and recently fallowed or tilled crop fields. Found in grasslands, freshly plowed and newly sprouting grain fields, and sod farms. Prefers grazed areas and areas with burrowing rodents.
Coccyzus americanus occidentalis Western yellow-billed cuckoo	FC/SE/--	Low	Yellow-billed cuckoos prefer open woodlands with clearings and a dense shrub layer. They are often found in woodlands near streams, rivers or lakes. Species last recorded in 1922 in the surrounding area.

**TABLE 3.4-3 (CONT.)
SPECIAL-STATUS SPECIES AND HABITAT WITH POTENTIAL TO OCCUR WITHIN THE PROPOSED PROJECT AREA AND GREATER KERN COUNTY**

Species/Natural Communities	Listing Status (USFWS/CDFG/ CNPS)	Likelihood of Occurrence	Comments
Dendrocygna bicolor Fulvous whistling-duck	--/SSC/--	None	Rice fields, swamplands, marshes with lots of reeds and swamp vegetation. Species last sighted in 1922 in the surrounding area.
Dipodomys ingens Giant kangaroo rat	FE/SE/--	Low	Prefer annual grassland on gentle slopes of generally less than 10 degrees, with friable, sandy-loam soils in the San Joaquin Valley. Species last sighted in 1990 in the immediate area.
Dipodomys nitratoides brevinasus Short-nosed kangaroo rat	--/SSC/--	Low	Found in the western San Joaquin Valley; mostly on flat and gently sloping terrain and on hilltops in desert-shrub associations, primarily saltbushes and California ephedra. Last reported in 2003 approx. 10 miles from Strand Ranch.
Dipodomys nitratoides nitratoides Tipton kangaroo rat	FE/SE/--	Low	Limited to arid-land communities occupying the Valley floor of the Tulare Basin of the San Joaquin Valley level or nearly level terrain. Last sighted in 1985 in the immediate vicinity of the project area.
Elanus leucurus White-tailed kite	CNDDB	None	Found in rolling foothills, and valley margins with scattered oaks and river bottomlands or marshes next to deciduous woodlands. Foraging habitat includes open grasslands, meadows, or marshes close to dense topped trees for nesting and perching. Last observed in the vicinity of the project area in 1992. Habitat on Strand Ranch would not likely support this species.
Eremophila alpestris actia California horned lark	--/SSC/--	Low	Associated with coastal regions, chiefly from Sonoma county to San Diego county; also found in the main part of the San Joaquin Valley and east to the foothills. Microhabitat includes short-grass prairie, "bald-hills", mountain meadows, open coastal plains, fallow grain fields and alkali flats. This species was last observed in 2006 with two occurrences in the area (Stevens and Rosedale) associated with agricultural fields.
Eumops perotis californicus Western mastiff bat	--/SC/--	Very Low	Found in open, semi-arid to arid habitats including conifer and deciduous woodlands, coastal scrub, grasslands, chaparral, etc. Roosts in crevices in cliff faces, high buildings, trees and tunnels. Last known record for the area was an occurrence in 1959.
Gambelia sila Blunt-nosed leopard lizard	FE/SE-FP/--	Low	Blunt-nosed leopard lizards live in the San Joaquin Valley region in expansive, arid areas with scattered vegetation. Today they inhabit non-native grassland and alkali sink scrub communities of the Valley floor marked by poorly drained, alkaline, and saline soils, mainly because remaining natural land is of this type. Use small mammal burrows for permanent shelter and dormancy.
Gopherus agassizzii Desert tortoise	FT/ST/--	Very Low	Inhabit semi-arid grasslands, gravelly desert washes and sandy canyon bottoms below 3,500 ft. Habitat on Strand Ranch is not suitable for this species.
Gymnogyps californianus California condor	FE/SE-FP/--	Low	California condors are found in southern central California deserts. Suitable permanent roosting sites must have rocky cliffs and rubble for nesting. The birds range over very large areas to find food.

TABLE 3.4-3 (CONT.)
SPECIAL-STATUS SPECIES AND HABITAT WITH POTENTIAL TO OCCUR WITHIN THE PROPOSED PROJECT AREA AND GREATER KERN COUNTY

Species/Natural Communities	Listing Status (USFWS/CDFG/ CNPS)	Likelihood of Occurrence	Comments
Haliaeetus leucocephalus Bald eagle	FT/ST-FPS/--	Very Low	Known to occur in Kern County according to USFWS. Species is found near large bodies of water, shorelines and areas where fish is abundant. Habitat on Strand Ranch is not suitable for this species.
Hypomesus transpacificus Delta smelt	FT/ST/--	Very Low	Endemic to the Sacramento-San Joaquin waters, these fish occupy brackish water and estuaries. Habitat on Strand Ranch is not suitable for this species.
Lytta hoppingi Hopping's blister beetle	CNDDB	Very Low	Found in the foothills of the southern end of the central valley. Last reported occurrence was in Taft in 1978.
Masticophis flagellum ruddocki San Joaquin whipsnake	--/SSC/--	Moderate	Associated with open, dry habitats, with little to no tree cover; found in valley grassland and saltbrush scrub in the San Joaquin valley. Species needs mammal burrows for refuge and oviposition sites. Last observed two occurrences were in Tupman and Stevens in 2000.
Onychomys torridus tularensis Tulare grasshopper mouse	--/SSC/--	Very Low	Tulare grasshopper mice typically inhabit arid shrubland communities in hot, arid grassland and shrubland associations. Habitat in project area may not support this species. Last sighted 12 miles from project area in 2002. Suitable habitat not present.
Perognathus inornatus inornatus San Joaquin pocket mouse	FSC/--/--	Low	Found in fine-textured, sandy soils. They may also occur on a variety of other substrates in annual grassland and desert shrub communities, especially where plant cover is not dense and soils are friable. Last sighted in 2003 in surrounding areas.
Phrynosoma coronatum (frontale population) Coast (California) horned lizard	--/SSC/--	Very Low	Found in a wide variety of vegetation types including coastal sage scrub, annual grassland, chaparral, oak woodland, riparian woodland and coniferous forest. Last sighting reported in Buttonwillow in 2005. Suitable habitat not present for this species.
Plegadis chihi White-faced ibis	--/SSC/--	Very Low	Frequents marshes, swamps, ponds and rivers. Last sighted in 1922 in the surrounding area. Habitat not present for this species.
Sorex ornatus relictus Buena Vista Lake shrew	FE/SSC/--	Low	Occupies the marshlands of the San Joaquin Valley and the Tulare Basin. Last sighted in 2000 in Stevens. Habitat not suitable to support this species.
Spea (=Scaphiopus) *hammondii* Western spadefoot	--/SSC/--	Moderate	Prefers open areas with sandy or gravelly soils, in a variety of habitats including mixed woodlands, grasslands, chaparral, sandy washes, lowlands, river floodplains, alluvial fans, playas, alkali flats, foothills, and mountains. Rainpools which do not contain bullfrogs, fish, or crayfish are necessary for breeding. Last sighted in 2000 in Stevens.
Taxidea taxus American badger	--/SSC/--	Moderate - High	Prefer to live in dry, open grasslands, farmlands, fields, and pastures. Seen on Strand Ranch in 2003.
Thamnophis gigas Giant garter snake	FT/ST/--	Moderate	Ideal habitat would be characterized as having dense emergent vegetation for escape from predation, deep and shallow pools of water (which persist throughout the seasonal cycle of activity) in which to forage and seek cover, open areas along the margins to allow for basking, and upland habitat with access to structures suitable for hibernation and escape from flooding.

**TABLE 3.4-3 (CONT.)
SPECIAL-STATUS SPECIES AND HABITAT WITH POTENTIAL TO OCCUR WITHIN THE PROPOSED PROJECT AREA AND GREATER KERN COUNTY**

Species/Natural Communities	Listing Status (USFWS/CDFG/ CNPS)	Likelihood of Occurrence	Comments
Toxostoma lecontei Le Conte's thrasher	--/SSC/--	Very Low	Generally found in open desert scrub, alkali desert scrub, and desert succulent scrub. In the San Joaquin Valley, the species is found primarily in habitats dominated by saltbush, and often frequents desert washes and flats with scattered saltbush. Habitat on Strand Ranch is not favorable for this species
Vulpes macrotis mutica San Joaquin kit fox	FE/ST/--	Moderate	Include grasslands and scrublands with active oil fields, wind turbines, and an agricultural matrix of row crops, irrigated pasture, orchards, vineyards, and grazed annual grasslands (nonirrigated pasture). Potential scat and tracks were observed during 2003 and 2006 PPA field surveys. Last sighted near Strand Ranch in 2002 and in the surrounding area in 1990 & 1990.
Xanthocephalus xanthocephalus Yellow-headed blackbird	CNDDB	Low	Nests in freshwater emergent wetlands in dense vegetation and deep water, often along lakes or ponds. Nests only where large insects, such as coonata are abundant, nesting is timed with emergence of aquatic insects. Last known occurrence was an observation in the area in 1923.
Plants			
Astragalus hornii var. *hornii* Horn's milk-vetch	--/--/1B	Very Low	Found in meadows, seeps and plays, along lake margins and alkaline sites.
Atriplex cordulata Heartscale	--/--/1B	Very Low	Hard, trampled soil, grassland, saline or alkaline soils.
Atriplex subtilis Subtle orache	--/--/1B	Very Low	Found generally in alkaline or saline soils.
Atriplex vallicola Lost Hills crownscale	FSC/--/1B	Very Low	Found in dried ponds, rain pools, and flats with Alkaline soils.
Calochortus striatus Alkali mariposa lily	--/--/1B	Very Low	Occurs in alkaline meadows and moist places.
Caulanthus californicus California jewel-flower	FE/SE/1B	Low	Found in several plant communities, including Non-native grassland, Upper Sonoran Subshrub Scrub, and Cismontane Juniper Woodland and Scrub. Historical records indicate that this species also occurred in the Valley Saltbush Scrub community in the past.
Cirsium crassicaule Slough thistle	--/--/1B	Very Low	Found in Chenopod scrub, marshes and swamps, and riparian scrub.
Delphinium recurvatum Recurved larkspur	--/--/1B	Very Low	Found on well-drained hillsides among grasses and in chaparral and oak woodland.
Eremalche kernensis Kern mallow	--/--/1B	Low	Found in chenopod scrub, valley and foothill grassland. Associated with dry, open sandy to clayey soils, usually within saltbrush scrub.
Eschscholzia lemmonii ssp. *kernensis* Tejon poppy	--/--/1B	Very Low	Found within the Tehachapi and Transverse Mountain Ranges between 250 to 750 meters.
Plants			
Lasthenia glabrata ssp. *coulteri* Coulter's goldfields	--/--/1B	Very Low	Found in coastal salt marshes, playas, valley and foothill grasslands, and vernal pools. Associated with alkaline soils. Last reported in the area in 1963.
Monolopia congdonii San Joaquin woollythreads	FE/--/1B	Very Low	Found in sandy or clayey grassland and alkaline plains.

TABLE 3.4-3 (CONT.)
SPECIAL-STATUS SPECIES AND HABITAT WITH POTENTIAL TO OCCUR WITHIN THE PROPOSED PROJECT AREA AND GREATER KERN COUNTY

Species/Natural Communities	Listing Status (USFWS/CDFG/ CNPS)	Likelihood of Occurrence	Comments
Stylocline citroleum Oil neststraw	--/--/1B	Very Low	Typically found in clayey soils in oil producing areas and is associated chenopod scrub.
Stylocline masonii Mason's neststraw	--/--/1B	None	Associated with chenopod scrub, pinyon-juniper woodland; microhabitat includes sandy washes.
Natural Communities			
Great Valley Cottonwood Riparian Forest	CNDDB	None	Confirmed not present.
Great Valley Mesquite Scrub	CNDDB	None	Confirmed not present.
Valley Sacaton Grassland	CNDDB	None	Confirmed not present.
Valley Saltbush Scrub	CNDDB	None	Confirmed not present.
Valley Sink Scrub	CNDDB	None	Confirmed not present.

SOURCE: CDFG, 2006; Skinner and Pavlik, 2004; and USFWS 2006.

Key

USFWS	*CDFG*	*CNPS*
FE = federally endangered	SE = state endangered	1B = CNPS List 1B plant ("Plants rare, threatened or endangered in California and elsewhere")
FT = federally threatened	ST = state threatened	
FC = federal candidate	SC = state candidate	
FSC = federal species of concern	SSC = state species of special concern	
FPS = Fully protected species	SE-FP = state fully protected	
CNDDB = Tracked by CNDDB; no special regulatory status		

Tipton kangaroo rat. The Tipton kangaroo rat is a California and federally listed endangered species. Tipton kangaroo rats eat mostly seeds, with small amounts of green, herbaceous vegetation and insects supplementing their diet when available. Burrow systems are usually in open areas but may occur in areas of thick scrub. Current occurrences are limited to scattered, isolated areas. In the southern San Joaquin Valley this includes the Kern National Wildlife Refuge, Delano, and other scattered areas within Kern County.[4] The Tipton kangaroo rat is known to occur in the area and could reenter the CVC slough region (PPA, 2003).

San Joaquin Kit Fox. The San Joaquin kit fox is a state threatened and federally listed endangered species. The San Joaquin kit fox (Vulpes macrotis mutica) is the smallest fox in North America, with an average body length of 20 inches and weight of about 5 pounds. Diet varies geographically, seasonally and annually, based on abundance of prey. They feed primarily on ground squirrels, kangaroo rats, desert cottontails, mice, insects, carrion and ground-nesting birds. Their habitat includes the San Joaquin Valley and Kern County area. The San Joaquin kit fox is known to occur in the area and could reenter the CVC slough region. Potential kit fox scat and track was found on the project site during PPA's 2006 reconnaissance surveys.

Swainson's hawk. The Swainson's hawk is a state threatened species and protected by the federal Migratory Bird Treaty Act. These birds sometimes travel in huge flocks and migrate from

4 USFWS species account for the Tipton Kangaroo Rat, June 6, 2007.

North America to Argentina but are monogamous and solitary nesters. They nest in strands with few trees in juniper-sage flats, riparian areas, and in oak savannahs. They require suitable adjacent foraging areas such as grasslands or alfalfa and grain fields which support rodent populations (PPA, 2006). Two Swainson's hawks were observed foraging on the site during PPA's field reconnaissance surveys in 2005. Large trees suitable for raptor nests exist on the project site and a raptor nest was noted as occurring in an old cottonwood in the south part of the project (PPA, 2006).

Tricolored blackbird. The Tricolored blackbird is a California species of special concern. This blackbird is restricted to California and is gregarious in all seasons, nesting in dense colonies, usually in freshwater marshes (PPA, 2006). Suitable nesting habitat exists south of the project within the riparian habitat of the Kern River (PPA, 2006). Tricolored blackbirds were observed foraging on the project site during field reconnaissance surveys conducted by PPA in the spring of 2005.

Western spadefoot toad. The western spadefoot toad is a California species of special concern. The western spadefoot tolerates a wide range of conditions from arid to semiarid. It prefers open areas of shortgrass plains and sandy and alkali flats, washes, and river flood plain (Behler & King, 1996). Intermittent pools of water, irrigation canal, reservoirs, edges of streams, and rain pools are frequented for breeding. This species has been reported to occur in Bakersfield and the Kern County area.

Wildlife

During the 2003 survey by PPA, 13 sensitive species were actively sought in the field. These 13 sensitive species are tricolored blackbird (*Agelaius tricolor*), Nelson's antelope squirrel (*Ammospermophilus nelsoni*), burrowing owl (*Athene cunicularia*), Swainson's hawk (*Buteo swainsoni*), mountain plover (*Charadrius montanus*), Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*), blunt-nosed leopard lizard (*Gambelia sila*), southwestern pond turtle (*Emys* (=Clemmys) *marmorata pallida*), San Joaquin pocket mouse (*Perognathus inornatus inornatus*), giant garter snake (*Thamnophis gigas*), Buena Vista shrew (*Sorex ornatus relictus*), western spadefoot toad (*Spea* (=Scaphiopus) *hammondii*), and San Joaquin kit fox (*Vulpes macrotis mutica*) (PPA, 2003). The burrowing owl, tricolored blackbird, and Swainson's hawk were observed during 2006 field surveys. Evidence of the San Joaquin kit fox was observed in during 2003 and 2006 field surveys.

Fourteen additional special-status species with the potential to occur within the vicinity of Strand Ranch were flagged during the CNDDB database search of the Tupman quadrangle, eight adjacent quadrangles, and the USFWS list of endangered and threatened species in Kern County. These species were noted after the 2003 survey (CNDDB, 2006; USFWS, 2006) and prior to ESA's 2007 survey. These 14 additional special-status species are western snowy plover (*Charadrius alexandrinus nivosus*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), fulvous whistling-duck (*Dendrocygna bicolor*), giant kangaroo rat (*Dipodomys ingens*), short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*), southwestern willow flycatcher (*Empidonax trallii extimus*), desert tortoise (*Gopherus agassizzii*), California condor

(*Gymnogyps californianus*), Tulare grasshopper mouse (*Onychomys torridus tularensis*), coast (California) horned lizard [*Phrynosoma coronatum* (frontale population)], white-faced ibis (*Plegadis chihi*), American badger (*Taxidea taxus*), Le Conte's thrasher (*Toxostoma lecontei*), and least Bell's vireo (*Vireo bellii pusillus*) (CNDDB, 2006). The American badger was observed during 2003 field surveys.

Lack of evidence during field surveys does not preclude the existence of some of these species at the project site. Due to unfavorable habitat types at Strand Ranch, the Nelson's antelope squirrel, white-faced ibis, blunt-nosed leopard lizard, southwestern pond turtle, western snowy plover, fulvous whistling-duck, southwestern willow flycatcher, desert tortoise, Tulare grasshopper mouse, coast (California) horned lizard, Le Conte's thrasher, least Bell's vireo and Buena Vista shrew, have a very low likelihood-no likelihood of occurrence (see Table 3.4-3).

Birds

The burrowing owl is a species that could occur at Strand Ranch due to the significant amount of surrounding vacant land for foraging and existing burrows at the site which can be utilized. Burrowing owls were observed on burrows on the property during PPA's 2006 reconnaissance surveys. In addition, two Swainson's hawks were observed foraging over the site during PPA's 2006 reconnaissance surveys and potential nesting habitat for this species exists (PPA, 2006).

The placement of the CVC, Pioneer Canal, and slough, with disturbed riparian habitat and trees nearby, provide potential for foraging at Strand Ranch by the western yellow-billed cuckoo, and California condor. Although the potential for foraging is present for these species, the riparian habitat is of lower function and value and would not likely support nesting or breeding activities. There is an adequate source of water supplied by the canals and agricultural drainages. Coupled with the abundance of open space for foraging, this type of habitat and conditions are favorable for the tricolored blackbird and mountain plover which could utilize the project site. Tricolored blackbirds were observed foraging on the property during PPA's 2006 field reconnaissance surveys.

Mammals

The San Joaquin kit fox is a federally endangered and state threatened species. The San Joaquin kit fox can utilize agricultural land and has been known to exist in the area, possibly entering through the CVC slough (PPA, 2003). The habitat found at Strand Ranch is favorable for this species and therefore, this fox could utilize the project site. Potential kit fox scat and track was found on the project site during 2003 and 2006 surveys.

The Tipton kangaroo rat was not observed during the 2003 survey. However, burrows were identified during both the 2003 and 2007 surveys that are likely rat burrows due to their size and tail-drag marks leading into the burrow entrances. Heermann's kangaroo rat (*Dipodomys heermanni*) burrows were identified at Strand Ranch in 2003. These burrows could be Tipton kangaroo rat burrows since Heermann's kangaroo rats and Tipton's kangaroo rats live sympatrically together (PPA, 2003). Based on observations and the above provided information, the Tipton's kangaroo rat could occur at the project site. The giant kangaroo rat is a federally and state endangered species. This species prefers annual grassland on gentle slopes of generally less than 10 degrees, with friable, sandy-loam soils. Due to habitat modification, most remaining populations are on poorer, marginal habitats which include shrub communities on a variety of soil types and on slopes up to about 22 degrees. The San Joaquin pocket mouse is found in fine-textured, sandy soils similar to those found at Strand Ranch and in areas where plant cover is not dense and soils are friable. Based on this information there is a low potential that the giant kangaroo rat and San Joaquin pocket mouse could occur at the project site.

The American badger is a state species of special concern. These mammals prefer to live in open areas such as grasslands, farmlands, fields and pastures. Small burrowing mammals such as ground squirrels, rats, gophers, and mice, make up much of the badgers diet. Strand Ranch supports adequate habitat for this species to live and forage. In addition, an American badger was observed on the property in 2003 (PPA, 2003). Therefore Strand Ranch supports this species.

Amphibians

The western spadefoot toad is a state species of special concern. This toad inhabits a wide variety of habitats and has been known to live in irrigation structures, such as the CVC (PPA, 2003) and Pioneer Canal. Therefore, there is potential for the occurrence of the western spadefoot toad at Strand Ranch.

Reptiles

The giant garter snake is a state and federally threatened species. The giant garter snake, the most aquatic of the garter snakes in California, prefers habitat characterized by deep and shallow pools of water, emergent vegetation and open areas for basking. Strand Ranch provides favorable habitat for this species near the CVC and Pioneer Canal. This giant garter snake has potential to occur on Strand Ranch (PPA, 2003).

Plants

During the 2003 and 2006 survey, no evidence of special-status plant species was found at Strand Ranch (PPA, 2003 & 2006). No *Atriplex* species were observed at the project site (PPA, 2006). The closest observed location of an *Atriplex* species is the Lost Hills crownscale, which was found five miles west-southwest in the Tule Elk State Preserve (PPA, 2003).

The alkali mariposa lily is distributed throughout the Mojave Desert. Records of this plant include the Kern, Los Angeles, and San Bernardino counties. The alkali mariposa lily (*Calochortus striatus*) was not observed on the project site (PPA, 2006) and the nearest recorded location is about five miles southwest of the project at Coles Levee and Union Road. More recently it was observed blooming in May and June of 2005, southwest of Rosamond (PPA, 2006).

The California jewel-flower (*Caulanthus californicus*) is listed as endangered by both USFWS and CDFG was not found at Strand Ranch. The closest occurrence was reported about seven miles north in 1900, but was reported extirpated from this location in 1986 (PPA, 2006). This unique flower is reported in the Paine Preserve where 13 plants were counted in 1986 (PPA 2006).

The slough thistle (*Cirsium crassicaule*) also was not found at Strand Ranch. The closest reported location is approximately five miles south-southwest in the Outlet Canal, which was observed in 1998 (PPA, 2003). The recurved larkspur (*Delphinium recurvatum*) was not found at Strand Ranch. The closest reported location is from a 1992 observation just west of the project in section 28 (PPA, 2006). The Tejon poppy (*Eschscholzia lemmonii* ssp. *kernensis*) is typically found within the Tehachapi and Transverse Mountain Ranges and was not observed at Strand Ranch (PPA, 2003). The closest reported location of this poppy is on Skyline Road about six miles southwest of the project site (PPA, 2003).

Coulter's goldfields (*Lasthenia glabrata* ssp. *coulteri*) is another plant that is tracked by CNDDB as a CNPS 1B plant. No lasthenia was identified on the project site and the closest reported occurrence by the CNDDB is about six miles southwest of the project site. The San Joaquin woollythreads (*Monolopia congdonii*) was not observed at Strand Ranch. The closet recorded observance was about two miles southeast of the project site just east of Highway 43 (PPA, 2003). Mason's neststraw (*Stylocline masonii*), a CNPS 1B plant, was not identified at the project site. Finally, the oil neststraw (*Stylocline citroleum*), which occurs in oil producing areas, was also not found at Strand Ranch; the closest recorded location was about 10 miles southwest in the Buena Vista Hills (PPA, 2003). No neststraw-like plants were found on the project site.

During PPA's 2003 and 2006 survey[5], and ESA's 2007 survey, all plants observed at Strand Ranch were noted. In addition to agricultural land, there is native and non-native vegetation present on the property. Riparian vegetation, such as willow (*Salix* sp.) and mulefat (*Baccharis salicifolia*), exist along the Pioneer Canal and the CVC slough.. Grasses, such as *Bromus* sp. are also found scattered in some of these areas. Non-native vegetation found on Strand Ranch include black mustard (*Brassica nigra*), five-stamen tamarisk (*Tamarix chinensis*), jimson weed (*Datura* sp.), and common monkeyflower (*Mimulus guttatus*). Native species (in addition to the riparian species listed above) include caterpillar phacelia (*Phacelia cicutaria*).

3.4.2 Regulatory Framework

Federal

Federal Endangered Species Act

Under the federal Endangered Species Act (FESA), the Secretary of the Interior and the Secretary of Commerce jointly have the authority to list a species as threatened or endangered (16 USC 1533(c)). Pursuant to the requirements of FESA, an agency reviewing a proposed project within its jurisdiction must determine whether any federally listed or proposed species may be present in the project region and determine whether the proposed project would have a potentially significant impact on such species. In addition, the agency is required to determine

[5] A complete list of plants observed during PPA's biological surveys can be found in appendix X of this document

whether the project is likely to jeopardize the continued existence of any species proposed to be listed under FESA or result in the destruction or adverse modification of critical habitat proposed to be designated for such species (16 USC 1536(3), (4)). Project-related impacts to these species or their habitats would be considered "significant." The "take" prohibition of the FESA prohibits any action that adversely affects a member of an endangered or threatened species.

Section 4(a)(3) and (b)(2) of the FESA requires the designation of critical habitat to the maximum extent possible and prudent based on the best available scientific data and after considering the economic impacts of any designations. Critical habitat is defined in section 3(5)(A) of the FESA as (1) areas within the geographic range of a species that are occupied by individuals of that species and contain the primary constituent elements (physical and biological features) essential to the conservation of the species, thus warranting special management consideration or protection, and (2) areas outside of the geographic range of a species at the time of listing but that are considered essential to the conservation of the species.

Migratory Bird Treaty Act

The federal Migratory Bird Treaty Act (16 U.S.C., Sec. 703, Supp. I 1989) prohibits killing, possessing, or trading in migratory birds except in accordance with regulations prescribed by the Secretary of the Interior. This act encompasses whole birds, parts of birds, and bird nests and eggs. Bird species and their nests that occur within the proposed project area would be protected under the MBTA.

State

California Endangered Species Act

Under the California Endangered Species Act (CESA), the CDFG is responsible for maintaining a list of threatened and endangered species (California Fish and Game Code 2070), candidate species, and species of special concern. Pursuant to the requirements of CESA, an agency reviewing a proposed project within its jurisdiction must determine whether any state listed endangered or threatened species may be present on the project region and determine whether the proposed project would have a potentially significant impact on such species. In addition, the CDFG encourages informal consultation on any proposed project that may impact a candidate species. If there were project-related impacts to species on the CESA threatened and endangered list, they would be considered "significant." Impacts to "species of concern" would be considered "significant" under certain circumstances, discussed below.

Although threatened and endangered species are protected by specific federal and state statutes, *CEQA Guidelines* Section 15380(b) provides that a species not listed on the federal or state list of protected species may be considered rare or endangered if the species can be shown to meet certain specified criteria. These criteria have been modeled after the definition in FESA and the section of the California Fish and Game Code dealing with rare or endangered plants or animals. This section was included in the *CEQA Guidelines* primarily to deal with situations in which a public agency is reviewing a project that may have a significant effect on, for example, a candidate species that has not yet been listed by either the USFWS or CDFG. Thus, CEQA provides an agency with the ability to protect a species from a project's potential impacts until the respective government agencies have an opportunity to designate the species as protected, if warranted.

California Department of Fish and Game Code

Fully-Protected Species

The California Fish and Game Code provides protection from "take" for a variety of species that possess "fully-protected species" status. Fully protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except for collecting these species for necessary scientific research and relocation of the bird species for the protection of livestock.

Bird and Nest Protection

Section 3503 of the California Fish and Game Code prohibits the killing of birds or the destruction of bird nests. Birds of prey are protected in California under the State Fish and Game Code, Section 3503.5 1992). Section 3503.5 states that it is "unlawful to take, possess, or destroy any birds in the order Falconiformes or Strigiformes (birds of prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto." Project impacts to these species would not be considered "significant" in this EIR unless they are known or have a high potential to nest on the site or rely on it for primary foraging.

Wetland Regulations

U.S. Army Corps of Engineers

Wetlands and other waters, e.g., rivers, streams and natural ponds, are a subset of "waters of the U.S." and receive protection under Section 404 of the Clean Water Act (CWA). The U.S. Army Corps of Engineers (USACE) has primary federal responsibility for administering regulations that concern waters and wetlands on the project site under statutory authority of the CWA (Section 404). In addition, the regulations and policies of various federal agencies (e.g., U.S. Department of Agriculture, and Natural Resource Conservation Service [NRCS], USEPA) mandate that the filling of wetlands be avoided to the extent feasible. The USACE requires obtaining a permit if a project proposes placing structures within navigable waters and/or alteration of waters of the United States.

The term "waters of the United States" as defined in Code of Federal Regulations (33 CFR 328.3[a] and [b]; 40 CFR 230.3[s]) includes those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. In extant regulations, these may be taken to be sloughs, wet meadows, or natural ponds; however, the Supreme Court of the United States recently ruled (January 8, 2001: *Solid*

Waste Agency of Northwestern Cook County (SWANCC) v. United State Army Corps of Engineers et al.) that certain isolated wetlands do not fall under the jurisdiction of the CWA.

Based on the Supreme Court ruling (SWANCC), non-navigable, isolated, intrastate waters are no longer defined as waters of the United States. Jurisdiction of non-navigable, isolated, intrastate waters may be possible if their use, degradation, or destruction could affect other waters of the Unites States, or interstate or foreign commerce. Jurisdiction over such other waters is analyzed on a case-by-case basis. Impoundments of waters, tributaries of waters, and wetlands adjacent to waters should be analyzed on a case-by-case basis.

A more recent Supreme Court case, *Rapanos v. United States* (2006), also questioned the definition of "waters of the United States" and the scope of federal regulatory jurisdiction over such waters, but left open the question as to whether the CWA extends to those waters and wetlands that have a "significant nexus" to navigable waters of the United States, or whether it is limited to waters with a continuous connection. The implications of this ruling are still being tested in the courts. For example, the California Ninth Circuit Court of Appeals decision, in *Northern California River Watch v. City of Healdsburg* (August 10, 2006), relied on the "significant nexus" definition, an interpretation that suggests little change in the scope of the CWA. To date, neither the USEPA nor the USACE have issued guidelines as to how to implement the CWA in light of these latest rulings. In practice, USACE jurisdictional authority remains as it was prior to *Rapanos*, although the potential exists for changes in the future based on Court decisions and pending regulatory guidance.

Central Valley Regional Water Quality Control Board

Under Section 401 of the federal CWA, the Central Valley Regional Water Quality Control Board (RWQCB) must certify that actions receiving authorization under section 404 of the CWA also meet state water quality standards. The RWQCB also regulates waters of the state under the Porter-Cologne Act Water Quality Control Act (Porter Cologne Act). The RWQCB requires projects to avoid impacts to wetlands if feasible and requires that projects do not result in a net loss of wetland acreage or a net loss of wetland function and values. The RWQCB typically requires compensatory mitigation for impacts to wetlands and/or waters of the state. The RWQCB also has jurisdiction over waters deemed 'isolated' or not subject to Section 404 jurisdiction under *Solid Waste Agency of Northern Cook County v. U.S. Army Corps of Engineers* (SWANCC)[6]. Dredging, filling, or excavation of isolated waters constitutes a discharge of waste to waters of the state and prospective dischargers are required obtain authorization through an Order of Waste Discharge or waiver thereof from the RWQCB and comply with other requirements of Porter-Cologne Act.

[6] Based on the Supreme Court ruling (SWANCC) concerning the Clean Water Act jurisdiction over isolated waters (January 9, 2001), non-navigable, isolated, intrastate waters based solely on the use of such waters by migratory birds are no longer defined as waters of the United States. Jurisdiction of non-navigable, isolated, intrastate waters may be possible if their use, degradation, or destruction could affect other waters of the Unites States, or interstate or foreign commerce. Jurisdiction over such other waters are analyzed on a case-by-case basis. Impoundments of waters, tributaries of waters, and wetlands adjacent to waters should be analyzed on analyzed on a case-by-case basis.

California Department of Fish and Game

Under Sections 1600 – 1616 of the California Fish and Game Code, the CDFG regulates activities that would substantially divert, obstruct the natural flow, or substantially change of rivers, streams and lakes. The jurisdictional limits of CDFG are defined in Section 1602 of the California Fish and Game Code as, "bed, channel, or bank of any river, stream, or lake, or deposit or dispose of debris, waste, or other material containing crumbled, flaked, or ground pavement where it may pass into any river, stream, or lake…." The CDFG requires a Lake and Streambed Alteration Agreement for activities within its jurisdictional area. Impacts to the jurisdictional area of the CDFG would be considered "significant" in this EIR.

Local

Kern County General Plan

Biology within the area of the proposed project is also governed by the *Kern County General Plan* (Kern County, 2004). Within the Land Use, Open Space, and Conservation Element General Provisions Section of the County General Plan, there are policies and implementation measures that are applicable to the proposed project:

- Policy 27: Threatened or endangered plant and wildlife species should be protected in accordance with State and federal laws.
- Policy 28: County should work closely with State and federal agencies to assure that discretionary projects avoid or minimize impacts to fish, wildlife, and botanical resources.
- Policy 29: The County will seek cooperative efforts with local, State, and federal agencies to protect listed threatened and endangered plant and wildlife species through the use of conservation plans and other methods promoting management and conservation of habitat lands.
- Policy 30: The County will promote public awareness of endangered species laws to help educate property owners and the development community of local, State, and federal programs concerning endangered species conservation issues.
- Policy 31: Under the provisions of the California Environmental Quality Act (CEQA), the County, as lead agency, will solicit comments from the California Department of Fish and Game and the U.S. Fish and Wildlife Service when an environmental document (Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report) is prepared.
- Policy 32: Riparian areas will be managed in accordance with United States Army Corps of Engineers, and the California Department of Fish and Game rules and regulations to enhance the drainage, flood control, biological, recreational, and other beneficial uses while acknowledging existing land use patterns.
- Implementation Measure Q: Discretionary projects shall consider effects to biological resources as required by the California Environmental Quality Act.

- Implementation Measure R: Consult and consider the comments from responsible and trustee wildlife agencies when reviewing a discretionary project subject to the California Environmental Quality Act.

Bakersfield General Plan

Strand Ranch is also located within the area governed by the *Metropolitan Bakersfield General Plan* (City of Bakersfield and Kern County, 2002). Within the Conservation Element Biological Resources Section of the Bakersfield General Plan, there are goals, policies, and an implementation measure that are applicable to the Proposed Project:

- Goal 1: Conserve and enhance Bakersfield's biological resources in a manner which facilitates orderly development and reflect the sensitivities and constraints of these resources.
- Goal 2: To conserve and enhance habitat areas for designated "sensitive" animal and plant species.
- Policy 1: Direct development away from "sensitive biological resource" areas, unless effective mitigation can be implemented.
- Policy 2: Preserve areas of riparian vegetation and wildlife habitat within floodways and along rivers and streams, in accordance with the Kern River Plan Element and channel maintenance programs designed to maintain flood flow discharge capacity.
- Implementation 3: Preserve habitat and avoid "take" of protected species as required in the Metropolitan Bakersfield Habitat Conservation Plan.

Metropolitan Bakersfield Habitat Conservation Plan

The MBHCP addresses the effect of urban growth on federally and State protected plant and animal species within the Metropolitan Bakersfield 2010 General Plan area. The MBHCP is a joint program of the City of Bakersfield and Kern County that was undertaken to assist urban development applicants in complying with State and federal endangered species laws. The MBHCP utilizes a mitigation fee paid by applicants for grading or building permits to fund the purchase and maintenance of habitat land to compensate for the effects of urban development on endangered species habitat. Half of the Strand Ranch falls within the MBHCP area. However, the MBHCP finds that "commercial agricultural" activities are exempt from the requirements of the plan. Therefore, the proposed project would not be subject to MBHCP requirements.

3.4.3 Project Impacts and Mitigation Measures

Significance Criteria

Based on the *CEQA Guidelines*, a project may be deemed to have a significant effect on the environment with respect to biological resources if it would:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service;

- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service;
- Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means;
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
- Conflict with any local policies or ordinances protecting biological resources, such as tree preservation policy or ordinance; and/or
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or approved local, regional, or state habitat conservation plan.

Impacts Discussion

The CVC and Pioneer Canal cross the project site on an east-west axis. Neither canal is considered a jurisdictional water feature. The canals are water supply conveyance facilities and thus are not considered waters of the US or waters of the state. These irrigation canals are not under the jurisdiction of (or subject to regulation by) the USACE (per Section 404 of the CWA), the CDFG (per Section 1600 of the Fish and Game Code), or the RWQCB (per Section 401 of the CWA).

The CVC is the water source for the slough that exists south of the CVC on Strand Ranch. The slough consists of a canal and borrow pit. Historically, the canal has been used by neighboring KWBA to convey water from the CVC to its recharge ponds east of Strand Ranch. Water conveyed through the canal to KWBA floods the slough. Although the riparian vegetation and conditions found in the slough meet the requirements of a wetland as defined by the USACE, there is no natural hydrological connection between the slough and any jurisdictional navigable waters, and therefore the slough is not a jurisdictional wetland. The proposed project would not impact the CVC, Pioneer Canal or slough. The proposed project would have no impact on riparian areas or wetlands.

The property will continue to be used for agricultural purposes approximately eight months of the year. Therefore, the proposed project is considered exempt from the stipulations contained within the MBHCP, which exempts "commercial agriculture." As a result of this exemption, no mitigation fee is required. However, the proposed project is therefore not covered by the 10(a) USFWS or the 2081 CDFG incidental take permits provided by the MBHCP for impacts to sensitive species.

The proposed project would convert agricultural land to recharge reservoirs. The area currently affords some wildlife movement since it is generally undeveloped and adjacent to native habitats. Wildlife movement across the site could continue with implementation of the project through corridors between recharge basins and across the basins themselves when they are not full of water. The proposed project would not eliminate or significantly discourage wildlife movement.

Impact 3.4-1: Activities associated with the construction of the proposed project could result in adverse impacts to special-status bird species. Less than Significant with Mitigation.

The proposed project could result in the displacement of burrowing owls. No protocol burrowing owl surveys were conducted at the site. Burrowing owls are considered sensitive by both the state and federal government. Burrowing owls are known to occur on the property and may inhabit small mammal burrows along edges of and within agricultural fields. If burrowing owls nest on the project site and these nesting birds are displaced by construction of the project, this would be a significant impact. It is recommended that a Burrowing Owl Survey be conducted according to the *Staff Report on Burrowing Owl Mitigation* prepared by CDFG (1995)(see **Mitigation Measure 3.4-1a**). With incorporation of **Mitigation Measure 3.4-1a** the impacts to burrowing owls would be less than significant.

The proposed project could also affect special-status species that have the potential to occur on the site, including the Swainson's hawk, tricolored blackbird, and the mountain plover as well as more common migratory birds that are protected by the MBTA. Direct impacts to biological resources would involve the removal of the almond tree orchard which has the potential to provide nesting opportunities for resident birds. Impacts to individual nesting special-status birds could occur if these species were nesting on or adjacent to the construction areas at the time of construction. Removal of trees or shrubs that provide nesting habitat could result in the direct mortality of birds. Tree removal, construction noise, vibrations, and human disturbance could cause nest abandonment, death of the young, or loss of reproductive potential at active nests located near project activities. This would be a significant impact. A migratory bird and raptor nesting survey would be conducted prior to construction activities (see **Mitigation Measure 3.4-1b**). Implementation of **Mitigation Measure 3.4-1b** would reduce potential impacts to special-status nesting and migratory birds to a less than significant level.

Mitigation Measures

Mitigation Measure 3.4-1a: A pre-construction survey shall be conducted for burrowing owls 14 to 30 days prior to clearing of the site by a qualified biologist in accordance with the most recent CDFG protocol, currently the *Staff Report on Burrowing Owl Mitigation* (CDFG 1995). Surveys shall cover areas disturbed by construction including a 500-foot buffer (within the Strand Ranch property). The survey would identify adult and juvenile burrowing owls and signs of burrowing owl occupation. This survey shall include two early morning surveys and two evening surveys to ensure that all owl pairs have been located.

If occupied burrowing owl habitat is detected on the Strand Ranch site, measures to avoid, minimize, or mitigate impacts shall be incorporated into the project and shall include the following:

- Construction exclusion areas shall be established around the occupied burrows in which no disturbance shall be allowed to occur while the burrows are occupied. During the non-breeding season (September 1 through January 31), the exclusion zone shall extend 160 feet around the occupied burrows. During the breeding season (February 1 through August 31), exclusion areas shall extend 250 feet around occupied burrows.
- Passive relocation of on-site owls may be implemented during the non-breeding season after coordinating with CDFG. Passive relocation shall be accomplished by installing one-way doors on the entrances of burrows located within 160 feet of the project site. The one-way doors shall be left in place for 48 hours to ensure that the owls have left the burrow.
- For each burrow affected by project construction, two alternate unoccupied natural or artificial burrows shall be provided outside of the 160-foot buffer zone (CDFG 1995). The alternate burrows shall be monitored daily for one week to confirm that owls have moved and acclimated.
- Burrows in the construction area shall be excavated using hand tools under the supervision of a qualified biologist and then refilled to prevent reoccupation. If any burrowing owls are discovered during excavation, the excavation shall cease and the owl(s) be allowed to escape. Excavation shall be completed when the biological monitor confirms that the burrow is empty.
- If owls are identified on or adjacent to the site, a qualified biologist shall provide a pre-construction worker education program to contractors and their employees that describes the life history and species protection measures that are in effect to avoid impacts to burrowing owls.

Mitigation Measure 3.4-1b: The following measures would reduce potential impacts to nesting and migratory birds and raptors to less than significant levels.

- Within 15 days of site clearing, a qualified biologist shall conduct a pre-construction, migratory bird and raptor nesting survey. The biologist must be qualified to determine the status and stage of nesting by migratory birds and all locally breeding raptor species without causing intrusive disturbance. This survey shall include species protected under the MBTA including the Swainson's hawk, tricolored blackbird, mountain plover. The survey shall cover all reasonably potential nesting locations for the relevant species on or closely adjacent to the project site.
- If an active nest is confirmed by the biologist, no construction activities shall occur within at least 500 feet of the nesting site until the end of the breeding

season when the nest has failed or the young have fledged. CDFG will be notified of the identification of active nests and will be consulted regarding resumption of construction activities.

- Removed trees that have been documented during pre-construction surveys as supporting Swainson's hawk nests shall be replaced with suitable native nest tree species (i.e., cottonwoods, etc.) within 1/2 mile of the project area and adjacent to suitable foraging habitat.

Significance After Mitigation: Less than significant.

Impact 3.4-2: Activities associated with the construction of the proposed project could result in adverse impacts to the American badger. Less than Significant with Mitigation.

American badgers are uncommon but known to occur in the general project region, and were observed on Strand Ranch by PPA in 2003. American badgers are a state species of concern. Construction activities including vegetation removal and any ground disturbing activities have the potential to result in the mortality or injury to American badgers. This would be a significant impact and it is recommended that a badger survey be conducted prior to construction activities (see **Mitigation Measure 3.4-2**). Implementation of **Mitigation Measure 3.4-2** would reduce potential impacts to the American badger to a less than significant level.

Mitigation Measures

Mitigation Measure 3.4-2: A qualified biologist shall conduct focused preconstruction surveys no more than two weeks prior to construction for potential American badger dens. If no potential American badger dens are present, no further mitigation is required. If potential dens are observed, the following measures are required to avoid potential adverse effects to the American badger:

- If the qualified biologist determines that potential dens are inactive, the biologist shall excavate these dens by hand with a shovel to prevent badgers from re-using them during construction.
- If the qualified biologist determines that potential dens may be active, the entrances of the dens shall be blocked with soil, sticks, and debris for three to five days to discourage use of these dens prior to project disturbance. The den entrances shall be blocked to an incrementally greater degree over the three- to five-day period. After the qualified biologist determines that badgers have stopped using active dens within the project boundary, the dens shall be hand-excavated with a shovel to prevent re-use during construction.

Significance After Mitigation: Less than significant

Impact 3.4-3: Activities associated with the construction of the proposed project could result in adverse impacts to the San Joaquin kit fox. Less than Significant with Mitigation.

Although not observed during ESA's general biological reconnaissance survey, the San Joaquin kit fox is known to exist in the area and could enter the project site through the CVC slough (PPA,2003). Evidence of kit fox scat and track was observed during 2003 and 2006 reconnaissance surveys. Any impact to this endangered species would be significant. Impacts to these species would likely be avoided since the CVC slough would not developed as part of the proposed project. Implementation of **Mitigation Measure 3.4-3** would reduce potential impacts to the San Joaquin kit fox to a less than significant level.

Mitigation Measures

Mitigation Measure 3.4-3: IRWD shall conduct a USFWS-approved "early evaluation" of the Strand Ranch to determine if a San Joaquin kit fox survey must be completed. If the evaluation shows that the San Joaquin kit fox does not utilize the property, then no further mitigation shall be required for this endangered species. If the "early evaluation" finds potential for the presence of kit fox, a San Joaquin kit fox survey shall be conducted by a qualified biologist, between May 1 and November 1, in accordance with the USFWS San Joaquin Kit Fox Survey Protocol (1999). Evidence must be provided to the CDFG and USFWS that the San Joaquin Fox Survey Protocol has been conducted. If it is determined that the San Joaquin kit fox has the potential to utilize the property then the following measures are required to avoid potential adverse effects to this species:

- IRWD shall design the recharge basins to avoid impacting the slough area if feasible.
- IRWD shall initiate discussions with the USFWS to determine appropriate project modifications to protect kit fox, including avoidance, minimization, restoration, preservation, or compensation.
- If evidence of active or potentially active San Joaquin kit fox dens is found within the area to be impacted by the proposed project, compensation for the habitat loss shall be determined and provided in consultation with USFWS and CDFG.

Significance After Mitigation: Less than significant

Impact 3.4-4: Activities associated with the construction of the proposed project could result in adverse impacts to the giant kangaroo rat, Tipton kangaroo rat, and San Joaquin pocket mouse. Less than Significant with Mitigation.

According to the biota report from PPA in 2003 and consultation with a kangaroo rat expert[7], there is potential for the Tipton's kangaroo rat (a federal and state endangered species) to exist

[7] Bill Vanherweg (*pers. comm.*) November 1, 2007

along the Pioneer Canal and within the slough area within the Strand Ranch. In addition, based on the habitat in these areas, CNDDB records, USFWS results for the Tupman quad, and two biological surveys, there is also the possibility for the Giant kangaroo rat (federally and state endangered) and San Joaquin pocket mouse (federal species of concern) to utilize these areas within the Strand Ranch as well. Each of these species could occur along the edges of the Pioneer Canal and within the slough area. This species requires friable soils and very specific habitat requirements that are not found throughout the entire Strand Ranch parcel, but are limited to the slough area and the border of the Pioneer Canal. The CVC berms have been recently improved and do not provide suitable habitat. With implementation of the following mitigation measures the impact to the above listed species will be less than significant.

Mitigation Measures

Mitigation Measure 3.4-4a: IRWD shall design the recharge basins to avoid impacting the edges of the Pioneer Canal and slough area south of the CVC if feasible. During construction, a buffer area shall be established to prevent disturbance to the canal berm and slough area. Exclusion fencing shall be required during construction to ensure that the canal edges are not disturbed. The width of the buffer zone shall be determined by a qualified biologist permitted to trap for the species and agreed upon with CDFG and USFWS.

Mitigation Measure 3.4-4b: If avoidance measures described above are not feasible, IRWD shall conduct protocol surveys to determine the presence or absence of the giant kangaroo rat, Tipton kangaroo rat, and San Joaquin pocket mouse. Surveys will be conducted in areas of suitable habitat along the edge of the Pioneer Canal and within the slough area. The survey protocol shall follow the USFWS and CDFG-approved survey protocol for the Morro Bay kangaroo rat (1996). The survey protocol is intended to provide the USFWS and CDFG with sufficient information to assess the presence or absence of state and federally listed species including the giant kangaroo rat, Tipton kangaroo rat, and San Joaquin pocket mouse. The surveys include visual surveys followed by trapping surveys. If no signs of the species are found during the surveys, and no kangaroo rats have been trapped, the survey is considered complete and the property is considered to be unoccupied by the species. If the species is found within the area to be impacted by the proposed project, compensation for the habitat loss shall be determined and provided in consultation with USFWS and CDFG.

Significance After Mitigation: Less than significant

Impact 3.4-5: Activities associated with the construction of the proposed project could result in adverse impacts to the giant garter snake. Less than Significant with Mitigation.

Based on the conditions at Strand Ranch, CNDDB records, consultation with the USFWS and two biological surveys, the giant garter snake has the potential to occur at the project site. This species was not observed on the property; however, any impact to this state and federally threatened species would be significant. Potential habitat for the giant garter snake is limited to areas with a water source immediately nearby. The only potential habitat located on the project site would be the Pioneer Canal and areas with dirt berms. With implementation of **Mitigation Measure 3.4-5**, any impacts to the giant garter snake would be less than significant.

Mitigation Measures

Mitigation Measure 3.4-5a: IRWD shall design the recharge basins to avoid impacting the edges of the Pioneer Canal if feasible. During construction, a buffer area would be established to prevent disturbance to the canal berm. Exclusion fencing would be required during construction to ensure that the canal edges were not disturbed. A 200-foot buffer zone from the banks of giant garter snake aquatic habitat would be established as suggested in the *USFWS Guidelines for the Giant Garter Snake (2003).*

Mitigation Measure 3.4-5b: If avoidance measures described above are not feasible, IRWD shall conduct pre-construction surveys in accordance with the *USFWS Guidelines for the Giant Garter Snake (2003)* to help determine the absence/presence of the giant garter snake.

The following measures would help to reduce the impacts to the giant garter snake if determined present.

- Avoid construction activities within 200 feet from the banks of giant garter snake aquatic habitat. Confine movement of heavy equipment to existing roadways to minimize habitat disturbance.
- Construction activity within habitat shall be conducted between May 1 and October 1. This is the active period for giant garter snakes. Direct mortality is lessened because snakes are expected to actively move and avoid danger. Between October 2 and April 30 contact the Service's Sacramento Fish and Wildlife Office to determine if additional measures are necessary to minimize and avoid take.
- 24-hours prior to construction activities, the project area shall be surveyed for giant garter snakes. Survey of the project area shall be repeated if a lapse in construction activity of two weeks or greater has occurred.

Significance After Mitigation: Less than significant

3.5 Cultural Resources

The assessment of project impacts on cultural resources under CEQA (*CEQA Guidelines*, Section 15064.5) is a two-step process: (1) determine whether the project site contains cultural resources (defined as prehistoric archaeological, historic archaeological, or historic architectural resources), then (2) if the site is found to contain a cultural resource, determine whether the project would cause a substantial adverse change to the resource. The setting discussion describes cultural resources in the vicinity of the project area. The impact discussion reviews the criteria for significant impacts on cultural resources and assesses the impact of the project on cultural resources.

3.5.1 Setting

Prehistoric Context

The first large archaeological investigation of the southern San Joaquin Valley consisted of the excavation of nine sites, and the recording of numerous others, in the vicinities of Kern and Tulare Lakes (Moratto, 1984). The researchers assigned the artifacts to the ancestral Yokuts, a late prehistoric (~1000 A.D.) complex characterized by flexed burials, pottery, obsidian arrow points, millingstones and mortars, and a prolific steatite industry. Many of the sites discovered were located on the east side of the Valley, and proved to be quite large—middens up to 170 meters across. One notable paleo-indian site, the Tranquility site (Fre-48) was found approximately 30 miles west of Fresno, which exhibited features and artifacts similar to those found in the Delta region. Additional work near Buena Vista Lake noted similarities between the two upper-components of material found and the Middle and Late Periods of the known sites from the Delta region.

A three-part cultural chronological sequence, the Central California Taxonomic System (CCTS) was developed by archaeologists to explain local and regional cultural change in prehistoric central California from about 4,500 years ago to the time of European contact (Lillard, Heizer, and Fenenga, 1939; Beardsley, 1948, 1954).

The Windmiller Pattern was the earliest comprehensive view of the region, at around the terminal-Paleo-Indian Period to Lower Archaic (~6,000 B.C. to ~3,000 B.C.) (Beardsley, 1954; Ragir, 1972). This cultural horizon reflected a people well adapted to riverine and marshland environments. Scholars have maintained that these Penutian speakers came from the Columbia Plateau or western Great Basin and settled in the bountiful Delta region where they gave rise to many of the Bay Area cultures that survived up to historic times, such as the Costanoan, Miwok, Yokut, and Wintun.

The Windmiller culture was characterized by a diversified economy. The artifactual evidence of the Windmiller tradition suggests a wide range of specialized technology suited to the exploitation of a wide ranch of resources. These artifacts included large projectile points (spear or dart tips), baked-clay net sinkers, bone fish hooks, and spears. Mortars and milling slabs are predominant during this time period, as well as charmstones and abalone shell and olive snail ornaments and beads.

The subsequent Berkeley Pattern or Cosumnes culture (~2,000 B.C. to A.D. 300) reflected a change in socioeconomic complexity and settlement patterns. Many of the settlements of this period, given their size and intensity of use, demonstrated that the populations were denser and more sedentary, yet continued to exploit a diverse resource base—from woodland to grassland and marshland (King, 1974).

Out of the Cosumnes Tradition came the Hotchkiss Tradition (or "Late Horizon") by the Emergent Period, or about 500 A.D. The peoples of the Hotchkiss Tradition were likely flourishing in the Stockton and Delta region up to contact with Europeans. Materials related to the Hotchkiss Tradition include mortars and pestles, bone awls, bow and arrow.

Ethnographic Background

The project area is located within the territory of the Yokut Indians, whose boundaries covered much of the southern Central Valley up to the San Joaquin River. As with many of the other Archaic peoples adapted to valley and plains environments, the Yokuts had numerous tribelets in various settlement areas within their respective territories.

The cultural practices inferred from the Windmiller pattern would have applied to the Yokuts, both economically and technologically. Many of the Yokut cultural practices were rich in complexity and reflected many of the Windmiller and Berkeley patterns referred to above. Principally, the Yokuts displayed a diffuse economy and concomitant technology base, with an equally rich social life and burial practices (Fredrickson, 1973; Ragir, 1972). The Yokuts likely focused on hunting deer, pronghorn, rabbits, and waterfowl as well as fishing for major food sources. Additionally, the Yokuts were deft artisans of various textiles and basketry (Kroeber, 1927).

Historical Background

The Kern County area was first claimed by the Spanish in 1769. In 1772, Commander Don Pedro Fages became the first European to enter the area. Many of the early California missionaries and explorers, Fages among them, who traveled through the passes of the Tehachapi Mountains noted the wild grapes that grew abundantly in the area. Hence, they called the Tejon Pass *La Canada de las Uvas* (Canyon of the Grapes), or the "grapevine" as it is called today. In 1848, the Kern area was ceded to the United States as part of the transfer of California, Nevada, and Utah and other lands under the Treaty of Guadalupe Hidalgo.

Kern County was created in 1866 from parts of Los Angeles and Tulare Counties, with the county seat located in the now abandoned mining town of Havilah. In its beginning, Kern County was dominated by mining in the mountains and desert. The area of the San Joaquin Valley was considered inhospitable and impassable at the time due to swamps, lakes, sharp tule reeds, and diseases such as malaria. This changed when settlers started draining lands for farming and constructing canals, most dug by hand by hired Chinese laborers, to both irrigate and drain these lands. Within 10 years the area of the San Joaquin Valley surpassed the mining areas as the economic influence of the county, and the county seat was moved from Havilah to Bakersfield in 1874.

Tensions between Native Americans (mostly Mohave and Paiutes) following attacks on miners and encroaching settlers in the mountains turned deadly on several occasions. Most notably, five Indians were killed in the town of Keyesville in 1856, and another 35 were killed by soldiers in the 1863 Keyesville Massacre. Relations with other tribes were more cordial. General Edward F. Beale, who arrived in California in 1846 as a hero of the Mexican-American war, established the first Indian reservation in California at Tejon and developed Tejon Ranch to provide protection for the Haidu and safer travel through Tejon Pass (Marschner, 2000).

Much of the modern development of Kern County began with the discovery of gold along the Kern River in 1855 and again in 1894; quartz deposits were discovered in 1860, oil in 1864, which became the county's principle industry. The railroad reached Kern County in the 1870s and effectively began the county's development and large-scale permanent settlements.

Paleontological Resources

Paleontological resources are fossilized evidence of past life found in the geologic record. Despite the huge volume of sedimentary rock deposits preserved worldwide and the enormous number of organisms that have lived through time, preservation of plant or animal remains as fossils is an extremely rare occurrence. Because of the infrequency of fossil preservation, fossils (particularly vertebrate fossils) are considered to be nonrenewable resources. Because of their rarity and the scientific information they can provide, fossils are highly significant records of ancient life. Paleontological resource localities are sites where the fossilized remains of extinct animals and/or plants have been preserved.

The project is within recent alluvial floodplain soils and surface deposits underlain by bedrock layers. However, these areas are less likely to harbor paleontological resources that would qualify as significant—in terms of scientific importance—for the purposes of CEQA (*CEQA Guidelines* 15064.5[a][3]).

Methods

Archival

Hudlow and Associates (2004) conducted a records search for the project area and a 1-mile buffer around the project area on December 23, 2003 at the Southern San Joaquin Valley Information Center (File No. 03-403). As a follow-up to this records search, ESA submitted an update request on May 8, 2007 which covered 90 percent of the project area (File No. 07-172). Both records searches included a review of the Directory of Properties in the Historic Property Data File for Kern County (Office of Historic Preservation, 2007) for information on sites of recognized historical significance in the National Register of Historic Places, California Register of Historical Resources, California Inventory of Historic Resources, California Historical Landmarks, and California Points of Historical Interest.

Field Methods

Hudlow and Associates conducted a field reconnaissance of the 640-acre project area in 2004 (Hudlow, 2004). Because the majority of the project area has been highly modified, the standard archaeological survey methods employed (pedestrian surveys) were constrained due to the lack of visible native ground surface and significant alteration of the topographic setting (extensive agriculture). However, the agricultural operations tend to expose the top two meters of soil, which redistributes surface phenomena (if any) and re-deposit cultural materials across the surface. From this perspective, some of the project area retained good surface visibility.

Native American Consultation

The Native American Heritage Commission was contacted on May 10, 2007 to request a database search for sacred lands or other cultural properties of significance to local Indian people. The records search (received May 24, 2007) did not indicate the presence of Native American sacred lands in the project areas. The Commission provided a list of people who may have specific information pertaining to cultural resources in the project areas, and letters were sent to each person. No response has been received to date.

Results

Both the 2003 and 2007 records searches at the Southern San Joaquin Valley Information Center indicated that no cultural resources surveys had been conducted within the project area; however, nine surveys had been conducted within one mile of the project area. No previously recorded historical resources or unique archaeological resources have been identified in the project area. One cultural resource had been identified and recorded within one mile of the project area (a broken prehistoric mano).

The field survey conducted by Hudlow (2004) failed to identify any evidence of prehistoric or historic cultural activity. The combination of factors that include the high disturbance of the ground surface and the deep alluvial flood plain sediments that characterize the project area significantly reduce the probability that intact historical resources would be located within the project area.

A single homestead is located on the northwestern corner of project area. The homestead appears to consist of a residence, a domestic well, a covered storage area, and a shed. The farm residence exhibits typical early-mid twentieth century rural vernacular architecture with minor Craftsman Style elements with later additions and/or an in-filled front porch. The other outbuildings are corrugated steel-clad sheds and open-frame storage areas. None of the structures or buildings are representative of the historic era (or 50-years old or older) and they appear to have been modified and moved since they were built (e.g., the in-filled front porch). As a result, they do not exhibit the standard of integrity required for such structures to qualify as historical resources under CEQA. The homestead does not exhibit high value architecture and it does not appear that the site is associated with an important individual or event in California history. Consequently, this homestead and its component structures are not considered historical resources.

3.5.2 Regulatory Framework

National Register of Historic Places

The National Register of Historic Places is the nation's master inventory of known historic resources. The National Register is administered by the National Park Service and includes listings of buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archaeological, or cultural significance at the national, state, or local level.

Structures, sites, buildings, districts, and objects over 50 years of age can be listed in the National Register as significant historical resources. However, properties under 50 years of age that are of exceptional importance or are contributors to a district can also be included in the National Register. The criteria for listing in the National Register include resources that:

- Are associated with events that have made a significant contribution to the broad patterns of history;
- Are associated with the lives of persons significant in our past;
- Embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- Have yielded or may likely yield information important in prehistory or history.

California Environmental Quality Act

CEQA requires that public or private projects financed or approved by public agencies assess the effects of the project on historical resources. CEQA also applies to effects on archaeological sites, which may be included among "historical resources" as defined by *CEQA Guidelines* Section 15064.5, subdivision (a), or may be subject to the provisions of Public Resources Code Section 21083.2, which governs review of "unique archaeological resources." Historical resources generally include buildings, sites, structures, objects, or districts, each of which may have historical, architectural, archaeological, cultural, or scientific significance.

Under CEQA, "historical resources" include the following:

- A resource listed in, or determined to be eligible by the State Historical Resources Commission, for listing in the California Register of Historical Resources (Public Resources Code, Section 5024.1).
- A resource included in a local register of historical resources, as defined in Section 5020.1(k) of the Public Resources Code or identified as significant in a historical resource survey meeting the requirements of Section 5024.1(g) of the Public Resources Code, will be presumed to be historically or culturally significant. Public agencies must treat any such resource as significant unless the preponderance of evidence demonstrates that it is not historically or culturally significant.

- Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may be considered to be a historical resource, provided the lead agency's determination is supported by substantial evidence in light of the whole record. Generally, a resource will be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing in the California Register of Historical Resources (Public Resources Code, Section 5024.1), including the following:
- Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
- Is associated with the lives of persons important in our past;
- Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or
- Has yielded, or may be likely to yield, information important in prehistory or history.
- The fact that a resource is not listed in or determined to be eligible for listing in the California Register of Historical Resources, not included in a local register of historical resources (pursuant to Section 5020.1[k] of the Public Resources Code), or identified in a historical resources survey (meeting the criteria in Section 5024.1[g] of the Public Resources Code) does not preclude a lead agency from determining that the resource may be a historical resource as defined in Public Resources Code Section 5020.1(j) or 5024.1.

Archaeological resources that are not historical resources according to the above definitions may be "unique archaeological resources" as defined in Public Resources Code Section 21083.2, which also generally provides that "non-unique archaeological resources" do not receive any protection under CEQA. If an archaeological resource is neither a unique archaeological nor a historical resource, the effects of the project on those resources will not be considered a significant effect on the environment. It is sufficient that the resource and the effects on it be noted in the EIR, but the resource need not be considered further in the CEQA process.

CEQA requires that if a project results in an effect that may cause a substantial adverse change in the significance of a historical resource, or would cause significant effects on a unique archaeological resource, then alternative plans or mitigation measures must be considered. Therefore, prior to assessing effects or developing mitigation measures, the significance of cultural resources must first be determined. The steps that are normally taken in a cultural resources investigation for CEQA compliance are as follows:

- Identify potential historical resources and unique archaeological resources
- Evaluate the eligibility of historical resources
- Evaluate the effects of the project on eligible historical resources

3.5.3 Project Impacts and Mitigation Measures

Significance Criteria

For the purposes of this EIR and consistent with Appendix G of the *CEQA Guidelines*, the proposed project is considered to have a significant impact if it would result in any of the following:

- A substantial adverse change in the significance of a historical resource that is either listed or eligible for listing in the National Register of Historic Places, the California Register of Historical Resources, or a local register of historic resources;
- A substantial adverse change in the significance of a unique archaeological resource;
- Disturbance or destruction of a unique paleontological resource or site or unique geologic feature; or
- Disturbance of any human remains, including those interred outside of formal cemeteries.

CEQA provides that a project may cause a significant environmental effect where the project could result in a substantial adverse change in the significance of a historical resource (Public Resources Code, Section 21084.1). *CEQA Guidelines* Section 15064.5 defines a "substantial adverse change" in the significance of a historical resource to mean physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of a historical resource would be "materially impaired" (*CEQA Guidelines*, Section 15064.5[b][1]).

CEQA Guidelines, Section 15064.5(b)(2), defines "materially impaired" for purposes of the definition of "substantial adverse change" as follows:

The significance of a historical resource is materially impaired when a project:

- Demolishes or materially alters in an adverse manner those physical characteristics of an historical resource that convey its historical significance and that justify its inclusion in, or eligibility for, inclusion in the California Register of Historical Resources; or
- Demolishes or materially alters in an adverse manner those physical characteristics that account for its inclusion in a local register of historical resources pursuant to Section 5020.1(k) of the Public Resources Code or its identification in an historical resources survey meeting the requirements of Section 5024.1(g) of the Public Resources Code, unless the public agency reviewing the effects of the project establishes by a preponderance of evidence that the resource is not historically or culturally significant; or
- Demolishes or materially alters in an adverse manner those physical characteristics of a historical resource that convey its historical significance and that justify its eligibility for inclusion in the California Register of Historical Resources as determined by a lead agency for purposes of CEQA.

In accordance with *CEQA Guidelines* Section 15064.5(b)(3), a project that follows the Secretary of the Interior's *Standards for the Treatment of Historic Properties with Guidelines for*

Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings or *Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings* is considered to have mitigated impacts to historic resources to a less-than-significant level.

Historic resources are usually 50 years old or older and must meet at least one of the criteria for listing in the California Register (such as association with historical events, important people, or architectural significance), in addition to maintaining a sufficient level of physical integrity (*CEQA Guidelines* Section 15064.5[a][3]).

Impacts Discussion

There are no visible or known cultural or paleontological resources of any kind in the project area. However, the project could potentially have the following impacts on unknown resources.

Impact 3.5-1: Project construction could adversely affect currently unknown cultural resources, including unique archaeological resources. Less than Significant with Mitigation.

No previously recorded archaeological sites exist within the project area and none have been identified through reasonable efforts that consisted of surface surveys by four archaeologists (Hudlow, 2004). No structures exist on the site that would be eligible for listing on the National Register of Historic Places. However, there is a possibility that previously unknown archaeological sites, such as shell midden soils, stone artifacts, and historic trash scatters, may occur within the project area. Inadvertent damage to significant buried archaeological deposits during construction would be a significant impact. Implementation of the following mitigation measure, however, would reduce the impact to a less-than-significant level.

Mitigation Measures

Mitigation Measure 3.5-1: In the event that prehistoric or historic subsurface cultural resources are discovered during ground-disturbing activities, all work within 50 feet of the resources will be halted and the project proponent will consult with a qualified archaeologist to assess the significance of the find according to *CEQA Guidelines* Section 15064.5. If any find is determined to be significant, the project proponent and the archaeologist will meet to determine the appropriate avoidance measures or other appropriate mitigation. The project proponent (as applicable) will make the final determination. All significant cultural materials recovered will be, as necessary and at the discretion of the consulting archaeologist, subject to scientific analysis, professional museum curation, and documentation according to current professional standards.

In considering any suggested mitigation proposed by the consulting archaeologist in order to mitigate impacts to historical resources or unique archaeological resources, the project proponent will determine whether avoidance is necessary and feasible in light of factors such as the nature of the find, project design, costs, and other considerations. If avoidance is infeasible, other appropriate measures (e.g., data recovery) will be instituted. Work may proceed on other parts of the project site while mitigation for historical resources or unique archaeological resources is being carried out.

Significance after Mitigation: Less than Significant.

Impact 3.5-2: Project construction could adversely affect unidentified paleontological resources. Less than Significant with Mitigation.

Paleontological resources are the fossilized evidence of past life found in the geologic record. Despite the tremendous volume of sedimentary rock deposits preserved worldwide and the enormous number of organisms that have lived through time, preservation of plant or animal remains as fossils is an extremely rare occurrence. Because of the infrequency of fossil preservation, fossils—particularly vertebrate fossils—are considered to be nonrenewable resources. Because of their rarity and the scientific information they can provide, fossils are highly significant records of ancient life.

While fossils are not expected to be discovered during project construction, significant fossils could be discovered during mining excavation activities, even in areas with a low likelihood of occurrence. Fossils encountered during excavation could be inadvertently damaged. If a paleontological resource is discovered, the impact to the resource could be substantial. However, implementation of the following Mitigation measure would minimize this impact to a less-than-significant level.

Mitigation Measures

> **Mitigation Measure 3.5-2:** In the event that paleontological resources are discovered, the project proponent (depending upon the project component) will notify a qualified paleontologist. The paleontologist will document the discovery as needed, evaluate the potential resource, and assess the significance of the find under the criteria set forth in *CEQA Guidelines* Section 15064.5. If fossil or fossil bearing deposits are discovered during construction, excavations within 50 feet of the find will be temporarily halted or diverted until the discovery is examined by a qualified paleontologist (in accordance with Society of Vertebrate Paleontology standards (Society of Vertebrate Paleontology, 1995). The paleontologist will notify the appropriate agencies to determine procedures that would be followed before construction is allowed to resume at the location of the find. If the project proponent determines that avoidance is not feasible, the paleontologist will prepare an excavation plan for mitigating the effect of the project on the qualities that make the resource important. The plan will be submitted to the project proponent for review and approval prior to implementation.

Significance after Mitigation: Less than Significant.

Impact 3.5-3: Project construction could result in damage to previously unidentified human remains. Less than Significant with Mitigation.

There is no indication that any particular site in the project area has been used for human burial purposes in the recent or distant past. Therefore, it is unlikely that human remains would be encountered during construction of the proposed project. However, in the unlikely event that human remains were discovered during excavation activities, including those interred outside of formal cemeteries, the human remains could be inadvertently damaged, which could be a significant impact. However, this impact would be minimized by implementation of the following Mitigation measure.

Mitigation Measures

> **Mitigation Measure 3.5-3:** If human skeletal remains are uncovered during project construction, the project proponent (depending upon the project component) will immediately halt work, contact the Kern County coroner to evaluate the remains, and follow the procedures and protocols set forth in Section 15064.5 (e)(1) of the *CEQA Guidelines*. If the County coroner determines that the remains are Native American, the project proponent will contact the NAHC, in accordance with Health and Safety Code Section 7050.5, subdivision (c), and Public Resources Code 5097.98 (as amended by AB 2641). Per Public Resources Code 5097.98, the landowner shall ensure that the immediate vicinity, according to generally accepted cultural or archaeological standards or practices, where the Native American human remains are located, is not damaged or disturbed by further development activity until the landowner has discussed and conferred, as prescribed in this section (PRC 5097.98), with the most likely descendents regarding their recommendations, if applicable, taking into account the possibility of multiple human remains.

Significance after Mitigation: Less than Significant.

3.6 Geology, Soils and Mineral Resources

This section describes the environmental setting for geology and soils as well as mineral resources in the project area and the applicable regulatory framework. Impacts of the proposed project due to geology, soils, and mineral resources are evaluated and mitigation measures are developed to reduce impacts to less than significant levels.

3.6.1 Setting

Regional Geology

The project site lies within the region of California referred to as the Great Valley geomorphic province.[1] The Great Valley geomorphic province is a long alluvial plain that runs approximately 400 miles through central California (CGS, 2002). The Great Valley can be further divided into the northern Sacramento Valley and the southern San Joaquin Valley. The project site is located within the San Joaquin Valley which is flanked by the Sierra Nevada Range to the east, and the Coast Range to the west as shown in **Figure 3.6-1**. The Coast Range is dominated by the northwest trending San Andreas fault. Large coalescing alluvial fans have developed along each side of the valley (CGS, 2002). The larger and more gently sloping fans on the east side consist of deposits derived from the massive intrusive igneous rock sources of the Sierra Nevada; whereas, the smaller and more steeply sloping fans on the west side are built up by sediments originating from predominantly sedimentary rocks of the Coast Range. As a result, the valley floor consists mainly of two kinds of alluvial materials that differ widely in provenance and their respective engineering properties (CGS, 2002).

The Sierra Nevada block has been tilted westward, caused by faulting and uplifting of the eastern edge. The western side is depressed and overlain by the sedimentary deposits of the valley. The southern boundary of the Sierra Nevada block is the east-west running Garlock fault. The site is located on alluvial deposits derived from the Sierra Nevada Range near the southern boundary of the San Joaquin Valley.

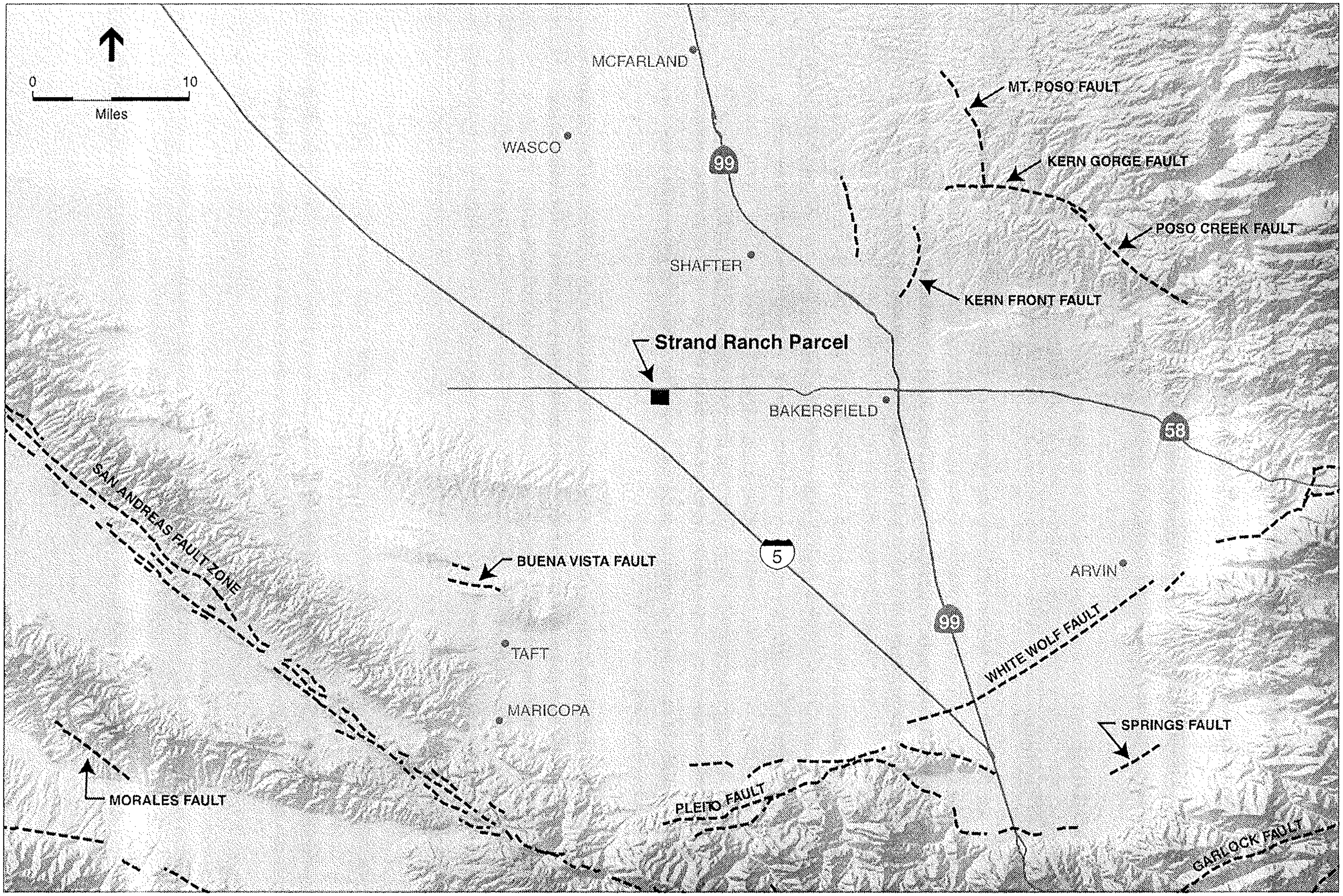
Topography

The project area is located within the southern end of San Joaquin Valley on a relatively flat Valley floor in Kern County. The square shaped project area ranges in elevation from approximately 320 to 325 feet above mean sea level. The site has a very gentle slope towards the northwest which is interrupted by a levee surrounding the Pioneer Canal which intersects the site.

Soils

The project site is covered by approximately 45 percent Wasco Fine Sandy Loam soils, 28 percent Wasco Sandy Loam soils, 15 percent Kimberlina Fine Sandy Loam soils, and

[1] A geomorphic province is an area that possesses similar bedrock, structure, history, and age. California has 11 geomorphic provinces (CGS, 2002).



SOURCE: ESRI 2006, USGS 2006; Kern County 2007.

Irvine Ranch Water District . 205426

Figure 3.6-1
Geology of the Southern San Joaquin Valley

12 percent River Wash soils (WDS, 2004a). Wasco Fine Sandy Loam is a deep, well-drained soil with a moderately rapid permeability and a high water capacity (WDS, 2004a). Wasco Sandy Loam is also a deep, well-drained soil with a moderately rapid permeability, but with a moderate water storage capacity (WDS, 2004a). Kimberlina Fine Sandy Loam is a deep, well-drained soil as well, but with a moderate permeability and high water capacity (WDS, 2004a). River Wash soils are generally sandy or gravelly deposits that occur adjacent to or as islands within the Kern River system (WDS, 2004a). With the exception of River Wash, all these soil types are ideally suited for irrigated row crops and exhibit high permeability (WDS, 2004a).

Based on the properties of these soil types, a few conclusions can be drawn about the expansive potential of these soils and their potential erodability. Due to their high permeability, all of the soils types at the Strand Ranch parcel have a very low surface runoff potential and, therefore, are not highly susceptible to fluvial erosion. However, each of these soil types is moderately susceptible to wind erosion when groundcover is not present. Additionally, the clay content of the Wasco Fine Sandy Loam, the Wasco Sandy Loam, and the Kimberlina Fine Sandy Loam soil type's ranges between 8 to 18 percent (WDS, 2004a). This makes them moderately susceptible to shrinkage or swelling. River Wash soils possess very little clay content and are not susceptible to shrinkage or swelling.

Regional Faults

Faults within the vicinity of the project area include the San Andreas, White Wolf, Kern Canyon, Garlock, and the Buena Vista fault as well as numerous unnamed faults and faults associated with these major faults. Figure 3.6-1 illustrates the faults in the vicinity of the project area. The San Andreas Fault, located approximately 27 miles southwest of the site, is a right-lateral strike-slip fault[2] that follows the southwestern foothills of the Temblor Range within the vicinity of the project area before bending inland across the Tehachapi Mountains towards the Antelope Valley. The San Andreas is the major active fault in California and was formed due to the interaction between the Pacific Plate (to the west) and the North American Plate (to the east). The White Wolf Fault, located approximately 20 miles south of the site, is a left-lateral oblique-reverse fault[3] that accommodates uplift caused by a compressional bend in the San Andreas Fault. The Kern Canyon Fault, located approximately 15 miles northeast of the site, is a right-lateral strike-slip fault similar to the San Andreas Fault and is generally regarded as a narrow, brittle fault zone. The Garlock Fault, located approximately 40 miles southeast is a left-lateral strike-slip fault and it intersects with the San Andreas Fault in Antelope Valley, California. The motion of the Garlock Fault causes deflection in the San Andreas, and deforms it slightly into a curve. The Garlock is the second largest fault in California behind the San Andreas. Finally, the Buena Vista fault, located approximately 15 miles southwest of the site, is a relatively short segmented fault that has

2 "Right-lateral" movement in a fault is if you were to stand on the fault and look along its length, the right block moves toward you and the left block moves away. A "strike-slip" fault is a fault in which surfaces on opposite sides of the fault plane have moved horizontally and parallel to the strike of the fault.

3 "Left-lateral" movement in a fault is if you were to stand on the fault and look along its length, the left block moves toward you and the right block moves away. An "oblique-reverse fault" is a type of fault formed when the hanging wall fault block moves up along a fault surface relative to the footwall and its trend is oblique to the strike.

experienced active creep that is likely related to oil extraction.[4] All of these faults are currently active[5] and may cause significant ground shaking and surface fault rupture.

Seismicity

The proposed project lies within a region of California that contains many active and potentially active faults and is considered an area of high seismic activity. The 2007~~1~~ California Building Code locates the entire region within Seismic Risk Zone 4. Areas within Zone 4 are expected to experience maximum magnitudes and damage in the event of an earthquake. In the past 100 years, there have been a number of earthquakes of magnitude 5.0 or larger reported on the active San Andreas, Garlock, and White Wolf Faults as well as unknown or unspecified faults.[6] Richter scale magnitudes of less than 4.9 generally do not result in significant damage, but magnitudes of 5.0 or greater can cause minimal to major damage to buildings depending on quality of construction and magnitude of the earthquake. **Table 3.6-1** shows historic earthquakes of magnitude 5.0 or greater in the vicinity of Kern County. The last earthquake to approach magnitude 8.0 in the vicinity of Kern County was the Fort Tejon Earthquake of 1857 about 75 miles northwest of Bakersfield, CA, which was estimated at a magnitude 7.9 and originated from the San Andreas Fault. A magnitude 8.0 earthquake can cause serious damage in areas several hundred miles across.

TABLE 3.6-1
HISTORIC EARTHQUAKES MAGNITUDE 5.0 OR GREATER IN KERN COUNTY AREA

Name	Date/Time	Fault	Location	Magnitude
Parkfield Earthquake	June 27, 1966/9:26 pm PST	San Andreas	6 miles NW of Parkfield, CA	6.0
Wheeler Ridge Earthquake	May 27, 1993/9:47 pm PST	Unknown	15 miles SSW of Bakersfield, CA	5.2
Kern County Earthquake	July 21, 1952/4:52 am PST	White Wolf	23 miles S of Bakersfield, CA	7.5
Tejon Ranch Earthquake	June 10, 1988/4:06 pm PST	Unknown	32 miles SSE of Bakersfield, CA	5.4
Mojave Earthquake	July 11, 1992/11:14 am PST	Garlock	50 miles E of Bakersfield, CA	5.7
Walker Pass Earthquake	March 15, 1946/5:49 am PST	Unknown	5 miles NNW of Walker Pass, CA	6.0

SOURCE: Information accessed from the Southern California Earthquake Data Center at http://www.data.scec.org/clickmap.html on May 16, 2006.

4 Fault creep is the slow continual deformation of bedrock across a fault without evidence of displacement from a single earthquake event.

5 An active fault is defined by the state of California as a fault that has had surface displacement within Holocene time (approximately the last 10,000 years). A potentially active fault is defined as a fault that has shown evidence of surface displacement during the Quaternary (last 1.6 million years), unless direct geologic evidence demonstrates inactivity for all of the Holocene or longer. This definition does not, of course, mean that faults lacking evidence of surface displacement are necessarily inactive. Sufficiently active is also used to describe a fault if there is some evidence that Holocene displacement occurred on one or more of its segments or branches (DOC, 1994).

6 Information accessed from the Southern California Earthquake Data Center at http://www.data.scec.org/clickmap.html on May 16, 2006.

Seismic Hazards

Surface Rupture

Seismically-induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake's seismic waves. The magnitude, sense, and nature of fault rupture can vary for different faults or even along different segments of the same fault. Ground rupture is considered more likely along active faults. The site is not within an Alquist-Priolo Fault Rupture Hazard Zone, as designated through the Alquist-Priolo Earthquake Fault Zoning Act, and no mapped active faults are known to pass through the immediate project vicinity (Hart, 1994). Therefore, the risk of ground rupture at the site is considered very low.

Ground Shaking

Areas most susceptible to intense ground shaking are those located closest to an earthquake-generating fault, and areas underlain by thick, loosely unconsolidated and saturated sediments. Ground movement during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and type of geologic material.

While the earthquake magnitude is a measure of the energy released in an earthquake, intensity is a measure of the ground shaking effects at a particular location. Areas underlain by bedrock typically experience less severe ground shaking than those underlain by loose, unconsolidated materials. Unconsolidated materials, even when located relatively distant from faults, can intensify ground shaking. The Modified Mercalli Intensity (MMI) scale (**Table 3.6-2**) is commonly used to measure earthquake effects due to ground shaking. The MMI values range from I (earthquake not felt) to XII (damage nearly total), and intensities ranging from IV to X could cause moderate to significant structural damage.

Ground shaking intensity at the project site is anticipated to be approximately equivalent to MMI VII to IX (strong to very strong) ground shaking. This MMI range is assumed because MMI for the Bakersfield area was modeled for the magnitude 7.9 Fort Tejon Earthquake of 1857 (the largest recorded earthquake in the area) and this range is what the model produced (Kern County Fire, 2005). Ground shaking of this range of intensity would likely cause some degree of damage to project facilities; however, well-designed structures are not anticipated to experience serious damage or collapse.

Liquefaction

Liquefaction is a phenomenon whereby unconsolidated and/or near saturated soils lose cohesion and are converted to a fluid state as a result of severe vibratory motion. The relatively rapid loss of soil shear strength during strong earthquake shaking results in the temporary fluid-like behavior of the soil. Soil liquefaction causes ground failure that can damage roads, pipelines, buildings with shallow foundations, and levees. Liquefaction can occur in areas characterized by water-saturated, cohesionless, and granular materials at depths less than 40 feet, especially in areas with a shallow water table. Saturated unconsolidated alluvium with earthquake intensities

TABLE 3.6-2
MODIFIED MERCALLI INTENSITY SCALE

Intensity Value	Intensity Description
I	Not felt except by a very few persons under especially favorable circumstances.
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably indoors, especially on upper floors of buildings, but many persons do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration similar to a passing of a truck.
IV	During the day felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motorcars rock noticeably.
V	Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars.
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.
XI	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII	Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.

SOURCE: Bolt, 1988.

greater than VII on the MMI Scale may be susceptible. Detailed liquefaction mapping does not exist within Kern County (Kern County Fire, 2005). According to the Kern County Fire Department Office of Emergency Services, the project site is not in an area with a shallow water table not likely to be susceptible to liquefaction (Kern County Fire, 2005). However, the groundwater table does fluctuate greatly in association with banking operations. During years of high groundwater recharge efforts, the groundwater table could potentially be shallow enough to present a liquefaction hazard, although such a condition has only occurred twice (1999 & 2006) since 1960.

Landslide

A landslide is a mass of rock, soil, and debris displaced down-slope by sliding, flowing, or falling. The susceptibility of land (slope) failure is dependent on the slope and geology as well as the amount of rainfall, excavation, or seismic activities. Factors that decrease resistance to movement in a slope include pore water pressure, material changes, and structure. Removing the lower portion (the toe) of a slope decreases or eliminates the support that opposes lateral motion in a slope. Shaking during an earthquake may lead materials in a slope to lose cohesion and collapse. Due to the relatively level topography in the vicinity of the project site, the potential for landslides is very low (Kern County Fire, 2005).

Nonseismic Hazards

Erosion

Erosion is the detachment and movement of soil materials through natural processes or human activities. The detachment of soil particles can be initiated through the suspension of material by wind or water. Silt-sized particles are the most easily removed particles, due to their size and low cohesiveness. Erosion problems in Kern County are prevalent on steep slopes, alluvial fans, earthquake fault zones, and urban drainage systems (Kern County Fire, 2005). In general, the project site does not contain steep slopes or alluvial fan soils, and is not near an earthquake fault zone, but it is near urban drainage systems and does contain soils with a moderate to slight potential for erosion. The project site would be susceptible to wind erosion.

Expansive Soils

Expansive soils possess a shrink-swell characteristic[7] that can result in structural damage over a long period of time. Expansive soils are largely comprised of silicate clays, which expand in volume when water is absorbed and shrink when dried. Highly expansive soils can cause damage to foundations and roads. There is currently no comprehensive catalog of expansive soils in Kern County, but problems with swelling soils are likely to continue if they are not properly identified and mitigated prior to construction (Kern County Fire, 2005).

Land Subsidence/Fissures

Subsidence is occurring in the San Joaquin Valley. Subsidence from groundwater withdrawal affects the San Joaquin Valley, particularly the southwest end of the Valley in the vicinity of the Buena Vista Lake Bed (Kern County Fire, 2005). Land subsidence can occur as a result of groundwater extraction where underlying soils can compact when water is removed. The extraction of mineral or oil resources can also result in subsidence. The usual remedial action for land subsidence is that of raising the water table by injecting water or by reducing groundwater pumpage (Kern County Fire, 2005). This increases the fluid pressure in the aquifer and, in most instances, subsidence decreases or stops after a period of time. According to the County General Plan Land Subsidence map, land subsidence has occurred in the area of the project site (Kern County Planning Department, 2004a).

Hyrdocompaction

Hydrocompaction is a form of land subsidence that occurs when unsaturated soils, low density fine grained soils with small pores and voids, are subjected to increased moisture content. The

[7] "Shrink-swell" is the cyclical expansion and contraction that occurs in fine-grained clay sediments from wetting and drying. Structures located on soils with this characteristic may be damaged over a long period of time, usually as the result of inadequate foundation engineering.

moisture alters the cementation structure of the normally arid soils. The rearrangement of the soil structure causes collapse and differential settlement to occur under relatively light loading. Irrigation of clayey alluvial-fan soils has resulted in hydrocompaction and subsidence of 3 to 15 feet on the western and southern margins of the San Joaquin Valley (USGS, 2007). To avoid hydrocompaction, contractors have hydrocompacted soils prior construction. For example, soils in many areas crossed by the California Aqueduct were intentionally hydrocompacted before aqueduct construction to avoid subsidence problems and subsequent subsidence due to hydrocompaction in these areas has been minimal.[8] The project site could be susceptible to hydrocompaction.

Mineral Resources

The California Geological Survey (CGS) classifies the regional significance of mineral resources in accordance with the California Surface Mining and Reclamation Act of 1975. Mineral Resource Zones (MRZ) have been designated to indicate the significance of mineral deposits. The MRZ categories are as follows:

- MRZ-1: Areas where adequate information indicates that no significant mineral deposits are present or where it is judged that little likelihood exists for their presence.
- MRZ-2: Areas where adequate information indicates significant mineral deposits are present, or where it is judged that a high likelihood exists for their presence.
- MRZ-3: Areas containing mineral deposits the significance of which cannot be evaluated from available data.
- MRZ-4: Areas where available information is inadequate for assignment to any other MRZ.

According to the *Mines and Mineral Resources of Kern County, California*, there are no MRZs within the vicinity of the project site (USGS, 1962). However, Strand Ranch is located within the Strand Oil Field. Mineral rights on the property are not owned by IRWD. As a condition of the property deed, IRWD is obligated to maintain four 3-acre oil well pads such that the mineral rights owners can access and extract subsurface oil resources in the future.

Petroleum Resources

Kern County has been a major oil producer since the early 1900s. Although, the reserves are projected to be ultimately depleted, continued exploration and advancement of technologies will continue within the county for decades to come (Kern County Planning Department, 2004a). Future discoveries are anticipated to occur within existing fields. The project site is located within the Strand Oil Fields (CDC, 2002).

[8] *Ibid.*

3.6.2 Regulatory Framework

State

California Building Code

The California Building Code is another name for the California Building Standards Code. The California Code of Regulations (CCR) Title 24 is assigned to the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. The California Building Code incorporates by reference the Uniform Building Code with necessary California amendments. The Uniform Building Code is a widely adopted model building code in the United States published by the International Conference of Building Officials. About one-third of the text within the California Building Code has been tailored for California earthquake conditions.

Local

Kern County Code

The Kern County Code (KCC) requires the issuance of grading, well drilling (for the Strand Ranch parcel recovery efforts only), construction, and building (for conveyance and recovery facilities) permits prior to construction of the proposed project. Chapter 17.28, Grading Code, of the KCC "requires that a grading permit be obtained for earthmoving project unless specifically exempt." The Grading Code does not specifically mandate preparation of an erosion control plan, but does state that "the faces of cut and fill slopes shall be prepared and maintained to control against erosion. This control may consist of effective planting. The protection for slopes shall be installed as soon as practicable and prior to calling for final approval."

Kern County General Plan

Both parcels are located within the area governed by the *Kern County General Plan* (County General Plan) (Kern County Planning Department, 2004a). Within the Land Use, Conservation, and Open Space and Safety Elements of the County General Plan, there is a goal, policies, and implementation measures that are applicable to the proposed project regarding geology, soils, and mineral resources:

Land Use, Conservation, and Open Space Element, Resource Section

- Goal 2: Protect areas of important mineral, petroleum, and agricultural resource potential for future use.
- Policy 14: Emphasize conservation and development of identified mineral deposits.
- Implementation Measure H: Use the California Geological Survey's latest maps to locate mineral deposits until the regional and Statewide importance mineral deposits map has been completed, as required by the Surface Mining and Reclamation Act.

Safety Element, Induced Surface Rupture, Ground Shaking, and Ground Failure Section

- Implementation Measure B: Require geological and soils engineering investigations in identified significant geologic hazard areas in accordance with the Kern County Code of Building Regulations.
- Implementation Measure C: The fault zones designated in the Kern County Seismic Hazard Atlas should be considered significant geologic hazard areas. Proper precautions should be instituted to reduce seismic hazard, whenever possible in accordance with State and County regulations.
- Implementation Measure H: Require that plans and permits for installation of major lifeline components such as highways, utilities, petroleum or chemical pipelines to incorporate design features to accommodate potential fault movement in areas of active faults without prolonged disruption of essential service or threat to health and safety.

Safety Element, Landslide, Subsidence, Seiche, and Liquefaction Section

- Policy 1: Determine the liquefaction potential at sites in areas of shallow groundwater (Map Code 2.3) prior to discretionary development and determine specific mitigation to be incorporated into the foundation design, as necessary, to prevent or reduce damage from liquefaction in an earthquake.
- Policy 2: Route major lifeline installations around potential areas of liquefaction or otherwise protect them against significant damage from liquefaction in an earthquake.
- Implementation Measure D: Discretionary actions will be required to address and mitigate impacts from inundation, land subsidence, landslides, high groundwater areas, liquefaction and seismic events through the CEQA process.

Bakersfield General Plan

The project site is also located within the area governed by the *Metropolitan Bakersfield General Plan* (Bakersfield General Plan) (City of Bakersfield and Kern County, 2002). Within the Safety Element of the Bakersfield General Plan, there are goals, policies, and implementation measures that are applicable to the proposed project regarding geology, soils, and mineral resources:

- Goal 1: Substantially reduce the level of death, injury, property damage, economic and social dislocation and disruption of vital services that would result from earthquake damage.
- Goal 5: Protect essential lifelines and prevent casualties and major social and economic disruption due to liquefaction in an earthquake.
- Policy 1: Ensure that earthquake survival and efficient post-disaster functions are a primary objective in the siting, design, and construction standards for discretionary essential facilities or the expansion of such facilities.
- Policy 13: Determine the liquefaction potential at sites in areas of high groundwater prior to the development and determine specific mitigation to be incorporated into the foundation design, as necessary to prevent or reduce damage from liquefaction in an earthquake.

- Policy 14: Route major lifeline installations around potential liquefaction areas or otherwise protect them against significant damage from liquefaction in an earthquake.
- Implementation 2: Require detailed studied for ground shaking characteristics, liquefaction potential, dam failure inundation and flooding potential, and fault rupture potential, as background to the design process for critical facilities under the city and county discretionary approval.
- Implementation 3: Require structures that are within the plan area and are subject to Building Department review to adhere to the most current seismic standards adopted as part of the Uniform Building Code.

3.6.3 Project Impacts and Mitigation Measures

Significance Criteria

Based on the *CEQA Guidelines,* a project may be deemed to have a significant effect on the environment with respect to geology and soils if it would:

- Expose people or structures to potential substantial adverse effects, including risk of loss, injury, or death involving:
    - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
    - Strong seismic ground shaking;
    - Seismic-related ground failure, including liquefaction;
    - Landslides;
- Result in substantial soil erosion or the loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse;
- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property; and/or
- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposals systems where sewers are not available for the disposal of waste water.

Additionally, according to the *CEQA Guidelines*, the proposed project would have a significant impact on the environment pertaining to mineral resources if it would:

- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state; and/or

- Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan.

Impacts Discussion

Based on the proposed project plans and the geologic environment of the project area, the proposed project would not result in impacts related to fault rupture, landslides/lateral spreading, expansive soils, wastewater disposal, or mineral resources. No impact discussion is provided for these topics for the following reasons:

- *Fault Rupture*. The faults most susceptible to earthquake rupture are active faults, which are faults that have experienced surface displacement within the last 11,000 years. There are no active faults that cross the project site, and the nearest active fault is more than 15 miles away. Therefore, the potential for fault rupture to affect the proposed project is very low.
- *Landslides and Lateral Spreading*. The proposed project is located within an area that is relatively flat with very little topographic relief. Therefore, there is very little potential for landslides or lateral spreading.
- *Expansive soils*. The proposed project does not include the construction of any permanent structures that would require a foundation system appropriate for the surface soils present. Therefore, there would be no impact associated with expansive soils.
- *Wastewater Disposal*. The proposed project does not include the use of a septic or other alternative disposal wastewater system, and therefore there would be no impact associated with this potential hazard.
- *Mineral Resources.* There are no aggregate mineral resource zones of known significance on or within the vicinity of the project site (USGS, 1962). As mentioned above, however, the project site is located within a known oil field, the Strand Oil Field. According to the General Plan for Kern County, future discoveries are anticipated to occur within existing fields.

Impact 3.6-1: The proposed project could expose people or structures to strong seismic ground shaking or liquefaction. Less than Significant.

Liquefaction occurs in saturated soils and the susceptibility decreases with groundwater depth. The project area has experienced and will likely continue to experience strong seismic ground shaking due to its proximity to a number of active faults, including the San Andreas Fault and the Garlock fault. If such an event were to occur during a time of a relatively high groundwater table from recharge activities, the site soils could be susceptible to liquefaction hazards. The California Building Code imposes standards that require engineers to account for such predictable forces during design of the proposed facilities. Additionally, the Kern County Building Code amends Section 1629.4.1 of the Uniform Building Code, which states that all of Kern County is designated as Seismic Zone 4 and structures must be designed in compliance with this seismic zone designation.

In the event that ground shaking caused damage to a recharge basin and/or conveyance structure, released water would likely infiltrate into the permeable soils that comprise the project site. The recharge basins would be constructed primarily below grade, which, coupled with the relatively flat topography, would hinder movement of water offsite. Therefore, the potential risk from strong seismic shaking is considered low and a less-than-significant impact is anticipated.

Government Code 53091 states that building and zoning ordinances of a city or county "shall not apply to the location or construction of facilities for the production, generation, storage, treatment, or transmission of water." Government Code 53091 includes grading ordinances, and therefore the proposed project is exempt and does not require a grading permit. However, the proposed project would be designed to be generally consistent with the requirements of a grading permit.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Impact 3.6-2: The proposed project could result in substantial soil erosion or the loss of topsoil. Less than Significant with Mitigation.

Grading activities associated with the construction of the recharge basins would involve earthmoving, excavation, stockpiling, and grading. These activities could expose soils to erosion processes. The extent of erosion would occur vary depending on slope steepness/stability, vegetation/cover, concentration of runoff, and weather conditions.

The project site is relatively flat which reduces the potential for erosion and loss of topsoil to a certain degree. To prevent water and wind erosion during the construction period, a Storm Water Pollution Prevention Plan (SWPPP) would be developed for the proposed project (see Section 3.8, Hydrology and Water Quality, for more information about the proposed project's SWPPP) as required for all projects which disturb more than one acre. As part of the SWPPP, the applicant would be required to provide erosion control measures to protect the topsoil. Topsoil materials would be stripped from the ground surface and used for construction of the earthern berms of the recharge ponds. This would ensure that organic matter, the existing seed bank, and topsoil texture are maintained for any future agricultural activities and soil-stabilizing revegetation efforts at the project site. Any stockpiled soils would also be watered and/or covered to prevent loss due to wind erosion as part of the SWPPP. As a result of these efforts, loss of topsoil and substantial soil erosion during the construction period are not anticipated.

During recharge operations, the recharge basins would contain water, which would inhibit erosion; during periods of non-recharge, the recharge basins would be subject to wind erosion. Plant cover at the project site would minimize wind erosion.

Mitigation Measures

Mitigation Measure 3.6-1: All topsoil stripped from the ground surface during construction shall be used for construction of the earthen berms and not hauled offsite. Any temporary stockpiles shall be managed through the use of best management practices as outlined in the SWPPP which shall include but not be limited to wetting and/or covering stockpiles to prevent wind erosion.

Significance after Mitigation: Less than Significant.

Impact 3.6-3: The proposed project could potentially experience subsidence as a result of hydrocompaction from recharge activities or due to groundwater recovery operations. Less than Significant.

Land subsidence as a result of hydrocompaction occurs when low density fine grained soils with small pores and voids are subjected to increased moisture content. The moisture alters the cementation structure of the normally arid soils. The rearrangement of the soil structure causes collapse and differential settlement to occur under relatively light loading. The western and southern margins of the San Joaquin Valley have historically been the most impacted by land subsidence due to hydrocompaction (USGS, 2007).

Subsidence can also occur as a result of groundwater extraction from a confined aquifer which results in the compaction of the confining clay layers. This type of subsidence is usually associated with severe, long term withdrawal in excess of recharge and has in the past been the primary cause of subsidence in the San Joaquin Valley (USGS, 2007). Additionally, compaction tends to happen more readily when the wells are open only to the confined part of the aquifer system than when they are open to the shallow water-table aquifer as well. There is no uniform confining layer beneath the proposed project site. In addition, according to the terms of the recovery agreement, the proposed project would not be able to extract any groundwater beyond that which has been recharged into the groundwater table. Therefore, the proposed project would not be able to establish the conditions, mentioned above, that are typically associated with subsidence to groundwater extraction.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Impact 3.6-4: The proposed project could block access to oil resources beneath the property. Less than Significant.

The project site is located within the Strand Oil Field. Mineral rights on the property are not owned by IRWD. Construction of recharge basins could limit access to these mineral resources by the mineral rights owners. As a condition of the property deed, IRWD is obligated to maintain four 3-acre oil well pads. **Figure 2-2** shows the likely location for these four "drill islands." As part of the project, these drill islands would be maintained in order to maintain access to future subsurface oil resources extraction by the mineral rights owners. With incorporation of these well pad areas in project designs, the project would not impede future access to subsurface mineral resources.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

3.7 Hazards & Hazardous Materials

This section assesses chemical usage and potential hazards at the project site and impacts that may occur as a result of implementing the proposed project. This section summarizes a hazardous materials database search conducted for the project area. Mitigation measures are developed to reduce potential impacts to less than significant levels.

3.7.1 Setting

Hazardous substances include chemicals regulated by both the United States Department of Transportation's (DOT) "hazardous materials" regulations and the EPA "hazardous waste" regulations. Hazardous materials are substances that have the capacity of causing a health hazard during exposure. Hazardous wastes require special handling and disposal because of their potential to damage public health and the environment. Hazardous wastes can occur in soils and in building materials. Past uses can contaminate soils, groundwater, and surface water through the improper disposal of wastes. Industrial uses can be sources of solvents, petroleum products, and metals. Agricultural uses can result in contamination from pesticides, herbicides, pathogens, and high levels of nitrates from fertilizers and animal waste.

Strand Ranch

A Phase 1 Environmental Site Assessment was performed by Geomatrix Consultants for the Strand Ranch parcel in 2003. The objective of the Environmental Site Assessment was to evaluate the property for potential evidence of releases of hazardous substances or petroleum hydrocarbons that may require remediation. According to a review of historical information, the property has been mainly used for agricultural purposes since the 1950's. Parcels adjacent to the property are used for agriculture and water banking and several oil and gas wells are scattered throughout the area (WDS, 2004c).

The Strand Ranch parcel includes a residence, a former storage shed, covered shelter and parking area. Pesticides were used on the property and previously stored in the former shed area. Surface staining was not evident on the floor of the shed or on the soil surrounding the shed.

An aboveground diesel fuel tank is located approximately 25 feet west of the storage building. The tank was resting on the soil surface and stained soil was observed beneath the tank. Another area of dark stained soil was observed approximately 20 feet west of the aboveground tank.

A large silage[1] stockpile was located north of the residence. The silage was produced on site and used for a cattle feeding business operated by Borba Farms. This silage pile has been removed from Strand Ranch.

Several agricultural irrigation wells are located on the property. The electric-powered wells contain a drum of lubricating oil attached to the pump. The wells and pumps were installed on

[1] Silage is fodder (course food for livestock) prepared by storing and fermenting green forage plants in a silo.

concrete slabs surrounded by locked enclosures constructed of metal posts and wire mesh. Minor dark staining was observed around the base of some of the pumps and concrete slabs.

A slough is located in the central portion of the property, south of the Cross Valley Canal. The area was used as a borrow pit for Kern County road construction and is currently used as a pumping area or irrigation sump/reservoir by the Kern Water Banking Authority (KWBA). The KWBA and IRWD will be renewing the agreement to allow water to be conveyed from the CVC to KBWA recharge areas via the unlined slough. About 125 yards south of the slough, two cotton trailers were used to store empty pesticide containers. Soil discoloration was not evident below the trailers. A pile of sandy soil was observed and described by the property owner's representative, Mr. Royce Fast, as an area used to burn household rubbish. The contents of the pile have since been removed off-site.[2]

Based on a questionnaire completed by Mr. Fast, and the Phase 1 assessment of the property conducted in 2003, the following conclusions were made:

- Currently and in the past, the adjoining property has been used for industrial purposes (oil production) and as a motor repair facility;
- Pesticides were previously stored in the former shed area and used on the property;
- Sacks of sulfur dust are stored on the property;
- A former burn pit for disposal of household rubbish is located in the central portion of the property; and
- There is currently stained soil on the property (diesel tank area) and staining around the base of concrete slabs and turbine pumps (irrigation wells).

The Strand Tract was not listed on regulatory agency lists of known hazardous substance sites. The closest site listed was Pool California Energy Services located approximately one mile north of the property which was listed on three hazardous wastes/hazardous substances databases: the Resource Conservation and Recovery Information System (RCRIS) Large Quantity Generator database, the EPA Facility Index System, and the California Hazardous Waste Information System (HAZNET). No violations were reported for Pool California Energy Service in any of the three databases. This is the only site located within one mile of the Strand Ranch Parcel.

Known On-Site Chemical Storage and Usage

Petroleum hydrocarbon staining was found at an aboveground diesel storage tank located on the property. Discolored soil was observed beneath the aboveground storage tank and a second area of discolored soil was observed about 20 feet west of the aboveground storage tank. It was also noted that pesticides were used on the property and stored in a former shed area.

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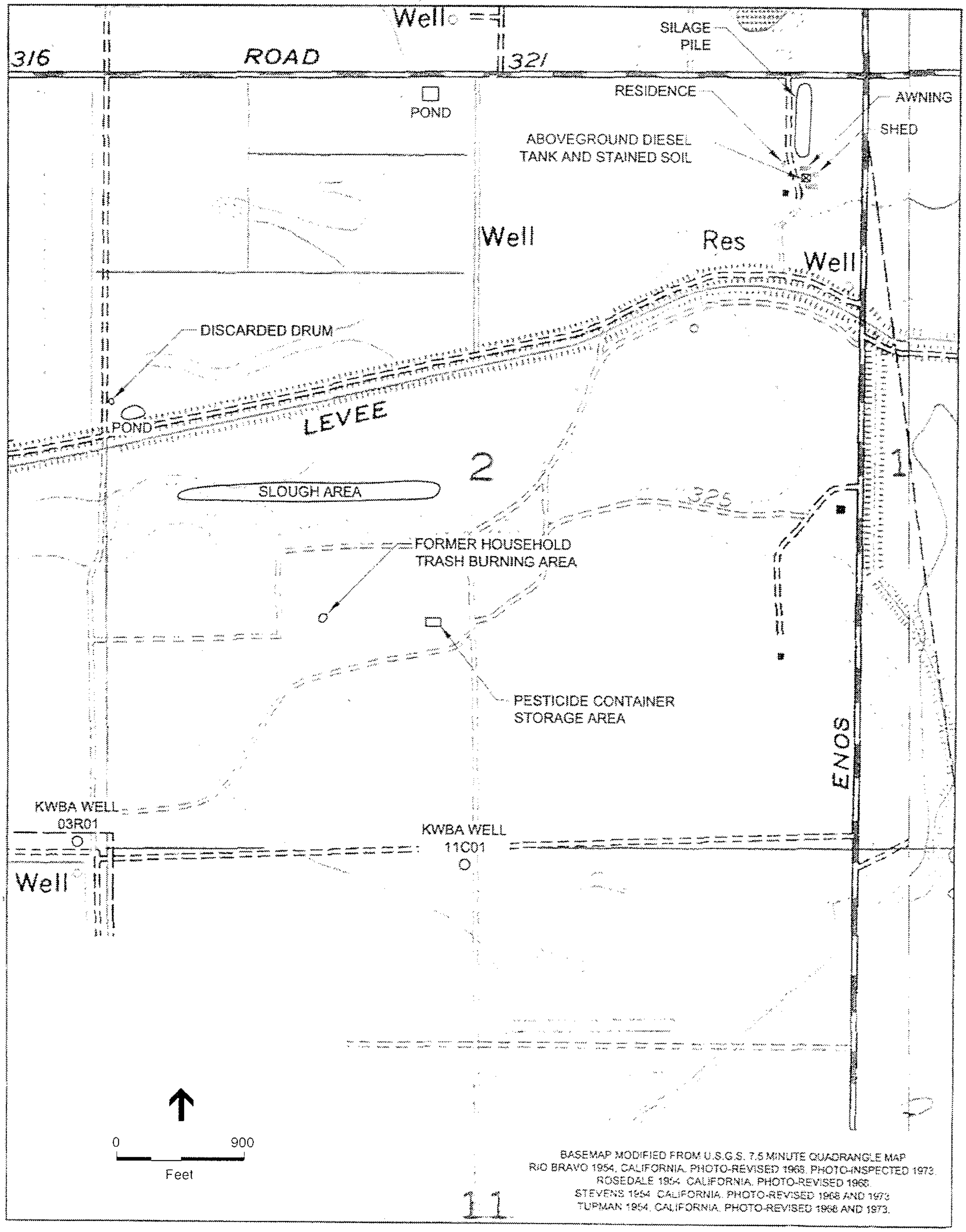
2 WDS. Phase 1 Environmental Site Assessment 600-Acre Property, Strand Tract. Prepared by Geomatrix Consultants. January 2004. Section 5.1 Parcel Reconnaissance



SOURCE: Western Development and Storage, Inc., 2004c.

Irvine Ranch Water District . 205426

Figure 3.7-1
Contaminated Sites on Strand Ranch

3.7.2 Regulatory Environment

The principal federal regulatory agency for hazardous wastes is the U.S. EPA. The key federal regulations pertaining to hazardous wastes are the:

- Resource Conservation and Recovery Act (RCRA);
- Superfund Amendment Reauthorization Act (SARA) Title III; and
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

In addition, a number of federal regulations exist regarding the use, removal, and disposal of asbestos containing materials. Applicable federal regulations are primarily contained in Titles 29, 40, and 49 of the CFR. In California, Title 22 and Title 23 of the CCR address hazardous materials and wastes. Title 22 defines, categorizes, and lists hazardous materials and wastes. Title 23 addresses public health and safety issues related to hazardous materials and wastes and specifies disposal options.

The Hazardous Waste Control Law (HWCL) is the State law similar to the federal RCRA program. HWCL is implemented by regulations contained in Title 26 of the CCR, which describes the requirements for the proper management of hazardous wastes, including:

- Criteria for identification and classification of hazardous wastes;
- Generation and transportation of hazardous wastes;
- Design and permitting of facilities that recycle, treat, store, and dispose of hazardous wastes;
- Treatment standards;
- Operation of facilities and staff training; and
- Closure of facilities and liability requirements.

Title 26 regulations include over 800 materials that may be hazardous and the criteria for identifying, packaging, and disposing of wastes identified as being hazardous. Title 26 also establishes permit requirements for facilities that recycle, treat, store, or dispose of hazardous wastes. Under HWCL and Title 26, the generator of a hazardous waste must complete a manifest that accompanies the waste from the generator to the transporter to the ultimate disposal location. Copies of the manifest must be filed with the Department of Toxic Substances Control (DTSC). The DTSC and the RWQCB share management of underground storage tanks and hazardous waste site remediation.

Significance Criteria

The criteria used to determine the significance of an impact are based on the initial study checklist in Appendix G of the *CEQA Guidelines*.

The proposed project may result in a significant impact if it would:

- create a significant hazard to the public or environment through the routine transport, storage, use, or disposal of hazardous materials;
- create a significant hazard to the public through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment;
- emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within ¼-mile of an existing or proposed school;
- be located on a site that is known to contain hazardous materials or is listed on a site compiled pursuant to Government Code Section 65962.5, and as a result could create a significant hazard to the public or the environment;
- result in a safety hazard for people residing or working in the project area for a project located within an airport land use plan, within two miles of a public airport or within the vicinity of a private airstrip;
- impair or interfere with the implementation of an adopted emergency response plan or emergency evacuation plan; or,
- expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands.

3.7.3 Impacts and Mitigation Measures

Impact 3.7-1: Project construction could encounter soils during excavation that have been exposed to contamination. Less than Significant.

Past agricultural land uses on the Strand Ranch parcel have resulted in small amounts of contaminated soils on site. Contamination could include small amounts of petroleum hydrocarbons from the aboveground diesel storage tank located on the property and pesticides from past storage and agricultural operations on the property. The petroleum-stained soils identified on the site were isolated near the storage tank. Prior to construction of the recharge basins, the stained soils will be removed from the property as part of the project. Construction of the recharge basins will involve scraping surface soils to create berms. The recharge basin floors will be below grade. Any residual pesticides in the surface soils of the former agricultural areas would be scraped off the recharge basin floor. The potential for residual pesticides to be transported to the groundwater by the recharge water is minimal since the surface soils will be scrapped from the basin floors.

Mitigation Measures

~~**Mitigation Measure:** No mitigation measures are required.~~

<u>**Mitigation Measure 3.7-1:** IRWD shall collect representative samples of soils remaining in place near the former fuel and pesticide storage areas identified in the Phase I Site Assessment. The samples shall be analyzed for total petroleum hydrocarbons and pesticides. IRWD shall remove from the site in accordance with applicable waste disposal regulations, soils identified as containing hazardous quantities of contaminates.</u>

Impact 3.7-2: Project operation could cause an increase in airborne insect populations. Less than Significant with Mitigation.

The proposed recharge basins would create new standing pools of water. If algae growth develops or insects such as midges or mosquitoes use the water as a breeding area, any standing pools of water could be considered a nuisance or a health threat to the surrounding community. Hatching midges can emerge in such tremendous numbers that they create nuisance problems. Midges often emerge simultaneously forming vast clouds of flying insects. They are especially attracted to lights. Large clouds of insects could form over local roadways creating a traffic hazard.

West Nile Virus, a disease transmitted by mosquitoes, has recently been detected in Kern County in the Metropolitan Bakersfield area. Spraying was conducted in August 2007 by the Kern Mosquito and Vector Control District (KMVCD) and the Kern County Department of Public Health Services to control mosquito populations in the Bakersfield area (Kern County Department of Public Health Services, 2007). The proposed project could contribute to a public health hazard if the standing water in the recharge basins contributed to an increase in the mosquito population in the project area.

Mitigation Measures 3.7-2~~1~~: would minimize the potential effects associated with increases in populations of mosquitoes and midges, reducing potential impacts to less than significant levels.

Mitigation Measures

> **Mitigation Measure 3.7-2~~1~~:** IRWD and Rosedale shall consult with the Kern County Department of Public Health Services and KMVCD to develop appropriate insect control measures that utilize non-toxic abatement methods.

Significance after Mitigation: Less than significant.

3.8 Hydrology, Groundwater Resources and Water Quality

This section provides an assessment of hydrology, groundwater resources and water quality conditions that could be affected by the proposed project. The setting section describes the existing hydrologic and hydrogeologic conditions within the project region including surface water features, groundwater resources, and water quality. The setting provides a discussion of the applicable regulatory environment associated with surface water, groundwater, and water quality. The significance criteria follow the regulatory discussion and are adapted from Appendix G of the *CEQA Guidelines*. Based on the significance criteria, the potential project-related impacts associated with hydrology, groundwater resources, and water quality are evaluated and appropriate mitigation measures are developed, where necessary.

3.8.1 Regional Setting

Climate

The project site is located within the southern end of the San Joaquin Valley of Central California. The climate is considered semi-arid with annual precipitation averages of approximately six inches. Over 50 percent of the annual rainfall occurs between January and March with scattered shower activity during the other nine months. Summers are dry with low humidity and very warm with most days in July and August above 90 degrees Fahrenheit.

Regional Topography and Hydrology

The project area is located on a relatively flat valley floor in Kern County within the southern portion of San Joaquin Valley. San Joaquin Valley is comprised of large coalescing alluvial fans that have developed along each side of the valley. The larger and more gently sloping fans on the east side consist of deposits eroded and carried down from the granitic Sierra Nevada mountains; whereas, the smaller and more steeply sloping fans on the west side are built up by sediments originating from marine sedimentary rocks of the Coast Range Temblor mountains. As a result, the valley floor consists mainly of two different kinds of alluvial materials that are derived from opposite sides of the basin and have different physical and geological properties. The project site is located along the Kern River Fan, which is comprised of unconsolidated sandy and silty sediments derived from the Sierra Nevada.

The project area lies within the Tulare Lake Hydrologic Unit which is comprised of 13 basins one of which, the San Joaquin Valley basin, contains seven subbasins (DWR, 2003). The underlying groundwater basins have been of importance to regional urban and agricultural use due to the large groundwater supplies within the underlying alluvial deposits. The aquifers are generally very thick and commonly reach over 1,000 feet with a maximum thickness of 4,400 feet in the southern end of the valley (DWR, 2003). The Tulare Lake Hydrologic Unit covers an 8,330 square mile area covering the southern half of the San Joaquin Valley, which is bound by the Temblor Range to the west, the Tehachapi Mountains to the south, and the southern Sierra

Nevada to the east. Natural surface water in the region originate in the uplands and are conveyed towards the valley floor and include such major drainages as San Joaquin (prior to heading north into the San Joaquin Hydrologic Unit), Kawea, Tule, Kings, and Kern Rivers.

The Kern River originates from several small lakes west of Mount Whitney in the high Sierra Nevada mountains. As it flows south through the Sierra Nevada, it emerges at Kernville into a widening valley before entering Lake Isabella, a reservoir formed on the river by the Isabella Dam. Downstream from the dam it flows southwest, through rugged canyons until emerging east of Bakersfield. Past Bakersfield, the river is highly diverted through a series of canals for agricultural and municipal water supply purposes. The Kern River Fan referred to locally as the Kern Fan, covers an area of approximately 200 square miles and contains prolific water-bearing sedimentary deposits that make up the principal water bearing units (Meillier, 2001). The fan deposits are heterogeneous but consist primarily of sand and gravel deposits along with some finer grained deposits. The sediments originate from weathered granodiorite from the Sierra Nevada Range.

Regional Hydrogeology

The project site is located within the Kern County Subbasin of the San Joaquin Valley Groundwater Basin (DWR, 2006). The subbasin covers the western third of Kern County and includes Kern River and Poso Creek. Geologically, the whole San Joaquin Valley represents a structural trough that is approximately 400 miles long and 70 miles wide filled with older marine and younger continental sediments eroded from the surrounding mountains. These continental sediments derived from the alluvial processes form a wedge of deposits that thicken toward the center of the valley.

The sedimentary deposits of the valley have been divided from oldest to youngest into the Olcese Formation followed by the Santa Margarita Formation, the more recent Tulare (western subbasin) and Kern River (eastern subbasin) Formations, older alluvium/stream and lacustrine deposits, younger alluvium, and local overbank-flood deposits. A previous DWR study estimated these sedimentary deposits to range in thickness from 175 to 2,900 feet with an average of 600 feet. For most of the basin, excluding the area of the Kern Fan, there are two water bearing units that are separated by an aquitard known as the Corcoran Clay, which restricts vertical groundwater flow between the overlying unconfined aquifer and the underlying confined aquifer. Specific yield, the amount of water in storage in the ground that will drain under the influence of gravity and a measurement of water available for man's use, ranges from about 3 – 12% in silts, 15 – 27% in sands and as high as 31% for gravels in the interval from surface down to 300 to 600 feet deep (DWR, 2006). The highest specific yield measurements are associated with sediments of the Kern Fan west of Bakersfield. The well-sorted, sandy sediments have higher specific yields than finer grained silts and clays.

According to estimates made by the Kern County Water Agency (KCWA), the total water storage capacity in the Kern County portion of the subbasin is 40 million acre-feet (af) (DWR, 2006). During the period of 1926 to 1970, unregulated groundwater extraction resulted in up to 9 feet of land subsidence in the south-central area of the subbasin. Since 1970, groundwater levels within the subbasin experienced two complete cycles of rising then falling water table due to climatic wet/dry cycling with the levels in 2000 equaling those that were observed in 1970.

Starting in 1978, groundwater banking operations began diverting surface water into the aquifer throughout the subbasin with the majority of operations centering in the Kern Fan area west of Bakersfield. Inflows in the subbasin include natural recharge of 150,000 af per year, artificial recharge of 308,000 af per year, applied water recharge of 843,000 af per year, and an estimated average subsurface inflow of 233,000 af per year for a total subbasin inflow of 1,534,000 af per year (DWR, 2006). Outflows from the subbasin occur as urban extraction at 154,000 af per year, agricultural extraction at 1,160,000 af per year, other extractions (oil industry related) at 86,333, for a total subbasin outflow of 1,400,300 af per year (DWR, 2006).[1]

General Aquifer Characteristics

The general hydrogeological framework for the subbasin, excluding the Kern Fan, has been characterized as two water bearing units or aquifers that are separated by an aquitard known as the Corcoran Clay. The upper aquifer is considered to be unconfined and extends down to a depth of approximately 200 to 400 feet (WDS, 2004a). The upper unconfined aquifer consists of interbedded silts, sands, with some minor deposits of clay (Meillier, 2001; and Crewdson, 2003). In the Kern Fan area west of Bakersfield, the Corcoran Clay is not present although there are numerous discontinuous silty layers that locally restrict vertical flow creating an aquitard between the shallow unconfined aquifer and the deeper semi-confined aquifer. Therefore, the Kern Fan aquifer is considered to be a 3-layer aquifer with a semi-confined or leaky deep zone, an intermediary zone, and the shallow unconfined zone.

Groundwater Levels and Direction of Flow

There are numerous monitoring wells in the project vicinity some of which have been monitored since at least 1960 (KCWA, 2007b). Groundwater levels are heavily influenced by recharge and recovery operations in the area. Western Development and Storage (WDS) conducted a review of available databases and determined that the average depth to groundwater at the project site has varied between approximately 30 and 180 feet below ground surface during the period of 1961 to 2003 (WDS, 2004a). With the onset of groundwater banking and recharge operations in the 1990s, water levels rose above historic levels but are still susceptible to the effects of large scale recovery activities (WDS, 2004a). Rosedale has measured groundwater levels at the project site since 1998 which have shown depths to water between 26 and 142 feet below ground surface (Rosedale, 2007a). WDS estimated that future groundwater levels beneath the project site could range in the future from less than 50 to more than 180 feet below ground surface (WDS, 2004a), independent of project operations.

While groundwater levels have varied considerably, the direction of groundwater flow has remained consistent toward the Northwest since the 1940s. The hydraulic gradient has varied in the project vicinity in the range from 0.0019 to 0.0048 (WDS, 2004a; Crewdson, 2007a). The

1 The total calculated subbasin outflow does not include what is considered to be minimal subsurface outflow because of the low groundwater gradient (DWR, 2006).

natural groundwater gradient is locally influenced by recharge and recovery activities and will generally increase during the early period of a recharge event due to the effective mounding of the groundwater table and decrease, flatten, or even reverse during a recovery period.

Regional Hydrogeological Studies

Several hydrogeological studies have been performed in the Kern Fan area that analyzes the aquifer characteristics within the region. The Department of Water Resources developed a ground water model of the Kern Fan area in 1995 that describes the three layer semi-confined aquifer condition generally accepted in the area. The DWR estimates of aquifer parameters were largely made based on well logs in the area and assigned specific yield values for each sediment type (DWR, 1995 as excerpted in Crewdson, 2004).[2] The result is a generalized model that is based on assumed values of sediment type and may not adequately reflect actual characteristics. Kenneth D. Schmidt and Associates have also analyzed aquifer characteristics through a review of specific capacity determinations from short-duration pump tests conducted in 2001 and late 2002 for wells located within the region. In 2003, Sierra Scientific Services cored three test holes within Rosedale and measured a complete set of physical properties on aquifer samples of all sediment types down to depths of about 100 ft (Crewdson, 2003) and reviewed and incorporated all of the aforementioned studies into the parameter analysis for the Strand Ranch Drawdown Study (Crewdson, 2007a).

Surface Water Quality

The Kern River has a number of beneficial uses according to the Water Quality Control plan for the Tulare Lake Basin (Basin Plan). Beneficial uses for Kern River include: municipal, agricultural supply, industrial supply, industrial process, hydropower generation, contact and non-contact recreation; warm freshwater habitat; wildlife habitat; and rare, threatened or endangered species (CRWQCB 2004). These identified uses dictate surface water quality management along the Kern River.

Based on these beneficial uses, the Basin Plan sets narrative or numeric water quality objectives to protect those uses. The water quality parameters for which numerical limits were selected from the sources listed above are: total alkalinity, total mercury, dissolved iron, dissolved copper, dissolved zinc, dissolved arsenic, dissolved lead, chloride, and ammonia. It should be noted that where the natural background level of a constituent is higher than the beneficial use protective numerical limit, the natural background level is considered to comply with the water quality objective (CRWQCB 2000). Under the Porter Cologne Water Quality Control Act, water quality may be changed to some degree without unreasonably affecting beneficial uses.

According to the requirements of the Clean Water Act, the Central Valley Regional Water Quality Control Board (RWQCB) has listed impaired water bodies due to elevated levels of contaminants. The Kern River is not listed as an impaired water body (RWQCB, 2003).

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[2] Specific yield is defined as the water in storage in the ground that would drain under the influence of gravity. The water that remains in the ground as a film on grain surfaces or trapped in small openings is referred to as specific retention. In general, coarser grained sediments with high porosity contain higher specific yields.

In addition to the Kern River, the other surface waters of the region that are incorporated into groundwater banking operations include the Friant-Kern canal and the California State Water Project (California Aqueduct). An overview of the water quality of all three of these regional surface water sources is provided in **Table 3.8-1**. The water quality of the California Aqueduct as it arrives in Kern County varies between wet and dry years and between winter and summer seasons. The total dissolved solids (TDS) values are typically much higher in dry climatic cycles than wet cycles and higher during winter months than summer months. The TDS values shown in Table 3.8-1 represent the highest averages during the winter season of a dry cycle.

TABLE 3.8-1
SURFACE WATER QUALITY FOR SELECT PARAMETERS

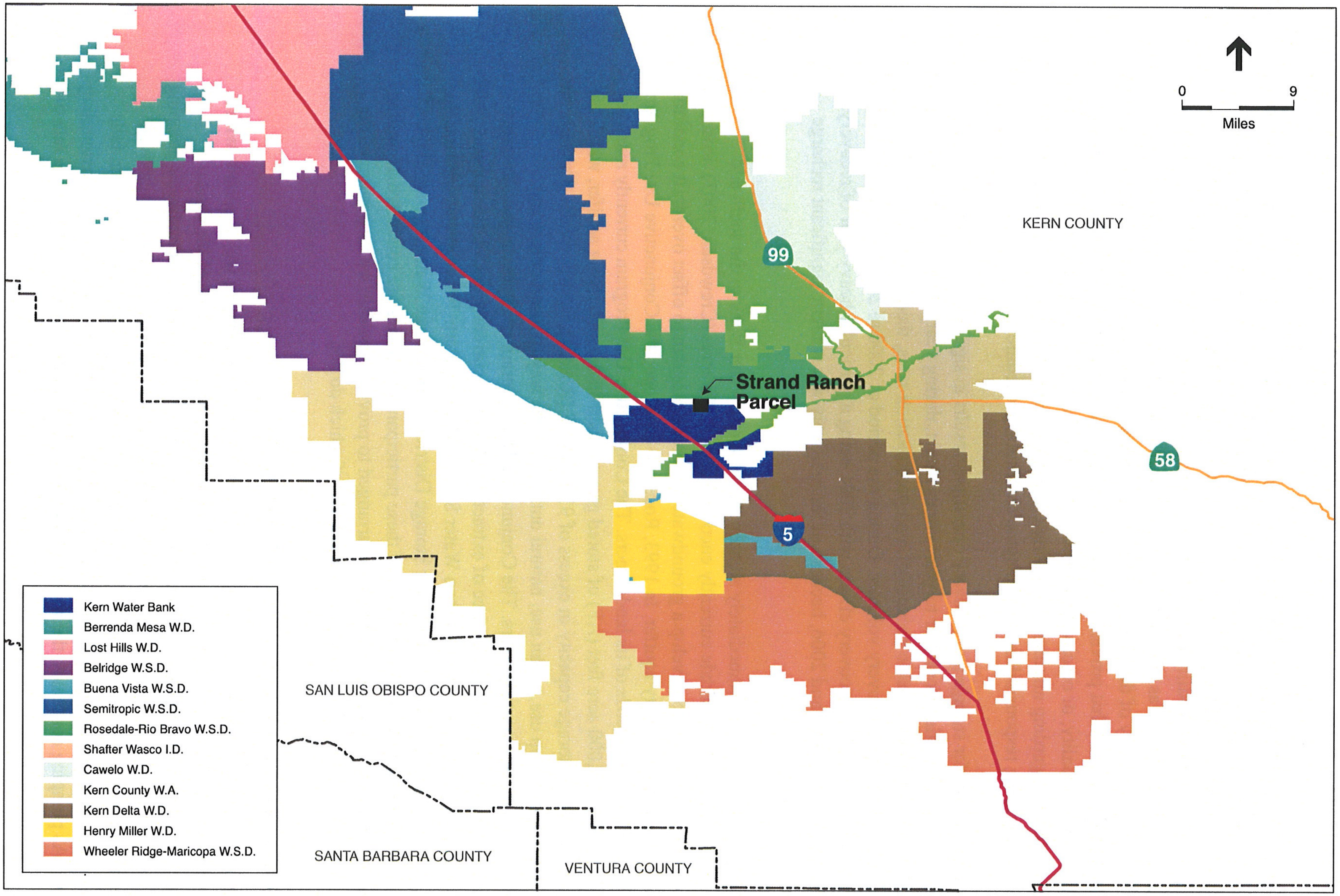
Analyte	Units	California Aqueduct	Friant-Kern Canal	Kern River	MCL
Total Dissolved Solids (TDS)	mg/l	334	41	88	500
pH	units	8.3	7.5	7.9	NA
Hardness (Hd)	mg/l	115	22	39	NA
Arsenic (As)	ug/l	7.0	2.9	5.2	~~50~~10
Alpha-emission activity	pCi/L	1.9	2.9	3.2	15
Nitrate (NO3)	mg/l	2.4	1.4	1.0	45

SOURCE: Crewdson, 2007b

Overview of Groundwater Banking Operations

Groundwater banking, also referred to as aquifer storage and recovery, was initiated in the Kern County subbasin in 1978, and by the year 2000, seven projects contained over 3 million af of banked water in a combined potential storage volume of 3.9 million af (DWR, 2006). Approximately two-thirds of this storage is in the Kern Fan area west of Bakersfield; the remainder is in the Arvin-Edison Water Storage District (WSD) in the southeastern subbasin or in the Semitropic WSD in the northwestern subbasin (DWR, 2006). Other water districts in the Kern Fan area include Shafter Wasco Irrigation District (ID), North Kern WSD, Rosedale Ranch ID, Cawelo WD, Improvement District 4, Kern Delta WD, Henry Miller WD, Buena Vista WSD, West Kern WD, Berrenda Mesa Water District, Kern County Water Agency (Pioneer Project), Kern Water Bank Authority, and the Rosedale-Rio Bravo WSD (Rosedale). **Figure 3.8-1** identifies the boundaries of the districts.

Groundwater banking consists of the importation of surface water from the Kern River, the SWP, or the Friant-Kern canal for diversion into recharge ponds for later extraction via groundwater pumping. These groundwater banking programs have supplemented variable surface water supplies and increased reliability during drought years by providing for wet-year carryover.



SOURCE: CASIL, 2007; Kern County, 2007; ESA, 2007.

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Figure 3.8-1
Kern County Water Districts

The City of Bakersfield was the first documented banking project with their property known as the 2,800-Acres Spreading Area. In the 1990s, banking programs were expanded with the construction of the Kern Water Bank, which includes 7,000 acres of recharge ponds and 13,000 acres of habitat/wildlife land, and the Kern County Water Agency's 2,200 acre Pioneer Banking Project, which was created for groundwater recharge and recovery operations (KCWA, 2007a). Many of these surrounding water districts have entered into a Memorandum of Understanding (MOU) that provides measures to protect the groundwater basin from overdraft, impairing water quality, or otherwise adversely affecting the basin or adjacent entities. The MOU includes details regarding minimum operating criteria, groundwater banking accounting practices, project monitoring responsibilities, and dispute resolution procedures.

The nature of aquifer storage and recovery operations results in significant changes in storage versus recovery activities from year to year. For example, during years when there are more surface water supplies available because of high precipitation rates, there tend to be much higher recharge volumes than recovery volumes. During the period of 2000 to 2004, the Kern Fan region was primarily focused on recovery efforts with 2001 being a particular heavy year of recovery. Conversely, during 2005 and 2006, because of the relatively wet winters, significant recharge efforts occurred.

The project site is located immediately adjacent to the Kern Water Bank to the south and Rosedale to the north. Rosedale currently encompasses 44,150 acres (Crewdson, 2003). Rosedale was established in 1959 to develop a groundwater recharge program to offset overdraft conditions in the regional Kern County aquifer. In 1993, Rosedale developed the Conjunctive Use Program to meet the long term needs of its landowners. The Conjunctive Use Program currently manages approximately 210,000 acre feet (AF) of stored groundwater in the underlying aquifer, which has an estimated total storage capacity in excess of 930,000 AF (Rosedale, 2001). Water demands for Rosedale include crop use, urban use, natural outflows in the way of evaporation, and commitments to third party bankers. The Conjunctive Use Program is a banking program, such that all recharge must occur in advance of extraction. Rosedale currently has six participants in its Conjunctive Use Program: Arvin Edison Water Storage District, Kern-Tulare Water District, Rag Gulch Water District, Buena Vista Water Storage District, Castaic Lake Water Agency and GLC (Coachella Valley Water District). Each of these participant operations are conducted according to individual agreements some of which are arranged to provide Rosedale with a portion of the recharged groundwater for their own use and some of which do not.

Groundwater Pumping Area of Influence

When a groundwater well is pumped, the aquifer surrounding the pumping well responds with a pattern of drawdown known as a *cone of depression*. The radius and depth of the cone of depression depends on the hydrogeologic characteristics of the aquifer and groundwater pumping rate. When pumping begins, the water level in the well begins to decline as water is removed from storage within the well and surrounding filter pack. The water level in the well then falls below the surrounding aquifer causing water to begin to move into the well from the surrounding aquifer. As pumping continues, the water level in the well continues to decrease until the rate of inflow equals the rate of withdrawal. In confined aquifers, withdrawal from the well causes a reduction in aquifer pressure and because storage in a confined aquifer is small, the cone of depression expands rapidly and can be widespread. Area of influence formed by pumping an unconfined aquifer results in drainage of water from the rocks through which the water table declines as the cone of depression forms. In an unconfined aquifer, the cone of depression generally expands very slowly.

Effects of Pumping Cycles

The shape of the *residual pumping depression* [3] formed by groundwater extraction is influenced by the daily groundwater pumping schedule. Groundwater depressions change when groundwater wells are turned on and off to respond to varying demand. The residual pumping depression from cyclic pumping resembles the shape of a "pan" rather than a cone.

Regional Recovery Operations

Groundwater extraction in the Kern Fan area fluctuates from year to year and tends to be concentrated during the growing season of May to September. For the first half of 2007, a total of 111,109 af of water has been extracted with the majority of that figure (74,452) coming from the Kern Water Bank (KCWA, 2007c). The total extraction projected for 2007 is approximately 355,000 af. For the first half of 2007, no extraction occurred in January or February and the heaviest periods occurred in April and May. No recovery operations associated with groundwater banking occurred at all during 2006 for the region and in 2005 only 4,740 af was recovered. Going back to 1981, annual recovery operations for the Kern Fan region have fluctuated between zero (1981-1983, 1986, 1993, and 2006) and a maximum of 191,475 af (2001 excluding the 355,000 af projected for 2007) (KCWA, 2007d).

Regional Recharge Operations

The Kern Fan has been identified as an excellent resource for groundwater banking operations due to its significant storage capacity and highly permeable overlying materials. The upper aquifer has been estimated to range in thickness from approximately 700 to 1,100 feet thick with some areas in the east approaching 3,000 feet thick (KWBA, 2007). Through 2005, the Kern Water Bank Authority recharged a cumulative total of 1,000,000 af into the ground (KWBA, 2007). For the period of 1995 to 2005, when groundwater banking operations began, Rosedale has banked a total of approximately 300,000 af (Roberts, 2007).

Volumetric recharge rates are controlled by the porosity and permeability of the subsurface materials and total pond area. Aquitards at depth can impede recharge efforts, however on the Kern Fan and in the project area, these layers impede but do not prevent recharge and recovery operations. The porosity of near surface soils tend to be very important to sustaining long term recharge operations. Pore spaces can eventually become clogged with finer grained material transported by the recharge water or by bio-growths found within the recharge water

[3] The residual pumping depression is the draw down that remains after pumping is discontinued and before the groundwater fully recovers.

(WDS, 2004b). Local project operators periodically scrape or treat their ponds to remove clogging deposits and encourage the growth of certain types of plants which keep the near-surface soil structure open and porous.

Groundwater Storage Capacity

For the purposes of artificial recharge projects, groundwater storage capacity in an aquifer is defined as the theoretical amount of groundwater that can be stored in an aquifer through surface recharge. Aquifer storage capacity is determined by calculating the available void space within the aquifer underlying a specified area down to the water table. The available storage capacity is then calculated from the difference of the total storage capacity and the existing volume of groundwater storage. As mentioned above, the total storage capacity of the San Joaquin Valley subbasin has been estimated by the Kern County Water Agency to be 40,000,000 af within the Kern County portion of the subbasin, covering an area of approximately 1,000,000 acres.

In 2003, an evaluation of the aquifer storage capacity was conducted for the entire Rosedale district (Crewdson, 2003). The findings were made on several quantitative findings from soil borings including an average depth of the aquifer at 720 feet below ground surface, an average groundwater depth of 120 feet below ground surface, specific yield values for different sediment types (33 percent for sand, 8.6 percent for silt, and zero percent for clay), and distribution of sediment types within the aquifer (50 percent sand, 48 percent silt, and 2 percent clay). Assuming a maximum aquifer height of 20 feet below ground surface (or 700 feet total), the total storage capacity of the aquifer in the district was determined to be 6,510,000 af. The volume of water already in storage was calculated to be 5,580,000 af leaving an available capacity of 930,000 af within the 44,150 acre extent of the district boundary. However, as noted in the report, deviations from the assumptions mentioned above would obviously directly affect the resultant calculations.

Regional Groundwater Quality

The San Joaquin Valley Groundwater basin is generally characterized by calcium bicarbonate waters in the shallow zones in the eastern subbasin with increasing sodium concentrations occurring with depth (DWR, 2006). Moving east to west, the bicarbonate levels are replaced by sulfate and chloride such that the west subbasin contains primarily sodium sulfate and calcium-sodium sulfate characteristics. TDS concentrations average approximately 400 to 450 milligrams per liter (mg/L) with a total range of 150 to 5,000 mg/L (Kern County Water Agency as referenced in DWR, 2006). Shallow groundwater in some areas of the subbasin contains high TDS, sodium chloride, and sulfate concentrations. Areas typically associated with lakebed deposits show elevated concentrations of arsenic. Historic agricultural uses of the region have contributed to elevated concentrations of nitrate, 1,2-Dibromo-3-chloropropane (DBCP – a soil fumigant), and ethylene dibromide (EDB – a pesticide). Other natural concentrations found in the area of interest include α-particles, uranium, barium, boron, and zinc.

The screening evaluation conducted by WDS, reviewed data collected from various sources in the region including the Kern Water Bank Authority, the Kern Fan Monitoring Committee, Rosedale, and DWR. Their findings concluded that many wells in the region are impacted by arsenic, boron, nitrates, chlorides, and in some areas agrichemical compounds such as EDB (WDS, 2004a). Most of the groundwater within the Kern Fan region originates as infiltration or recharge from Kern River surface water. The change in water chemistry between the surface waters of the Kern River and the groundwater occurs as a result of both natural and manmade factors. As the water naturally recharges through the sediments derived from the erosion of the granitic material from the Sierra Nevada mountain range, some constituents such as naturally occurring arsenic and radioactive elements are introduced into the water. Manmade sources of contaminants in the groundwater include agricultural practices, oilfield operations, and accidental spills from hazardous material use associated with commercial and industrial activity. Within the Kern Fan region, the groundwater aquifer is characterized by three aquifer zones (shallow, intermediate, and deep) that all contain distinct water chemistries.

The shallow zone is generally considered to be the upper 300 feet of the aquifer. The water chemistry is characterized as generally having moderate concentrations of total dissolved solids (TDS), moderate hardness (calcium concentrations), elevated nitrates, elevated alpha emitters, and a slightly basic pH (Crewdson, 2007b). The intermediate zone (approximately 300 to 400 feet deep) is generally characterized as a transitional zone that can resemble either the shallow or deep zone depending on where in the zone a sample is obtained. The deep zone (approximately 400 to 700 feet deep) is characterized as being soft (low calcium concentrations), having low TDS, high pH, high arsenic, low alpha, and low nitrates (Crewdson, 2007b).

3.8.2 Project Setting

Project Topography

The project site is located approximately 10 miles west of Bakersfield. The square shaped project area ranges in elevation from approximately 320 to 325 feet above mean sea level. The site is relatively flat with a very gentle slope towards the northwest, interrupted by a levee surrounding the Pioneer Canal which intersects the site. The nearest natural surface water body to the project site is the Kern River which is located approximately two miles south.

Project site hydrogeology

The aquifer characteristics of the project site are considered in general to be consistent with the Kern Fan region although there is little detailed information on the project site available. The aquifer has been characterized in a hydrogeological study of the project site as a stratified sequence of interbedded alluvial silts and sands that is approximately 700 feet thick (Crewdson, 2007a). The 700 foot aquifer includes a 300 foot thick shallow unconfined zone, a 100 foot middle zone, and a 300 foot deep semi-confined zone. The Corcoran clay, which is present elsewhere in the valley, does not underlie the project site. The aquifer is considered semi-confined due to the likely presence of finer-grained sediments which, where present, act to retard the vertical flow of groundwater.

According to observations made by the current property operator, the existing wells outfitted with 125 to 150 horsepower pumps consistently produce pumping rates in the range of 1,600 to

1,700 gallons per minute (gpm) or 3.57 to 3.79 cubic feet per second (cfs) (WDS, 2004b). The Kern Water Bank wells located immediately adjacent to the project site, equipped with larger horsepower pumps, produce 2,060 to to 3,161 gpm or 4.59 to 7.04 cfs (WDS, 2004b).

Strand Ranch Recharge Operations of 2006

As part of the Interim Recharge Project, Rosedale constructed three recharge ponds on the project site in 2006 in the southwest corner of the property covering approximately 120 acres. Diverted water from the CVC was directed into these ponds during the period of July 2006 through December 2006. A total of 2,983 af was recharged into the ground over this period with a daily average ranging from 0.11 to 0.43 af per day per acre with the higher averages occurring during the late summer months (RRBWSD, 2007c). The average rate was 0.17 af per day per acre. Rosedale operators considered these rates to be relatively low due to relatively saturated conditions from the previous heavy precipitation winter. The theoretical rates for these ponds with a deep water table are in the range from 0.21 to 0.67 af per day per acre for a weighted average of 0.27 af per day per acre (WDS, 2004b). No recovery of this banked water occurred on the property other than for the existing agricultural use.

Project Site Extraction

The project site currently has seven agricultural wells, two of which are inoperable. These wells were installed prior to the purchase of the property by Irvine Ranch Water District and little information is known regarding the construction details, however they are believed to be completed only in the shallow zone of the aquifer. Groundwater extraction for the purpose of irrigation of leased agricultural lands on the project site is estimated at approximately 700 af per year. These existing agricultural wells would not be used for recovery of groundwater for the proposed project.

Project Site Groundwater Quality

There are seven agricultural wells located on the project site referred to as Well Nos. 1 through 7. However, two of the wells (Nos. 5 and 7) are inoperable. Generally speaking, Well Nos. 1 through 4 and Well No. 6 are located in the eastern or central portion of the Strand Ranch parcel. Figure 10 of **Appendix G** shows the locations of the wells (Crewdson, 2007b). All of these wells are considered shallow wells but according to available DWR records, two of the wells may have originally been completed as deep as 540 feet. However, the DWR reports are considered unreliable based on the lack of review under which they are prepared. As part of their environmental screening investigation for the project site, WDS sampled two of the onsite shallow agricultural wells (No. 1 and No. 6) in December of 2003 from wells set at an unknown depth. The results of both sampling events are presented in **Table 3.8-2.** All five operating wells were sampled in August of 2005, and the resulting water quality analysis is presented with other water quality data in **Appendix G** (Crewdson, 2007b). The TDS concentrations are generally higher than what would be expected for the shallow zone in the region. The higher TDS concentrations are considered to be a result of a brine plume that is migrating onto the project site.

TABLE 3.8-2
STRAND RANCH SHALLOW WELL SAMPLING RESULTS DETECTED COMPOUNDS ONLY

Analyte	Units	Well No. 1	Well No. 2	Well No. 3	Well No. 4	Well No. 6	Regulatory Standards and Guidance
Alpha, Gross	pCi/l	7.8 (9.99[4]	9.2	7.6	8.0	22 (24.6)	MCL 15
Alpha, Minimum Detectable Activity	pCi/l	2.00	2.00	2.00	2.00	2.00	
Alpha, Two Sigma Error	pCi/l	2.4	2.5	2.3	2.6	4.3	
Benzene	ug/l	ND	0.7	ND	ND	ND	MCL 5
Agressiveness Index-Calculated	Na	12.44	12.22	12.41	12.35	12.43	
Alkalinity in CaCO3 units	mg/l	90.1 (100)	54.9	89.6	95.9	157 (180)	
Arsenic	ug/l	ND	1.4	ND	ND	ND	MCL 10
Barium, dissolved	ug/l	170 (140)	170	200	130	100 (140)	CA MCL 1000
Bicarbonate Alkalinity as HCO3	mg/l	110 (100)	66.8	109	117	191 (180)	
Bromide	ug/l	1100	ND	1700	900	420	
Calcium, Total	mg/l	110 (93)	110	130	85	78 (88)	
Carbon Dioxide, Free	mg/l	2.27	1.38	2.83	2.42	4.96	
Carbonate as CO3	mg/l	0.568	0.345	0.447	0.604	0.783	
Chloride	mg/l	180 (150)	260	270	140	200 (92)	MCL 250
Copper, dissolved	ug/l	ND (ND)	ND	ND	ND	5.6 (2.1)	CA MCL 1000
Chromium, dissolved	ug/l	3.6	6.9	2	4.1	ND	
Dissolved Organic Carbon	mg/l	ND	ND	0.3	ND	0.37	
Field pH	Units	7.4	7.6	7.5	7.5	7.3	
Fluoride	mg/l	0.05	0.08	0.08	0.06	0.05	MCL 4
Hexavelant chromium (dissolved)	ug/l	1.9 (1.5)	1.9	1.8	2.5	1.3 (1.2)	CA MCL 50
Hydorxide as OH	mg/l	0.01	0.01	0.01	0.01	0.01	
Langelier Index – 25 degree	None	0.54	0.32	0.51	0.45	0.53	
Lead, dissolved	ug/l	ND	ND	ND	ND	1.5	

4 Samples collected from December 2003. Wells 1 and 6 only.

TABLE 3.8-2 (CONT.)
STRAND RANCHSHALLOW WELL SAMPLING RESULTS DETECTED COMPOUNDS ONLY

Analyte	Units	Well No. 1	Well No. 2	Well No. 3	Well No. 4	Well No. 6	Regulatory Standards and Guidance
Magnesium, total	mg/l	4.4 (4.4)	2.7	4.8	3.2	4.3 (4.3)	
Manganese	ug/l	ND (ND)	4.4	6.6	ND	ND (2)	CA MCL 50
Mercury	ug/l	ND	1.01	ND	ND	ND	
Odor	TON	2	1	2	1	1	MCL 3
pH	Units	7.9 (7.88)	7.9	7.8	7.9	7.8 (7.66)	MCL 6.5-8.5
Potassium, total	mg/l	1.7 (1.4)	1.7	1.8	1.4	1.3 (1.5)	
Sodium, total	mg/l	52 (50)	75	83	52	49 (55)	
Source temperature	Degrees C	24.1	23.4	23.3	23.5	23.3	
Specific Conductance	Umho/cm	944	1070	1190	775	683	
Sulfate	mg/l	37 (33)	21	28	30	82 (33)	MCL 250
Total Dissolved Solids (TDS)	mg/l	660 (540)	710	800	510	410 (480)	MCL 500
Total Hardness as CaCO3	mg/l	293	286	344	225	212	
Turbidity	NTU	0.35 (0.15)	0.3	0.25	0.20	0.35 (3.8)	MCL 5
Uraniium (pCi/L)	pCi/l	14.1 (20.2)	6.70	14.1	13.4	27.5 (34.4)	CA MCL 20
Uranium ((ug/L)	ug/l	21	10	21	20	41	MCL 30
Zinc, dissolved	ug/l	ND	ND	ND	ND	5.2	
pH of CaCO3 saturation (25C)	Units	7.36	7.58	7.29	7.45	7.27	
pH of CaCO3 saturation (60C)	Units	6.92	7.14	6.85	7.00	6.83	

SOURCE: WDS, 2004a, MWH Laboratories,2005

Mg/l Milligrams per liter
Ug/l Micrograms per liter
pCi/l Pico Curies per liter
MCL Maximum Contaminant Level – Federal
CA MCL California Maximum Contaminant Level
ND Not detected

(Crewdson, 2007b).[5] Analysis of sampling data of other wells in the Kern Fan region indicate that there are two plumes of brine-affected shallow groundwater one of which appears to be migrating onto the project site.[6] The source of the brine plume, according to the sampling data appears to originate in the up gradient direction of the project site, to the southeast in the area known as the Strand Oil Field. Table 3.8-2 lists sampling results above Non-Detect. **Appendix H** contains the laboratory data sheets identifying all constituents analyzed including those not detected.

Erosion

Erosion and sedimentation are natural processes driven by surface runoff that can be accelerated by human activities such as construction earthwork activities. During construction, removal of vegetation or impervious areas (concrete, asphalt, etc.) expose soils to precipitation and surface runoff and can accelerate surface soil erosion. The process often results in loss of topsoil, creation of erosional features including rills and gullies, and sediment-filled streams and channels. Erosion potential is determined by four principal factors: the characteristics of the soil, extent of vegetative cover, topography, and climate. Soil texture and permeability determine the resistance of soil to entrainment by surface runoff. Vegetative cover plays a critical role in controlling erosion by shielding and binding the soil. Slope influences the rate of runoff and is directly correlated with erosion potential where flatter topography has a much lower potential for erosion. The intensity and duration of rainfall determines the extent and the capacity for flowing water to detach and transport soil particles.

Excessive sedimentation may reduce channel or basin capacities and require increased dredging or cleaning of channels. Erosion along stream banks can erode nearby property, causing a loss of land or possibly increased flooding. Increased sedimentation can also restrict storm drains and channels and lead to flooding during storms that the drainage system should capably handle. In addition, development can increase the likelihood of erosion and sedimentation along unlined drainage channels as a result of increased storm water flows.

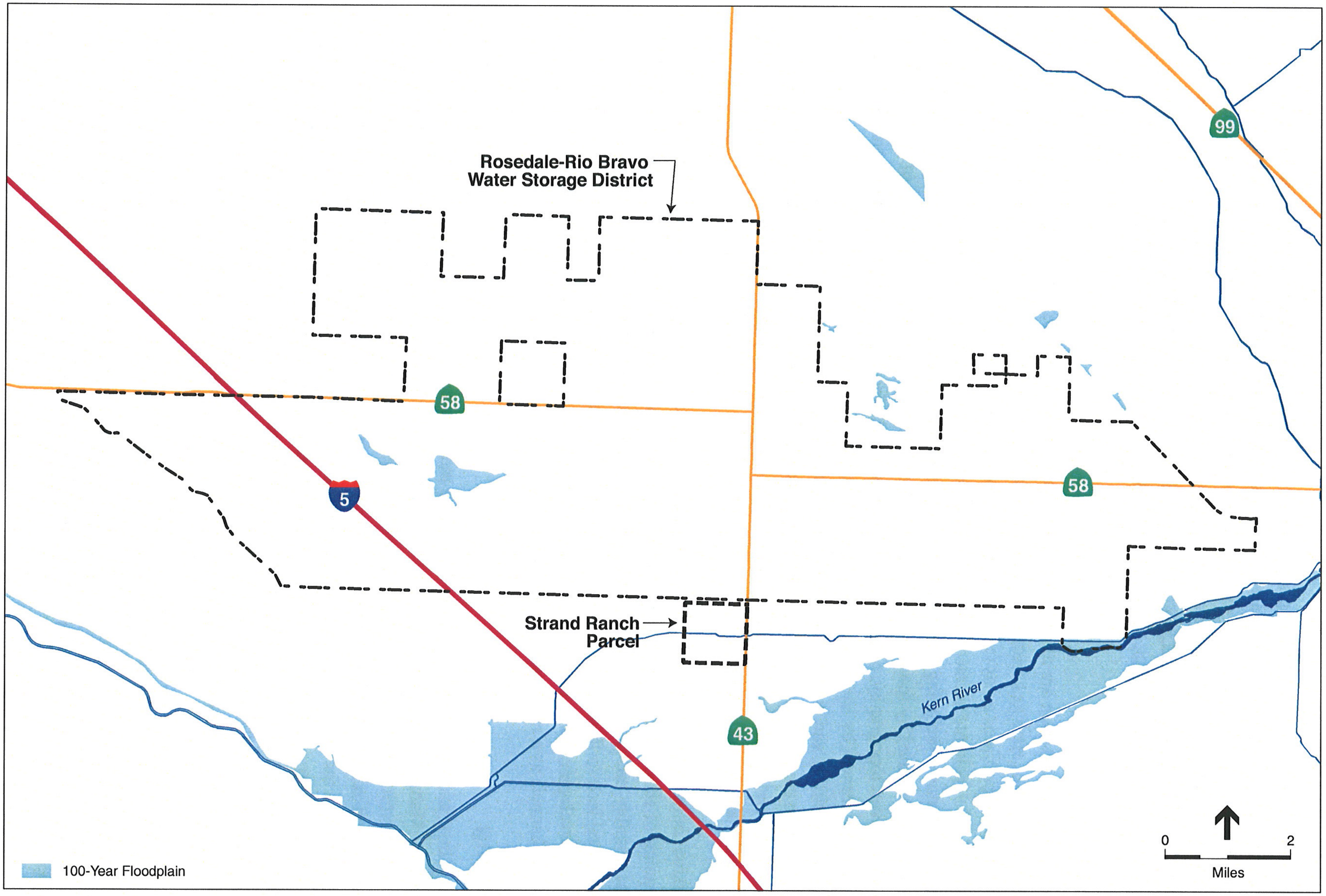
Flooding

A Flood Insurance Rate Map (FIRM) is the official map of a community prepared by the Federal Emergency Management Agency (FEMA) to delineate both the special flood hazard areas and the flood risk premium zones applicable to a community. FEMA has designated various 100-year and 500-year flood zone within the project area, which are generally associated with various creeks and drainages in the area.[7] FEMA designates flood zones using a series of letters, for example, Zone A indicate areas of the 100-year flood, Zone B areas are those between the limit of 100-year flood and 500-year flood, and Zone C areas experience minimal flooding. The project site is located in broad area that is designated as Zone C (FEMA, 1986). **Figure 3.8-2** shows flood zones in the project area, which are mostly associated with the Kern River.

5 Brine water contains higher salt content and typically higher TDS concentrations. Oil production and refining processes produce large quantities of brine as wastewater.

6 The unidentified source of brine has been characterized as occurring in a recharge mound area such that the plumes are spreading in different directions (Crewdson, 2007b).

7 A 100-year flood has a one percent chance of occurring in a given year and while a 500-year flood has a 0.2 percent chance.



SOURCE: Kern County, 2007; ESA, 2007.

Irvine Ranch Water District . 205426

Figure 3.8-2
100-Year Flood Hazard Area

3.8.3 Regulatory Framework

Federal, State, Regional and Local Requirements

Clean Water Act

Regulatory authorities exist on both the state and federal levels for the control of water quality in California. The U.S. Environmental Protection Agency (EPA) is the federal agency, governed by the Clean Water Act (CWA), responsible for water quality management.

The purpose of the CWA is to protect and maintain the quality and integrity of the nation's waters by requiring states to develop and implement state water plans and policies. Section 303 of the CWA requires states to establish water quality standards consisting of designated beneficial uses of water bodies and water quality standards to protect those uses for all Waters of the United States. Under Section 303(d) of the CWA, states, territories and authorized tribes are required to develop lists of impaired waters. Impaired waters are the waters that do not meet water quality standards, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for water on the lists and develop action plans to improve water quality. This process includes development of Total Maximum Daily Loads (TMDL) that set discharge limits for non-point source pollutants. The recently passed Ducheny Bill (AB 1740) requires the SWRCB and its nine Regional Water Quality Control Boards to post this list and to provide an estimated completion date for each TMDL (SWRCB, 2003). The list is administered by the Regional Boards, in this case, Central Valley Regional Water Quality Control Board. The Kern River is not included in the 2002 California 303(d) List of Impaired Water Bodies (SWRCB, 2003).

Total Maximum Daily Load

California has identified waters that are polluted and need further attention to support their beneficial uses. These water bodies are listed under the CWA Section 303(d) list, which requires States to identify these polluted waters. Specifically, Section 303(d) requires that each state identify water bodies or segments of water bodies that are "impaired" (i.e., not meeting one or more of the water quality standards established by the state). Approximately 500 water bodies or segments have been listed in California. Once the water body or segment is listed, the state is required to establish "Total Maximum Daily Load" or TMDL for the pollutant causing the conditions of impairment. The TMDL is the quantity of a pollutant that can be safely assimilated by a water body without violating water quality standards. The EPA estimates that within the next 15 years, 40,000 TMDLs must be developed. At this time, the EPA has finalized only about eight TMDLs and four have been approved. Listing of a water body as impaired does not necessarily suggest that the pollutants are at levels considered hazardous to humans or aquatic life or that the water body segment cannot support the beneficial uses. The intent of the 303(d) list is to identify the water body as requiring future development of a TMDL to maintain water quality and reduce the potential for continued water quality degradation.

National Pollutant Discharge Elimination System

Part of the CWA provides for the NPDES, in which discharges into navigable waters are prohibited except in compliance with specified requirements and authorizations. Under this system, municipal and industrial facilities are required to obtain a NPDES permit that specifies allowable limits, based on available wastewater treatment technologies, for pollutant levels in their effluent. In California, the EPA has delegated the implementation of this program to the State Board and to the Regional Boards.

Storm water discharges are regulated somewhat differently. Storm water runoff from construction areas of one acre or more require either an individual permit or coverage under the statewide General Construction Storm Water Permit. In addition, specific industries, including waste water treatment plants that have direct storm water discharges to navigable waters are required to obtain either an individual permit issued by the Regional Board, or obtain coverage under the statewide General Industrial Storm Water Permit for storm water discharges.

A non-point source is a diffused source, such as land runoff, precipitation, deposit from the atmosphere, or percolation. Major non-point sources of water pollution are agriculture, mining, oil and gas extraction, pastureland and feedlots, land disposal, and urban runoff. For non-point sources, the Basin Plan outlines the approach that the Regional Board has taken to control non-point source pollution in its Urban Runoff Management scheme. Part of the strategy involves the permitting of storm water discharges from all facilities associated with industrial activities and from all construction activities that result in the disturbance of land totaling one acre or more.

California Toxics Rule

The EPA is responsible for implementing federal laws designed to protect air, water, and land. EPA has developed national water quality standards in accordance with the CWA and these standards are used to determine the amount and the conditions under which pollutants can be discharged. The EPA published the California Toxics Rule (CTR) in the Federal Register (FR) establishing water quality standards for toxic pollutants for California waters (FR 31681). On April 28, 2000 the Office of Administrative Law approved the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Implementation Plan [SIP]). The State Water Resources Control Board adopted the policy in March 2000. The SIP establishes the implementation policy for all toxic pollutants.

State Water Resources Control Board

The State Water Resources Control Board (SWRCB), located in Sacramento, is the agency with jurisdiction over water quality issues in the State of California. The SWRCB is governed by the Porter-Cologne Water Quality Act (Division 7 of the California Water Code), which establishes the legal framework for water quality control activities by the SWRCB. The intent of the Porter-Cologne Act is to regulate factors which may affect the quality of waters of the State to attain the highest quality which is reasonable, considering a full range of demands and values. Much of the implementation of the SWRCB's responsibilities is delegated to its nine Regional Boards. The project site is located within the Central Valley Region.

Regional Water Quality Control Board, Central Valley Region

The Central Valley Regional Water Quality Control Board (RWQCB) is responsible for the protection of beneficial uses of water resources within the Central Valley Region. The RWQCB uses planning, permitting, and enforcement authorities to meet this responsibility, and adopted the Water Quality Control Plan for the Tulare Lake Basin (Basin Plan) second edition on January, 2004, which was approved by the SWRCB and the Office of Administrative Law.[8] This updated and consolidated plan represents the Regional Board's master water quality control planning document. The Basin Plan comprehensive program requirements are designed to be consistent with federal regulations (40 CFR Parts 122-124) and are implemented through issuance of NPDES permits to point source and non point sources of pollutant discharges including construction activities. The Basin Plan identifies beneficial uses and establishes water quality objectives for surface waters in the Region, as well as effluent limitations and discharge prohibitions intended to protect those uses.

Construction Activity Permitting

Storm water runoff from construction areas of one acre or more require either an individual permit or coverage under the statewide General Construction Storm Water Permit. In addition, specific industries, including waste water treatment plants that have direct storm water discharges to navigable waters are required to obtain either an individual permit issued by the Regional Board, or obtain coverage under the statewide General Industrial Storm Water Permit for storm water discharges.

The RWQCB administers the NPDES storm water-permitting program in the Central Valley region. Construction activities on one acre or more are subject to the permitting requirements of the NPDES General Permit for Discharges of Storm Water Runoff Associated with Construction Activity (General Construction Permit). The General Construction Permit requires the preparation and implementation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP is prepared before construction begins. The plan would include specifications for Best Management Practices (BMPs) that would be implemented during project construction to control degradation of surface water by preventing the potential erosion of sediments or discharge of pollutants from the construction area. The General Construction Permit program was established by the RWQCB for the specific purpose of reducing impacts to surface waters that may occur due to construction activities. BMPs have been established by the RWQCB in the *California Storm Water Best Management Practice Handbook* (2003), and are recognized as effectively reducing degradation of surface waters to an acceptable level. Additionally, the SWPPP would describe measures to prevent or control runoff degradation after construction is complete, and identify a plan to inspect and maintain these facilities or project elements.

8 The Tulare Lake Basin Plan covers only the southern portion of the Central Valley region. The Central Valley Regional Water Quality Control Board has produced a separate basin plan for the Sacramento and San Joaquin Valley regions.

Local Ordinances

Kern County General Plan

The Kern County General Plan includes elements to protect the groundwater and surface water resources of the county through various goals and policies. The following policies would apply to the proposed project:

- Encourage the development of the County's groundwater supply to sustain and ensure water quality and quantity for existing users, planned growth, and maintenance of the natural environment.
- The Kern County Environmental Health Services Department will develop guidelines for the protection of groundwater quality which will include comprehensive well construction standards and the promotion of groundwater protection for identified degraded watersheds.
- Encourage effective groundwater resource management for the long-term benefit of the County through the following:
  - Promote groundwater recharge activities in various zone districts.
  - Support for the development of Urban Water Management Plans and promote Department of Water Resources grant funding for all water providers.
  - Support the development of Groundwater Management Plans.
  - Support the development of future sources of additional surface water and groundwater, including conjunctive use, recycled water, conservation, additional storage of surface water, and groundwater and desalination.

Kern County Code - Water Well Ordinance

Title 14 Section 14.08 of the Kern County Code covers Water Well Systems and includes well construction standards and permitting procedures. The well construction standards include reference to the adoption of State Department of Water Resources well construction standards found in Bulletin 74-81 which was amended with Bulletin 74-90.

3.8.4 Impacts and Mitigation Measures

Significance Criteria

The *CEQA Guidelines* provide guidance on impact significance criteria in the revised Appendix G-Environmental Checklist. The relevant criteria to determine if the proposed project could have a significant impact on Hydrology and Groundwater Resources are adapted from the *CEQA Guidelines* and are listed below.

- violate any water quality standards or waste discharge requirements;
- substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would

drop to a level that would not support existing land uses or planned uses for which permits have been granted);

- substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on or off site;
- substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on or off site;
- create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
- otherwise substantially degrade water quality;
- place housing within a 100-year flood hazard zone as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
- place within a 100-year flood hazard area structures that would impede or redirect flood flows;
- expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam; or
- cause inundation due to seiche, tsunami, or mudflow.

Impacts Discussion

Surface Runoff

The following significance criteria pertain to site drainage and surface runoff impacts.

- substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on or off site;
- substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on or off site;
- create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;

The proposed project would slightly alter drainage patterns on Strand Ranch by constructing recharge ponds on an otherwise level topographic surface. However, no river or stream would be altered in the course of construction. Once constructed, the recharge ponds would detain a majority of the surface runoff on the project site. Project operations would include maintenance of the earthen berms to minimize the effects of any potential erosion. Therefore, there would be no impact from erosion or siltation due to alteration of the drainage patterns.

The proposed project would not increase the rate or amount of surface runoff. There would not be a substantial increase in impervious surfaces. The proposed recharge basins would retain most of the surface runoff thereby decreasing both the rate and amount of runoff from the site. The proposed project does not include the installation of new storm drainage systems nor does it contain elements that would create more runoff for stormwater drainage. There would be no impact to surface runoff.

Flood Impacts

The following significance criteria pertain to flood impacts.

- place housing within a 100-year flood hazard zone as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;
- place within a 100-year flood hazard area structures that would impede or redirect flood flows;
- cause inundation due to seiche, tsunami, or mudflow.

The project does not include construction of any housing or other structures that could be affected by a flood. Nor is the project site located within an inundation area of a levee or dam. Furthermore, the project site is not located in a region that is susceptible to seiche, tsunami, or mudflow. There would be no impact from flooding.

Groundwater Impacts

The following significance criteria pertain to groundwater impacts.

- substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted);
- otherwise substantially degrade water quality;

The following impacts discuss impacts to groundwater and groundwater quality.

Impact 3.8-1: The proposed project would lower groundwater levels at neighboring wells during periods of recovery. Less than Significant.

The proposed project is designed to limit impacts to wells pumping on adjacent properties. The project would construct five to eight production wells on Strand Ranch and up to three production wells within Rosedale's existing service area (see Figure 2-4) with recovery rates of approximately five cfs for each well. The wells on Strand Ranch would be located at a minimum of an 880-foot setback from the adjacent southern property line where the closest neighboring wells are located. Recovery operations from the Strand Ranch wells and project wells in Rosedale would be limited to a combined rate of 36 cfs with the following exception: Rosedale would have the ability to increase the combined rate of recovery to 40 cfs as required to meet mitigation requirements imposed by the MOU. As an example, this could occur in response to a request from a neighboring property to limit recovery operations on Strand Ranch to a certain period of time.

Groundwater supplies would not be depleted by the project. The proposed Strand Ranch Integrated Banking Project is designed to always maintain a positive project balance such that no net water would be removed from the basin. There is zero likelihood of recharge and recovery occurring simultaneously. The project would operate by recharging water in a wet year and recovering water as needed in future dry years. The project will always put more water into the ground then it will remove. IRWD could only recover water up to the amount previously banked with Rosedale minus an amount consistent with the existing MOU (currently ranging from 11 to 15 percent) to account for losses to the basin. The net depletion to the basin resulting from the recovery operations would be compensated if not exceeded by recharge. In addition, the project would assist in reducing the potential for overdraft conditions by eliminating groundwater extraction that currently occurs for agricultural production. The project would cause no long term negative effect to the basin.

Groundwater modeling was conducted by Sierra Scientific Services (Crewdson, 2007a) to assess the potential that pumping from proposed project wells would affect neighboring groundwater extraction wells. The project calls for construction of five to eight production wells on Strand Ranch with a combined capacity of 36 cfs. For analysis purposes, the modeling work considered seven wells on Strand Ranch. The proposed project also calls for construction of up to three production wells in Rosedale's existing service area with a combined capacity of 15 cfs. The modeling work included the following pumping scenarios:

- 7-well pumping scenario on Strand Ranch: A total of seven wells would be constructed on Strand Ranch at an offset of 880 feet from the adjacent southern property line. The scenario simulated an expected combined extraction rate of 35 cfs day for as many days (250 days) as it takes to achieve an annual extraction of 17,500 af/year.
- 3-well pumping scenario in Rosedale: A total of three wells would be constructed at the proposed Rosedale well field shown in Figure 2-4. The scenario simulated three in-line wells at a 1/3 mile spacing and an expected combined extraction rate of 15 cfs.

The groundwater modeling report is included as **Appendix F**. Aquifer parameters used for the modeling were obtained from data published by local sources and are referenced in an exhibit in **Appendix F** titled: "Aquifer Parameters and Parameter Values". In the absence of parameter data specific to the Strand Ranch site, the analysis used a range of parameters deemed realistic for the local area (Crewdson, 2007a).

According to results from the "7-well pumping" scenario, steady state conditions from pumping of the wells at the maximum proposed rate would result in temporary drawdown of between 3 to 29 feet at land sections with neighboring KWBA wells (Table 2 of Appendix F). The highest drawdown potential would occur at the two KWBA wells immediately adjacent to the property (Crewdson, 2007a). This calculation assumes that pumping would occur continuously over a 250-day period (8.3 months), simulating the maximum annual production of 17,500 af. These drawdown impacts would be temporary and occur only as long as project wells are pumping plus the time to reach a new equilibrium once pumping is terminated which could be a period of weeks. After the wells are turned off the water table would return to an unimpacted steady state water surface elevation within a few weeks.

According to the "3-well pumping" scenario, steady state conditions from pumping of the wells at the maximum proposed rate would result in temporary drawdown of less than one foot at neighboring KWBA wells (Exhibit 4 of Appendix F). The closest KWBA wells are approximately ¾ to one mile south of the proposed well locations in Rosedale, south of Stockdale Highway.

Temporary impacts to neighboring wells would only occur during periods when the neighboring wells are pumping simultaneously with the project wells. Both the seven-well and three-well drawdown analyses were performed assuming that adjacent KWBA wells were not pumping simultaneously with the proposed project wells. Under a scenario of both sets of wells pumping simultaneously, the effect at the KWBA wells due to pumping from the seven Strand Ranch wells and three Rosedale wells would still be within the one to 29 feet range. This small range of impact on water surface elevations on adjacent wells would not result in a loss of the KWBA to perform recharge and recovery operations.

Historic groundwater level data suggest that water levels in the region fluctuate substantially on an annual basis due to extraction and recharge efforts. Historical groundwater level data were collected from three monitoring wells located within a two-mile radius of the project site. The groundwater level observations show that groundwater has fluctuated up to 190 feet over a 13 year period. In 2001, the average groundwater levels in all of the KWBA production wells fluctuated a total of 140 feet throughout the year.

The 3- to 29-foot maximum drawdown potential of the project while the project wells are pumping was compared with historic groundwater fluctuations in the region. Since the average well depth of nearby KWBA wells is 900 feet and since they have exhibited annual level fluctuations up to 140 feet, the proposed project's potential to lower water surface elevations at KWBA wells by one to 29 feet would not significantly impact the function of the neighboring wells. The range of expected drawdown at the nearest neighboring wells appears to be well within the range of current fluctuation such that an adverse effect will be unlikely. Based on the CEQA significance criteria listed above the project will not substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted). Therefore the environmental impacts would be considered less than significant. No mitigation measures would be required. However, there will be temporary drawdown impacts to neighboring wells during periods of extraction by the neighboring wells.

The temporary drawdown impacts to neighboring wells would be subject to the existing commitments and conditions of the MOU, which provides language that mitigates the potential for adverse affects of adjoining entities. Under the MOU, groundwater banking operations are to be "consistent with avoiding, mitigating or eliminating to the greatest extent practicable, significant adverse impacts" (KCWA, 2004). Mitigation measures that are identified in the MOU include but are not limited to the following: (i) with the consent of the affected groundwater pumper, lower the pump bowls or deepen wells as necessary to restore groundwater extraction capability to such pumper, (ii) with the consent of the affected groundwater pumper, provide alternate water supplies to such pumper, and (iii) with the consent of the affected groundwater pumper, provide financial compensation to such pumper. Groundwater recovery operations at Strand Ranch would adhere to the requirements of Rosedale's current MOU. No other mitigation is required beyond of the existing commitments contained within the MOU.

Mitigation Measures

Mitigation Measure: No other mitigation is required.

Impact 3.8-2: Groundwater quality could be affected by the addition of recharge water, neighboring contamination plumes, and intermixing of aquifer layers with varying water quality. Less than Significant.

As described in the setting section, the aquifer beneath the project site has been characterized as having three zones with varying water chemistry. Construction of a well with open screening across all three zones could potentially serve as a conduit for vertical migration of water that may not have previously existed. Water migrating downward could cause constituents found in the upper zone to increase in the lower zones. A comparison of water quality parameters for the shallow and deep zones is shown in **Table 3.8-3**. The averages shown in the table indicate that no contaminates in either the deep or shallow aquifer zones exceed maximum contaminant levels (MCLs) for drinking water as established in Title 22 of the California Code of Regulations.

The water quality of the surface water sources for groundwater banking is in general better than that of the shallow groundwater zone and also below MCLs (Table 3.8-3).The introduction of higher quality surface water into the shallow zone will improve water quality. This could depend on seasonal variations in water quality. The average TDS of SWP water in the winter season (334 mg/l) is generally equivalent to the shallow groundwater zone and therefore would not significantly impair the water quality.

As described in the setting section, a residual brine plume from an upgradient, non-project related source (that is no longer active) is known to exist in the shallow aquifer under the project site. The brine plume occurred as a result of a neighboring land use that is no longer occurring. Table 3.8-3 summarizes TDS concentrations from groundwater within the brine plume that are higher than those typically found in the unimpacted shallow aquifer beneath adjacent lands. An analysis was conducted by Sierra Scientific Services to evaluate the potential effect of the brine plume on the groundwater quality underlying the project site (Crewdson, 2007b). According to this analysis, implementation of the proposed project would ultimately remediate the entire plume (Crewdson, 2007b) due to dilution from the addition of higher quality water through recharge and due to extraction of plume water from the shallow aquifer by recovery wells. The brine plume is already within the capture zone of the proposed project wells and within the capture zone of the adjacent KWBA wells. The project would continue to remediate the plume, but it would not otherwise introduce contaminants into the aquifer, or cause the TDS levels in extraction water to exceed MCLs.

TABLE 3.8-3
~~SURFACE~~ WATER QUALITY FOR SELECT PARAMETERS

Analyte	Units	GW Shallow	GW Deep	GW Brine	CA Aqueduct	Friant-Kern	Kern River	MCL
Total Dissolved Solids (TDS)	mg/l	229	119	385 – 2,380	334	41	88	500
pH	units	7.8	9.4	7.2 – 7.9	8.3	7.5	7.9	NA
Hardness (Hd)	mg/l	122	6	163 – 991	115	22	39	NA
Arsenic (As)	ug/l	0.7	45	NA	7.0	2.9	5.2	~~50~~10
Alpha-emission activity	pCi/L	5.1	0.8	NA	1.9	2.9	3.2	15
Nitrate (NO3)	mg/l	9.9	0.8	19 - 28	2.4	1.4	1.0	45

NA = Not Available
GW Shallow = Water quality of shallow groundwater zone
GW Deep = Water quality of deep groundwater zone
GW Brine = Range of water quality parameters within Brine plume located offsite of the project area.
Values shown are averages except for Brine plume where a range is shown.

SOURCE: Crewdson, 2007b

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Impact 3.8-3: Recharge operations on the proposed project site could result in groundwater mounding that could potentially impact underground structures or impair recharge efforts of adjacent groundwater banking operations. Less than Significant with Mitigation.

During periods of shallow groundwater, underground structures such as support structures of the CVC, or other sub-surface infrastructure could be damaged by upward pressure caused by rising groundwater. The CVC is essentially above-ground on the Strand Ranch, but some support structures may extend below grade. Mounding groundwater resulting from natural conditions, off-site recharging, or recharging on the Strand Ranch could impact the integrity of these structures or cause cracks in sub-surface concrete panels. Mitigation measure 3.8-1 would impose recharge restrictions on the Strand Ranch during periods of time when the groundwater levels are extremely shallow. With this mitigation, impacts to subsurface structures from recharging water would be less than significant.

Groundwater modeling conducted for the proposed project evaluated the potential that recharge at the proposed recharge facilities would affect neighboring groundwater extraction wells. The recharge modeling studies included the following scenarios:

- Annual recharge volume of 17,500 afy: Recharge was simulated in a 450 acre recharge pond with different infiltration rates of 0.20, 0.25, and 0.30 ft/day for as many days as it takes to achieve an annual recharge volume of 17,500 af/year.

- Annual recharge duration of 365 days: Recharge was simulated in a 450 acre recharge pond with different infiltration rates of 0.20, 0.30, and 0.40 ft/day for 365 days. These scenarios simulate use of all recharge basins on Strand Ranch during wet hydrologic periods when high-flow Kern River water would be available year round and recharge basins would be kept full for 365 days per year.

The groundwater modeling report is included as **Appendix F**. Aquifer parameters used for the modeling were obtained from data published by the KWBA and are referenced in addendum to **Appendix F** titled: "Aquifer Parameters and Parameter Values". In the absence of parameter data specific to the Strand Ranch site, the analysis used a range of parameters deemed realistic for the local area (Crewdson, 2007a).

The proposed project site is located just to the north of the KWBA. Recharge operations may cause groundwater levels to rise or mound beneath the project site and adjacent area. Based on the recharge modeling studies of an annual recharge volume of 17,500 afy, (over the range of possible infiltration rates of 0.2 to 0.3 ft/day) the temporary increase in water surface elevation within neighboring square-mile sections including those with KWBA wells would range from one to 33 feet (Table 5 of Appendix F), with a section-wide average rise of 6 to 14 feet. The highest increases in water surface elevation would be encountered at the two KWBA wells immediately adjacent to the property (Crewdson, 2007a). This simulated recharge of 17,500 af on Strand Ranch would occur continuously over a 129 to 194-day period (4.3 to 6.5 months). These recharge effects would be temporary and occur only as long as project recharge ponds were in operation plus the time to reach a new equilibrium once recharge operations are terminated. After recharge has ceased the water table would return to an unimpacted steady state water surface elevation within a period of months.

If recharge is allowed to continue for 365 days, recharge volume would be in the range of 33,000 to 65,000 af for infiltration rates of 0.20 to 0.40 ft/d, respectively. The corresponding maximum temporary water level rises in the eight sections adjacent to the project site would be in the range of 11 to 36 ft (section-wide averages).

Groundwater levels fluctuate significantly and are directly affected by recovery and storage activities. Groundwater levels in the area have been recorded as shallow as 20 feet bgs and as deep as 270 feet bgs (KCWA, 2007b). Groundwater levels beneath the project site are expected to range from approximately 30 to 180 feet below ground surface (WDS, 2004b). A high groundwater table can result in a reduced capacity for groundwater banking and even cause flooding of lower lying areas.

Under the terms of the proposed project agreement, the normal recharge goal is 17,500 af per year. The proposed Strand Ranch Integrated Banking Project is designed to always maintain a positive project balance. Water must always be stored in the aquifer prior to removing a like volume from the aquifer.

The proposed project would be subject to the existing commitments and conditions of the MOU, which provides language that mitigates the potential for adverse affects of adjoining entities.

Adverse effects of higher water surface elevations are covered under the MOU. Groundwater recharge operations at Strand Ranch would adhere to the requirements of Rosedale's current MOU. No mitigation would be required beyond the existing commitments contained within the MOU.

Mitigation Measures

Mitigation Measure 3.8-1: IRWD and Rosedale will agree with the KCWA on a monitoring and operations plan to avoid impacts to CVC facilities as a result of project operations. As part of said monitoring and operations plan IRWD and Rosedale will install and monitor piezometers adjacent to the CVC within the Strand Ranch property. When groundwater approaches 12 feet bgs beneath the CVC, IRWD and Rosedale will consult with geotechnical engineers to determine if conditions might pose a risk to subsurface structures if further recharge operations were to continue. Under such conditions, piezometer data collected on the Strand Ranch as well as information from the geotechnical engineers will be shared with KCWA. If subsurface structures are determined to be at risk from high groundwater, IRWD and Rosedale will temporarily cease recharge activities until water surface elevations no longer pose a risk to subsurface structures.

Significance After Mitigation: Less than Significant.

Surface Water Quality

The following significance criteria pertain to surface water quality.

- Violate any water quality standards or waste discharge requirements;
- Otherwise substantially degrade water quality;

The following impact discusses potential impacts to surface water quality.

Impact 3.8-4: Earthwork activities associated with construction of recharge ponds could expose soils to erosion and sedimentation in runoff. Less than Significant with Mitigation.

Construction of the proposed project would require excavation, grading and recontouring of the soils at the project site in order to build up earthen berms. During these activities, soils could be become exposed to high winds or heavy precipitation causing a substantial increase in sedimentation in storm water run-off and loss of topsoil. However, because the project would disturb more than one acre, IRWD would be required to prepare and submit a SWPPP to minimize erosion hazards during grading and demolition activities. As part of this process, IRWD would file a Notice of Intent with State Water Resources Regional Control Board, in compliance with the statewide National Pollutant Discharge Elimination System (NPDES) General Permit for Discharges of Storm Water Runoff Associated with Construction Activity (General Construction Permit) for storm water discharges from the construction site, and would formulate a SWPPP outlining the erosion control and pollution prevention measures to be used during the course of construction.

The SWPPP would include best management practices (BMPs) to minimize the impacts of construction to a less than significant level.

Mitigation Measures

Mitigation Measure 3.8-2: Rosedale and IRWD shall require that the following BMPs are included in the construction SWPPP:

- Establish an erosion control perimeter around active construction and contractor layout areas including silt fencing, jute netting, straw waddles, or other appropriate measures to control sediment from leaving the construction area.
- Install containment measures at fueling stations and at fuel and chemical storage sites.
- Employ good house-keeping measures including clearing construction debris and waste materials at the end of each day.

Significance After Mitigation: Less than Significant.

Levee Failure

The following significance criteria pertain to levee failure.

- Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam

The following impact discusses potential impacts from levee failure.

Impact 3.8-5: Failure of the earthern berms that surround the recharge ponds could cause flooding of surrounding areas. Less than Significant.

The proposed recharge ponds would be constructed by excavating, grading, and recontouring the existing soils at the project site and building perimeter berms to retain diverted surface waters for recharge activities. The perimeter berms would be compacted and constructed to minimize any potential damage that may occur. In the event that damage occurs to the berms, either through erosion or seismic activity (see also discussion in Section 3.6 Geology, Soils, and Seismicity), released water would likely infiltrate into the permeable soils that comprise the relatively flat area surrounding the project site. When the basins are full of water, most of the water would be below grade, which also would hinder movement of water offsite. Water flowing off site would rejoin the Kern River approximately two miles south of the project site. The potential impact to flooding in the area would be less than significant.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Impact 3.8-6: The quality of water extracted from the Strand Ranch could exceed thresholds imposed by the conveyance facilities. Less than Significant with Mitigation.

Introducing water into the CVC and California Aqueduct would be subject to the pump-in water quality requirements imposed by the KCWA and DWR. Prior to pumping extracted groundwater into the CVC and California Aqueduct, it would be IRWD's and Rosedale's responsibility to ensure that the water quality was sufficient to meet KCWA and DWR requirements. Any water that did not meet water quality requirements imposed by the conveyance facility operators would not be conveyed within the canals.

Mitigation Measures

Mitigation Measure 3.8-3: IRWD and Rosedale shall ensure that water quality testing is conducted prior to introduction of extracted groundwater into the CVC or California Aqueduct subject to review and approval by the KCWA and DWR.

Significance After Mitigation: Less than Significant.

3.9 Land Use, Planning and Recreation

This section describes the existing land use, planning, and recreation in the vicinity of the project area, the impacts to land use and planning and recreation as a result of the proposed project, and mitigation measures that would reduce significant impacts.

3.9.1 Setting

Project Vicinity

Strand Ranch is located at the corner of Stockdale Highway and Enos Lane (Highway 43) in unincorporated Kern County, about 10 miles south of Shafter, California and six miles from the eastern boundary of Bakersfield, California. Land use in the vicinity of the project area is dominated by agriculture and open space, but also includes groundwater recharge activities, mineral and petroleum extraction, industrial land uses, and scattered rural residences. The Kern River and floodplain, the dominant natural feature in the vicinity of the project site, is located approximately 2.5 miles south and east of Strand Ranch.

Existing Land Use Designations

Strand Ranch

Strand Ranch has been used for agriculture since at least 1946 (WDS, 2004a). In recent years, Strand Ranch has produced crops such as alfalfa, corn, carrots, garlic, wheat, and cotton. In addition, there is an almond orchard, which was planted in the early 1990s (WDS, 2004a).

The proposed project at Strand Ranch is subject to the goals, policies, and procedures contained in the *Kern County General Plan* (County General Plan) (Kern County Planning Department, 2004a).

According to the Land Use, Open Space & Conservation Element of the County General Plan, the western half of Strand Ranch is currently designated Intensive Agriculture (Kern County Planning Department, 2006b). This designation refers to areas devoted to the production of irrigated crops with a minimum parcel size of 20 acres. This designation also includes other land uses such as groundwater recharge acres, petroleum extraction, and public utility uses (Kern County Planning Department, 2004a). Therefore, the proposed project is compatible with the County General Plan.

The eastern half of Strand Ranch falls within the planning area of the *Metropolitan Bakersfield General Plan* (Bakersfield General Plan), which is an element of the County General Plan (City of Bakersfield and Kern County, 2002). According to the Bakersfield General Plan, the land use designation at Strand Ranch is Resource-Intensive Agriculture (R-IA). This designation is similar to the Intensive Agriculture designation in the County General Plan. The Intensive Agriculture designation refers to areas devoted to the production of irrigated crops with a minimum parcel size of 20 acres.

The proposed project is exempt from the *Kern County Zoning Ordinance* (County Zoning Ordinance) per Government Code 53091, which states that the building and zoning ordinances "of a county or city shall not apply to the location or construction of facilities for the production, generation, storage, treatment, or transmission of water…by a local agency." According to Zoning Map 121 of Kern County, the entire Strand Ranch parcel is zoned as Exclusive Agriculture (A) (Kern County Office of the County Surveyor, 1970a). Strand Ranch is also part of Agricultural Preserve Number 9, as designed by Kern County.[1] The purpose of the Exclusive Agriculture District is to designate areas suitable for agricultural uses and prevent encroachment by and conversion of land to non-agricultural uses. The Permitted Uses in the Exclusive Agriculture District include water storage and groundwater recharge facilities (County Zoning Ordinance, Section 19.12.020 (F)) Therefore, although it is exempt, the proposed project is compatible with the existing County Zoning Ordinance.

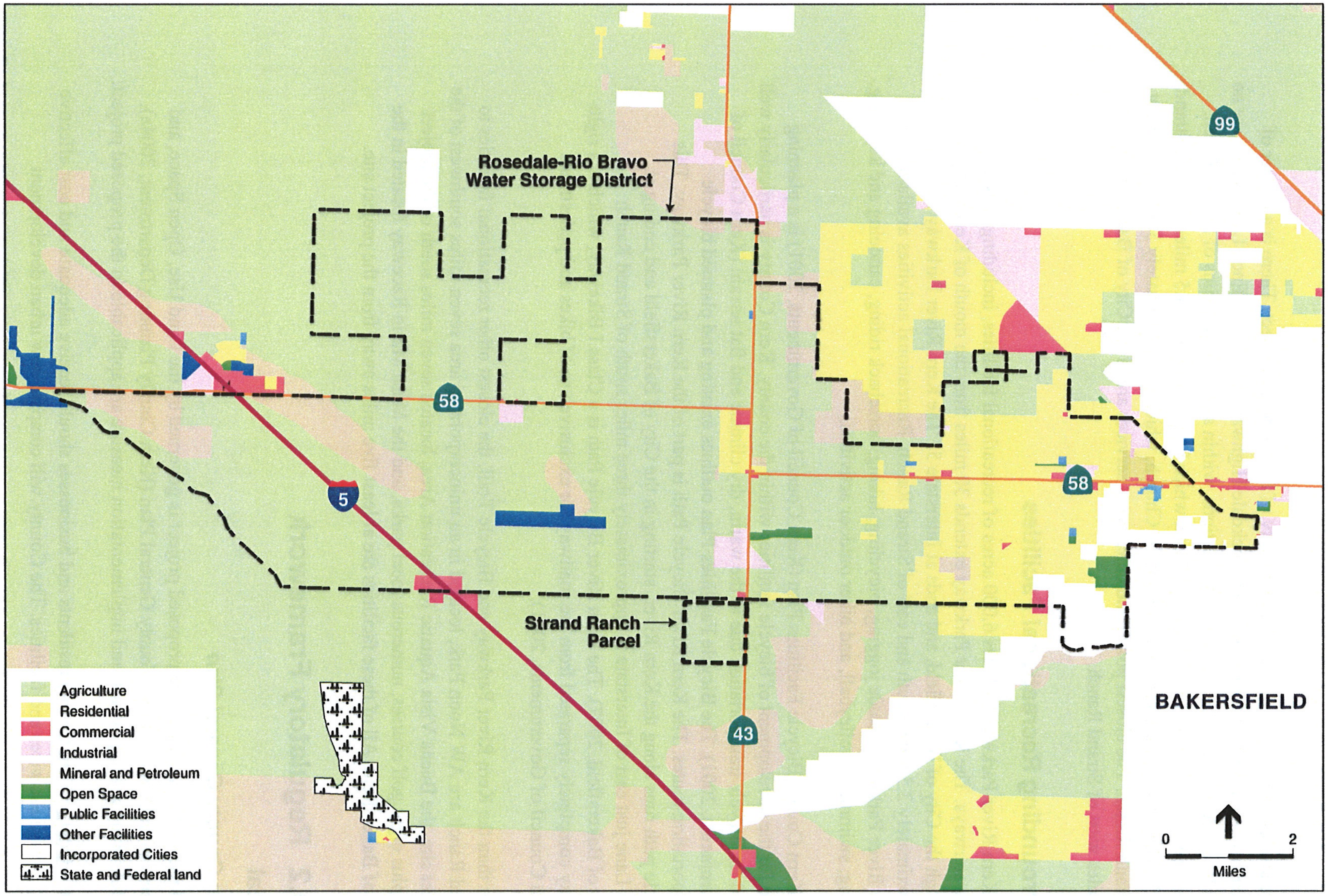
Surrounding Land Uses

According to Zoning Maps 100, 120, 122, and 140, areas surrounding the Strand Ranch parcel are lands zoned by the County Zoning Ordinance as A (Exclusive Agricultural), A-1 (Limited Agricultural), E(1/4) (Estate-1/4 Acre), E(1/2) (Estate 1/2-Acre), E(1) (Estate 1-Acre), E(2 1/2) (Estate-2 1/2-Acres), E(5) (Estate-5 Acres), E(10) (Estate-10 Acres), E(20) (Estate-20 Acres), R-1 (Low-Density Residential), R-2 (Medium-Density Residential), MS (Mobilehome Subdivision), MP (Mobilehome Park), C-1 (Neighborhood Commercial), C-2 (General Commercial), CH (Highway Commercial), RF (Recreation Forestry), OS (Open Space), NR(5) (Natural Resources-5 Acres), NR(20) (Natural Resources-20 Acres), M-1 (Light Industrial), M-2 (Medium Industrial), and M-3 (Heavy Industrial) (Kern County Office of the County Surveyor, 1969; 1970b; 1970c; 1970d). Actual land use in the project area is characterized by agriculture, rural residential, groundwater recharge, mineral extraction, and light industrial and commercial activity. **Figure 3.9-1** illustrates the land use designations of the project site and surrounding properties.

The property immediately east of Strand Ranch and north of the CVC is used for agriculture and includes two oil wells. The property north of Strand Ranch is used for agriculture. The property west of Strand Ranch and north of the CVC is used for agriculture and includes a PG&E power transmission corridor and a substation (WDS, 2004a). South of the CVC, all adjacent properties are owned by KWBA and include groundwater recharge basins. Therefore, the proposed project would be compatible with existing surrounding land uses.

The Southern Pacific Railroad (SPRR) is approximately one-half mile from the northeast corner of Strand Ranch (Kern County Planning Department, 2004c) (Figure 3.11-1). In the project vicinity, the Buttonwillow Branch of the SPRR runs west out of Bakersfield and crosses the Kern River, Cross Valley Canal, Stockdale Highway, and SR-58. Interstate 5 is approximately 1.5 miles south and west from Strand Ranch.

[1] Personal communication. Sara Kopp, Kern County Planning Department. August 31, 2007. (661) 862-8793.



SOURCE: Kern County, 2007.

Irvine Ranch Water District . 205426

Figure 3.9-1
Land Use

There are few sensitive land uses in the vicinity of the proposed project. There is a cluster of residences and a pet boarding facility on Stockdale Highway, just east of Enos Lane. There are no schools, churches, hospitals, police or fire stations, within a three mile radius of Strand Ranch. The closest school is Rio Bravo Greely School, which is approximately 4.5 miles north of Strand Ranch. The closest church is Rosedale Baptist Church, which is approximately 3 miles northeast of Strand Ranch. The closest police and emergency services are in the City of Bakersfield, over 10 miles west of Strand Ranch.

Surrounding Recreational Facilities

The Kern River Parkway includes 6,000 acres of recreational facilities, including parks, trails, and waterways. The Kern River Parkway extends 30 miles from the mouth of Kern Canyon, west through the City of Bakersfield, and ends at Interstate 5. The Kern River Parkway is approximately 2.5 miles south and east of Strand Ranch. Recreational activities available at Kern River Parkway include jogging, bicycling, hiking, horseback riding, canoeing and kayaking, fishing, swimming, volleyball, and other outdoor activities.

The Kern County Bicycle Facilities Plan (Kern Council of Governments, 2001) is a planning guide for the development of bicycle facilities within the county. Kern County is particularly well suited for bicycle transportation due to the warm, dry climate and flat terrain (Kern Council of Governments, 2001). The Bicycle Facilities Plan outlines existing and planned bicycle transportation routes. The Kern River Bicycle Path is part of the Kern River Parkway. This bicycle path runs along the Kern River, starting in the City of Bakersfield and ending at Enos Lane just east of Interstate 5, approximately three miles south of Strand Ranch (City of Bakersfield, 2007). The Kern River Bicycle Path is a Class I Bikeway, which is a right-of-way completely separated from the roadway for exclusive use of bikes and pedestrians (Kern Council of Governments, 2001).

Other than the Kern River Parkway and Bicycle Trail, the closest other recreational facilities to Strand Ranch are AW Noon Park, located in an unincorporated area seven miles southwest of the project site, the Buena Vista Aquatic Recreation Area, located seven miles south of the project site, plus eight golf courses, numerous local parks, and the Mesa Marin Raceway located in the City of Bakersfield. All of these facilities are at least five miles away from the project site.

3.9.2 Regulatory Framework

Local

Kern County General Plan

Land use in the vicinity of the proposed project is governed by the Land Use, Open Space, and Conservation Element of the County General Plan (Kern County Planning Department, 2004a). The following goals, policies, and implementation measure are applicable to the proposed project:

- Goal 1: Kern County residents and businesses should receive adequate and cost effective public services and facilities. The County will compare new urban development proposals and land use changes to the required public services and facilities needed for the proposed project.

- Goal 5: Ensure that adequate supplies of quality (appropriate for intended use) water are available to residential, industrial, and agricultural users within Kern County.
- Policy 35: Ensure that adequate water storage, treatment, and transmission facilities are constructed concurrently with planned growth.
- Policy 39: Encourage the development of the County's groundwater supply to sustain and ensure water quality and quantity for existing users, planned growth, and maintenance of the natural environment.
- Implementation Measure X: Encourage effective groundwater resource management for the long-term benefit of the County through the following:
  - Promote groundwater recharge activities in various zone districts.
  - Support the development of future sources of additional surface water and groundwater, including conjunctive use, recycled water, conservation, additional storage of surface water, and groundwater and desalination.

Kern County Zoning Ordinance

The land use categories set forth in the County General Plan are implemented through the County Zoning Ordinance (Kern County, 2005). Strand Ranch is currently zoned as Exclusive Agriculture (A). According to Section 19.12.020 of the County Zoning Ordinance, permitted uses for the Exclusive Agriculture designation include water storage or groundwater recharge facilities. The proposed project is exempt from the County Zoning Ordinance per Government Code 53091, which states that the building and zoning ordinances "of a county or city shall not apply to the location or construction of facilities for the production, generation, storage, treatment, or transmission of water…by a local agency."

Metropolitan Bakersfield General Plan

The project site is within the planning area of the Metropolitan Bakersfield General Plan (City of Bakersfield and Kern County, 2002). The Land Use Element of the Bakersfield General Plan includes a goal and implementation measure that are applicable to the proposed project:

- Goal 3: Accommodate new development which is compatible with and complements existing land use.
- Implementation 7: Local guidelines for project processing shall reflect *CEQA Guidelines* which state that the environmental effects of a project must be taken into account as part of the project consideration.

Metropolitan Bakersfield Habitat Conservation Plan

Strand Ranch is within the planning area covered by the *Metropolitan Bakersfield Habitat Conservation Plan* (MBHCP) (see Figure 3.4-3). The MBHCP is a program that addresses the effect of urban growth on federally and state protected plant and animal species within the Metropolitan Bakersfield 2010 General Plan area. The MBHCP is a joint program of the City of Bakersfield and Kern County that was undertaken to assist urban development applicants in complying with state and federal endangered species laws.

The MBHCP utilizes a mitigation fee paid by applicants for grading or building permits to fund the purchase and maintenance of habitat land to compensate for the effects of urban development on endangered species habitat. The lands to be acquired for the program are generally located outside the Metropolitan Bakersfield area.

Kern County and the City of Bakersfield have entered into a legal agreement with the California Department of Fish and Game and the U.S. Fish and Wildlife Service that spells out obligations in conjunction with the MBHCP. The agreement allows the County and the City to receive habitat mitigation credit that can be applied against future habitat loss that accompanies urban development.

Half of the Strand Ranch falls within the MBHCP area. The MBHCP finds that "commercial agricultural" activities are exempt from the requirements of the plan. Strand Ranch would continue to be used for agricultural purposes approximately eight months of the year, and therefore, the proposed project is considered exempt from the stipulations contained within the MBHCP. (See Section 3.4, Biological Resources for more information.)

3.9.3 Project Impacts and Mitigation Measures

Significance Criteria

The *CEQA Guidelines* establish that the proposed project would normally have a significant effect on land use and planning if it would:

- Physically divide an established community;
- Conflict with any applicable land use plan, policy, or regulation, of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect; and/or
- Conflict with any applicable habitat conservation plan or natural community conservation plan.

Additionally, the *CEQA Guidelines* establish that the Proposed Project would normally have a significant effect on recreation if it would:

- Increase the use of existing neighborhood and regional parks or other recreational facilities such that a substantial physical deterioration of the facility would occur or be accelerated; and/or

- Include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment.

Impacts Discussion

Impact 3.9-1: The proposed project could conflict with applicable land use plans, policies, or regulations, of an agency with jurisdiction over the project. Less than Significant with Mitigation.

The Kern County and Bakersfield General Plans designate the land use at Strand Ranch as Intensive Agriculture. The Intensive Agriculture designation allows groundwater recharge facilities as compatible land uses. Strand Ranch is zoned for Exclusive Agriculture. The Kern County Zoning Ordinance allows groundwater recharge facilities in Exclusive Agriculture Districts. The proposed project does not require a conditional use permit (CUP). The proposed project is compatible with applicable land use plans, policies, and regulations.

As part of the proposed project, Strand Ranch would be annexed into Rosedale's service area and assimilated into its Conjunctive Use Program. Rosedale would assume control of operation and maintenance for all facilities on Strand Ranch for the duration of the proposed project. IRWD would maintain ownership of the Strand Ranch and its facilities. The annexation of Strand Ranch by Rosedale requires approval by the Kern County LAFCO, which is responsible for reviewing and approving proposals for changes in the boundaries of special districts in the county. The Kern County LAFCO may use this EIR to comply with their CEQA review requirements. Annexation of Strand Ranch by Rosedale would not conflict with applicable land use plans, policies or regulations once approved by the Kern County LAFCO.

The Strand Ranch parcel is divided into four quadrants by mid-section lines designated by Kern County. These mid-section lines are reserved by the county for arterial roadways and require a setback of 90 feet. In order for the proposed project to be consistent with county land use policies, the mid-section lines would need to be eliminated through an amendment to the Kern County General Plan. If the mid-section lines were eliminated, the proposed project facilities would not have to be designed to accommodate the setback from the mid-section lines.[2] With implementation of **Mitigation Measure 3.9-1**, the mid-section lines would be eliminated, and the proposed project would not conflict with any applicable land use plan, policies or regulations. The impact of the proposed project to land use would be less than significant.

Mitigation Measures

> **Mitigation Measure 3.9-1:** A General Plan Amendment shall be requested from Kern County to eliminate the mid-section line setback requirements from Strand Ranch.

Significance after Mitigation: Less than significant.

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[2] Lorelie Oviatt, Kern County Planning Department, Personal Communication. September 24. 2007.

3.10 Noise

This section presents information on ambient noise and vibration conditions in the vicinity of the proposed project and identifies potential impacts associated with noise and vibration due to construction and operation of the proposed project.

3.10.1 Setting

Sound and Noise

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise can be defined as unwanted sound. Sound is characterized by various parameters that include the rate of oscillation of sound waves (frequency), the speed of propagation, and the pressure level or energy content (amplitude). In particular, the sound pressure level has become the most common descriptor used to characterize the loudness of an ambient sound level. The decibel (dB) scale is used to quantify sound intensity. Since the human ear is not equally sensitive to all frequencies within the entire spectrum, noise measurements are weighted more heavily within those frequencies of maximum human sensitivity in a process called "A-weighting," referred to as dBA. With regard to increases in A-weighted noise levels, it is widely accepted that the average person can barely perceive noise level changes of 3 dBA, while a change in noise levels of 5 dBA is a readily perceptible increase in noise levels and the minimum required increase for a change in community reaction (Caltrans, 1998). An increase of 10 dBA is perceived as a doubling of loudness.

Time variation in noise exposure is typically expressed in terms of the average energy over time (L_{eq}), or alternatively, as a statistical description of the sound level that is exceeded over some fraction of a given period of time. For example, the L50 noise level represents the noise level that is exceeded 50 percent of the time. Half the time the noise level exceeds this level and half the time the noise level is less than this level. This level is also representative of the level that is exceeded 30 minutes in an hour. Several methods have been devised to relate noise exposure over time to human response. The Day-Night Noise Level (DNL) is a 24-hour Leq that adds a 10 dBA penalty to sounds occurring between 10:00 p.m. to 7:00 a.m. to account for the increased sensitivity to noise events that occur during the quiet late evening and nighttime periods. A commonly used noise metric for this type of study is the Community Noise Equivalent Level (CNEL). The CNEL adds a 5 dBA penalty to noise occurring during evening hours from 7:00 p.m. to 10:00 p.m., and a 10 dBA penalty to sounds occurring between the hours of 10:00 p.m. to 7:00 a.m. to account for the increased sensitivity to noise events that occur during the quiet late evening and nighttime periods. Thus, the CNEL noise metric provides a 24-hour average of A-weighted noise levels at a particular location, with an evening and a nighttime adjustment, which reflects increased sensitivity to noise during these times of the day. The DNL and the CNEL are similar noise descriptors in most urban dominated environments. These descriptors are best used for measuring average increases in overall noise over a daily period and not single event noises, which are best described as unique events.

Vibration

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. There are several different methods that are used to quantify vibration. The peak particle velocity (PPV) is defined as the maximum instantaneous peak of the vibration signal. The PPV is most frequently used to describe vibration impacts to buildings. The root mean square (RMS) amplitude is most frequently used to describe the affect of vibration on the human body. The RMS amplitude is defined as the average of the squared amplitude of the signal. Decibel notation (Vdb) is commonly used to measure RMS. The decibel notation acts to compress the range of numbers required to describe vibration (FTA, 1995). Typically, ground-borne vibration generated by man-made activities attenuates rapidly with distance from the source of the vibration.

Existing Ambient Noise and Vibration Environment

Noise

The proposed project would be located in a rural, agricultural area. Noise sources in rural areas are typically natural, including insects, birds, wind, and weather. Accordingly, existing ambient noise levels in rural areas such as the project sites are low. Background noise levels in rural areas typically range between 35 and 45 dBA DNL. The primary sources of noise in the rural agricultural areas are roadway traffic and farm machinery on a seasonal basis. Background noise levels are approximately 40 dBA in rural residential areas and 45 dBA in agricultural cropland with equipment operating (FERC 2002, USEPA 1978).

Vibration

Similar to the environmental setting for noise, the vibration environment is dominated by traffic from nearby roadways. Heavy trucks can generate ground-borne vibrations that vary depending on vehicle type, weight, and pavement conditions. As heavy trucks typically operate on major streets, existing ground-borne vibration in the project vicinity is largely related to heavy truck traffic on the surrounding roadway network. Vibration levels from adjacent roadways are generally not perceptible in the project area.

Sensitive Receptors

Noise

Human response to noise varies considerably from one individual to another. Effects of noise at various levels can include interference with sleep, concentration, and communication; physiological and psychological stress; and hearing loss. Given these effects, some land uses are considered more sensitive to ambient noise levels than others. People in residences, motels and hotels, schools, libraries, churches, hospitals, nursing homes, auditoriums, natural areas, parks and outdoor recreation areas are generally more sensitive to noise than are people at commercial and industrial establishments. Consequently, the noise standards for sensitive land uses are more stringent than for those at less sensitive uses. The Kern County Noise Element has identified the following land uses as sensitive receptors: residential areas, schools, convalescent and acute care hospitals, parks and recreational areas, and churches (Kern County Planning Department, 2004a). The Strand Ranch project site is located in a rural area consisting of scattered single-family, ranch-style residences. There are few sensitive land uses in the vicinity of the proposed project. There is a cluster of residences and a pet boarding facility on Stockdale Highway, just east of Enos Lane. There are no schools, churches, hospitals, police or fire stations, within a three mile radius of Strand Ranch. The closest school is Rio Bravo Greely School, which is approximately 4.5 miles north of Strand Ranch. The closest church is Rosedale Baptist Church, which is approximately 3 miles northeast of Strand Ranch.

Vibration

Sensitive receptors for vibration include structures (especially older masonry structures), people (especially residents, the elderly and sick), and vibration sensitive equipment. Sensitive vibration receptors for the proposed project are the same as the noise sensitive receptors presented above.

3.10.2 Regulatory Framework

Federal, State, and local agencies regulate different aspects of environmental noise and vibration. Federal and State agencies generally set noise standards for mobile sources such as aircraft and motor vehicles, while regulation of stationary sources is left to local agencies. Local regulation of noise involves implementation of general plan policies and noise ordinance standards. Local general plans identify general principles intended to guide and influence development plans; local noise ordinances establish standards and procedures for addressing specific noise sources and activities. The Kern County has developed general plan policies, goals, and guidelines regarding the ambient noise environment, which would be applicable to the proposed project, as discussed below.

Federal

Federal Noise Policies

There are no Federal noise standards that directly regulate environmental noise related to construction or operation of the proposed project. With regard to noise exposure and the workplace, the Office of Environmental Health and Safety regulations safeguard the hearing of workers exposed to occupational noise.

Federal Vibration Policies

The Federal Railway Administration (FRA) and the Federal Transmit Administration (FTA) have published guidance relative to vibration impacts. According to the FRA, fragile buildings can be exposed to ground-borne vibration levels of 0.5 PPV without experiencing structural damage (FRA, 1998). The FTA has identified the human annoyance response to vibration levels as 80 RMS (FTA, 1995).

State

There are no State noise standards that directly regulate environmental noise related to construction or operation of the proposed project. The State has promulgated the California Noise Insulation Standards, found in *California Code of Regulations*, Title 24 (known as the Building Standards Administrative Code), Part 2 (known as the California Building Code), Appendix Chapters 12 and 12A. These standards set forth an interior standard of DNL 45 dBA for habitable spaces. These standards may be applied to residences located near construction activity or stationary noise sources as a method of examining potentially intrusive noise.

State Vibration Policies

There are no adopted State policies or standards for ground-borne vibration. Caltrans does recommend that extreme care be taken when sustained pile driving occurs within 7.5 meters (25 feet) of any building, and 15 to 30 meters (50 to 100 feet) of a historic building or a building in poor condition.

Local

County policies for noise are included in the Noise Element of the Kern County General Plan (Kern County Planning Department, 2004a). The purpose of the Noise Element is to: (1) establish reasonable standards for maximum desired noise levels in Kern County, and; (2) develop an implementation program which could effectively deal with the noise problem. The County noise goals, policies, and standards are based on standards suggested by the USEPA and the California Department of Health. The Noise Element requires that proposed commercial and industrial uses or operations be designed or arranged so they would not subject residential or other noise sensitive land uses to exterior noise levels in excess of 65 dBA DNL or less in outdoor activity areas and interior noise levels in excess of 45 dBA DNL.

3.10.3 Project Impacts and Mitigation Measures

Significance Criteria

Based on the *CEQA Guidelines*, a project may be deemed to have a significant effect on the environment with respect to noise and/or ground-borne vibration if it would result in:

- Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- Expose persons to or generate excessive groundborne vibration or groundborne noise levels;
- Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project and in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
- Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project and in excess of standards

established in the local general plan or noise ordinance, or applicable standards of other agencies;

- For a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, expose people residing or working in the project area to excessive noise levels; or
- For a project within the vicinity of a private airstrip, expose people residing or working in the project area to excessive noise levels.

The following noise analysis addresses the first four of these general criteria. The last two are not discussed further within this section since the project area is not located within 2 miles of a public or private airport.

A change in noise levels of less than three dBA is not discernible to the general population; an increase in average noise levels of three dBA is considered barely perceptible, while an increase of five dBA is considered readily perceptible to most people (Caltrans, 1998). Therefore a noise increase of 5 dBA or greater would be considered to have a significant impact.

Impacts Discussion

Impact 3.10-1: Proposed project construction activities could intermittently and temporarily generate noise levels above existing ambient levels in the project vicinity. Less than Significant.

The proposed project would involve temporary noise sources associated with general construction activity. Construction is expected to last for a maximum period of 12 months. Noise impacts from construction activities would be a function of the noise generated by construction equipment, the equipment location, and the timing and duration of the noise-generating activities. Construction would involve site clearing; demolition; excavation and backfill; construction of basins, conveyances, and recovery facilities; and site restoration. Each stage involves the use of different kinds of construction equipment and, therefore, has its own distinct noise characteristics. **Table 3.10-1** shows typical exterior noise levels at various phases of commercial construction, and **Table 3.10-2** shows typical noise levels associated with various types of construction related machinery.

TABLE 3.10-1
ESTIMATED NOISE LEVELS FROM CONSTRUCTION ACTIVITIES

Construction Phase	Noise Level (dBA, L_{eq} at 50 feet[a])
Ground Clearing	84
Excavation	89
Foundations	78
Construction	85
Finishing	89

[a] Average noise levels correspond to a distance of 50 feet from the noisiest piece of equipment associated with a given phase of construction and 200 feet from the rest of the equipment associated with that phase.

SOURCE: Bolt, Baranek, and Newman, *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*, 1971.

TABLE 3.10-2
TYPICAL NOISE LEVELS FROM CONSTRUCTION EQUIPMENT

Construction Equipment	Noise Levels (dBA at 50 feet)	
	Without Noise Control	With Feasible Noise Control [a]
Earthmoving		
Front Loaders	79	75
Backhoes	85	75
Dozers	80	75
Tractors	80	75
Scrapers	88	80
Graders	85	75
Trucks	91	75
Pavers	89	80
Material Handling		
Concrete Mixers	85	75
Concrete Pumps	82	75
Cranes	83	75
Derricks	88	75
Stationary Equipment		
Pumps	76	75
Generators	78	75
Compressors	81	75
Impact Equipment		
Pile Driver	101	95
Jack Hammer	88	75
Rock Drills	98	80
Pneumatic Tools	86	80
Other		
Saws	78	75
Vibrators	76	75

a. Feasible noise controls represent estimates obtained by using quieter procedures or equipment and noise control features that would require no major design or extreme cost. Quiet equipment can be designed with enclosures, mufflers, or noise-reduction features.

SOURCE: Bolt, Beranek and Newman, 1971

The construction noise levels presented in Table 3.10-1 represent conservative worst-case conditions in which the maximum amount of construction equipment would be operating during a one-hour period. These estimated maximum noise levels would not be continuous, nor would they be typical of noise levels throughout the construction period. As indicated in Table 3.10-1, excavation activity would intermittently generate noise levels of up to 89 dBA (without mufflers) at a reference distance of 50 feet from construction activity.

The nearest sensitive receptor to the Strand Ranch site is a single-family residences located approximately 1,250 feet northeast of the project site. Noise levels at this residence could reach approximately 62 dBA during construction activity. These levels would not exceed the 65-dBA exterior noise level at the nearest sensitive receptors. In addition, construction would be restricted to the less noise sensitive daytime hours in compliance with local noise ordinances. As such, this would constitute a less than significant impact and no mitigation would be required.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Impact 3.10-2: Proposed project construction activities could expose sensitive receptors to excessive ground-borne vibration levels. Less than Significant.

As shown in **Table 3.10-3**, use of heavy equipment (e.g., a large bulldozer) generates vibration levels of 0.031 PPV or 81 RMS at a distance of 50 feet. Ground-borne vibration attenuates quickly with distance and the RMS level from heavy equipment would be approximately 79 RMS at 60 feet, which is below the 80 RMS standard. In addition, as shown in Table 3.10-3, vibration levels would not exceed the potential building damage threshold of 0.5 PPV. There are no sensitive receptors located within 60 feet of Strand Ranch. The nearest sensitive receptor to the Strand Ranch site located approximately 1,250 feet to the northeast. Construction-related vibration impacts would be less than significant.

TABLE 3.10-3
VIBRATION VELOCITIES FOR CONSTRUCTION EQUIPMENT

Equipment	PPV at 50 ft (inches/second)[a]	RMS at 50 ft (Vdb)[b]
Large bulldozer	0.031	81
Caisson drilling	0.031	81
Loaded trucks	0.027	80

[a] Fragile buildings can be exposed to ground-borne vibration levels of 0.5 PPV without experiencing structural damage.
[b] The human annoyance response level is 80 RMS.

SOURCE: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment*, April 1995.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Impact 3.10-3: Operational activities associated with the proposed Project could permanently generate noise levels above existing ambient levels in the project vicinity. Less than Significant.

Upon completion of construction activities, the majority of project operational activity would be passive and would include the movement of water through pipes. Potential noise sources resulting from project implementation include the pump station and noise associated with vehicular trips for maintenance/repair activities. Maintenance would involve activities such as clearing debris and dredging recharge basins and vegetation management activities. Vegetation management in the right-of-way could include control of noxious weeds and trimming of shrubs or trees for safety upkeep. Recharge basin maintenance would require transportation of minimal heavy equipment to the project site (e.g., backhoe and front loader), a small maintenance crew, and a few truck trips to haul away debris. Maintenance activities would occur infrequently and are not expected to substantially increase ambient noise levels in the area above existing levels without the project.

The booster pump station may include a diesel generator to provide emergency electrical supply in the event of a power outage. The emergency diesel generator would not be operated regularly. The generator would be enclosed within the structure of the pump station. While generators could result in noise levels of up to 78 dBA at 50 feet (Table 3.10-2), the noise would attenuate to a less than significant level over the 1,250 feet distance to the nearest receptor.

During project operation, increase in vehicular trips to the site would result from monitoring crews visiting Strand Ranch periodically to perform routine inspections of conveyance structures, recharge basins, and other project facilities. Monitoring crews would be smaller than those required for existing farming operations. Therefore, the impact of the project on roadside noise levels would be less than significant.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

3.11 Transportation and Traffic

This section describes the existing transportation networks and traffic conditions in the project vicinity and the applicable regulatory framework. The effects of the proposed project on transportation and traffic are primarily temporary impacts during project construction.

3.11.1 Setting

Roadway Network

The project site is located in rural Kern County in the southern San Joaquin Valley west of Bakersfield, California. Kern County is a major transportation corridor that includes trucking routes, passenger vehicles, and railways. The roadway system in Kern County has been operating at acceptable conditions with isolated incidence of crowding (Kern County Planning Department, 2004c). Together, Interstate 5 and the State highway system provide inter-regional connectivity to the project area from all directions (**Figure 3.11-1**). Interstate 5 (I-5) and State Route 99 (SR-99) provide north-south access to the project area, and State Route 46 (SR-46) and State Route 58 (SR-58) provide east-west access to the project area. The project area also includes secondary arterial, collector, and local roads that serve regional and local transportation needs.

I-5 is a major north-south freeway that runs from the Mexican to Canadian border, connecting California, Oregon, and Washington. I-5 is 8.5 miles from the project site.

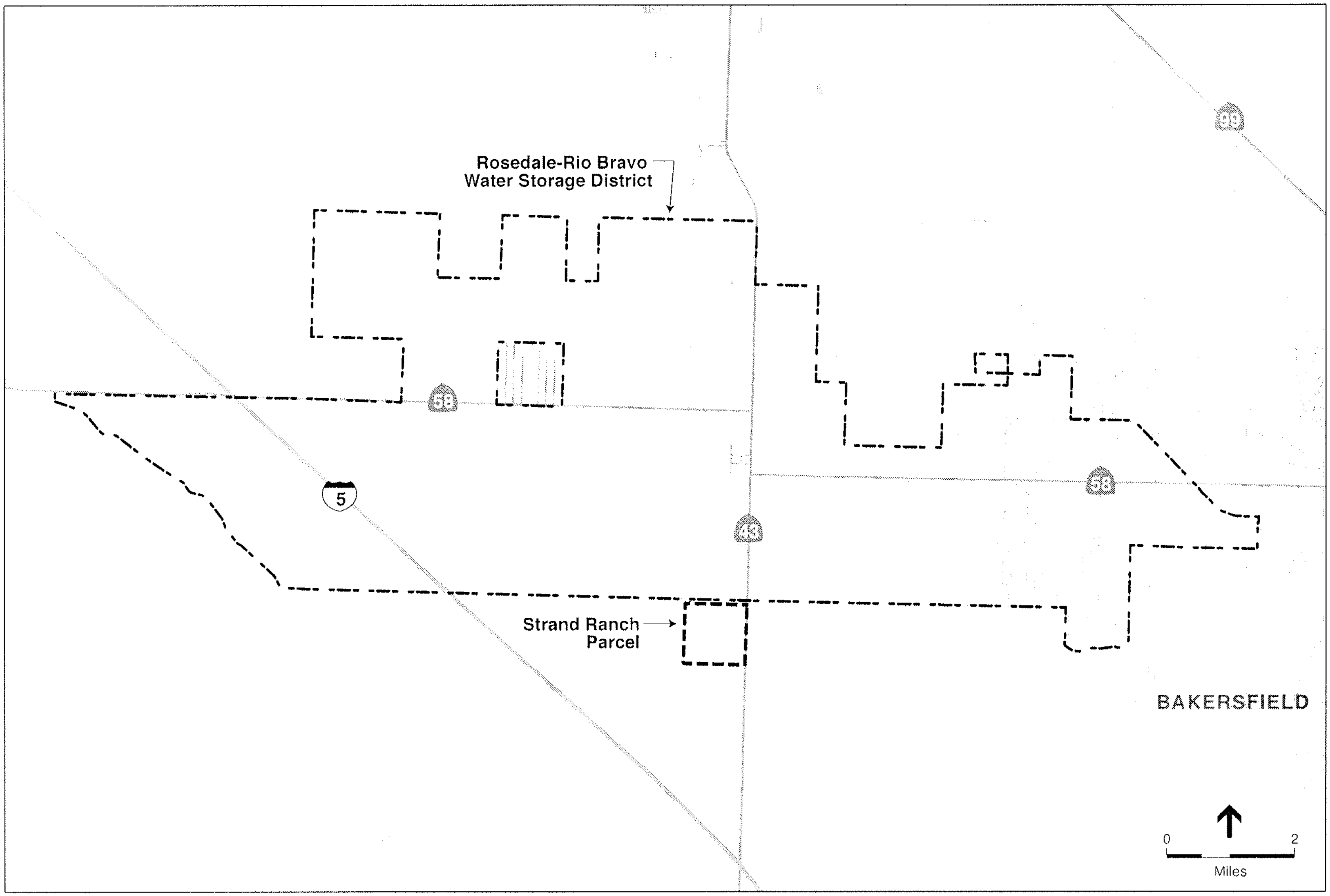
SR-99 branches from I-5 south of Bakersfield and continues north through Fresno to Sacramento. SR-99 is a six-lane freeway in Kern County with sections of eight-lanes as it travels through Bakersfield.

SR-46 begins at SR-99 and travels west through Wasco, into San Luis Obispo County over the Coast Range, through Paso Robles, and ending at U.S. Highway 1 near the coast. SR-46 is 27.3 miles from the project site.

SR-58 begins in San Luis Obispo County, travels east through Kern County through Bakersfield and Mojave, and ends in San Bernardino County. SR-58 is 12.48 miles from the project site.

Truck Routes

Truck traffic makes up 20 to 30 percent of traffic on Kern County roads (Kern County Planning Department, 2004c). The total County average truck miles traveled (VMT) is 24 percent, which is higher than the state average of 10 percent (Kern County Planning Department, 2004c). The County's VMT ranks fourth in the state of all the counties (Kern County Planning Department, 2004c). Most trucks traveling through Kern County are interstate carriers; interstate trucking is controlled and regulated by Caltrans.



SOURCE: Kern County, 2007; ESA, 2007.

Irvine Ranch Water District . 205426

Figure 3.11-1
Regional Transportation Network within Project Site

Public Transit

Golden Empire Transit (GET) provides transit bus service to the Metropolitan Bakersfield area, including 80 buses and 18 routes (GET, 2007). Kern Regional Transit (KRT) provides transit bus service to outlying areas of Kern County with connections between Bakersfield, Wasco, Shafter, Buttonwillow, Kern River Valley, and other cities (Kern County Regional Transit Division, 2007). The Buttonwillow and Lost Hills-Bakersfield KRT Routes are in the vicinity of the project site. KRT bus routes connects to GET but routes and to AMTRAK passenger trains. The AMTRAK station is located at Truxton Ave and S Street in Bakersfield. The AMTRAK San Joaquins Route originates in Bakersfield and connects to northern cities such as Fresno and Sacramento. There are no AMTRAK trains running south from Bakersfield (AMTRAK, 2007).

Two railroad lines cross through central Kern County, the Atchison, Topeka & Santa Fe Railroad (ATSFRR) and the Southern Pacific Railroad (SPRR) (Kern County Planning Department, 2004c). Both lines run in a general north-south direction through Bakersfield. In the project vicinity, the Buttonwillow Branch of the SPRR runs west out of Bakersfield and crosses the Kern River, Cross Valley Canal, Stockdale Highway, and SR-58.

City and County Bikeways

Bicycling accounts for less two percent of the total miles traveled in Bakersfield. The flat terrain is very conducive to bicycling for transportation to work, recreation, and school. Bicycle facilities are classified as follows:

- Bike Path (Class 1): separate right of way with exclusive use of bicycles and pedestrians with crossflow minimized.
- Bike Lane (Class 2): striped lane for one-way bike travel on street or highway, and
- Bike Route (Class 3): shared use with pedestrian or motor vehicle traffic.

Kern County developed and adopted the first Bikeways Plan in the mid 1970's that called for bicycle lanes on various streets, exclusive bike paths on canals, along railroad right-of-ways, and along Kern River. Today they have a new Kern County Bicycles Facilities Plan adopted in 2001. Many of the routes have been constructed since the first Bikeways Plan. Over thirty miles of bike lanes exist along various streets including Stockdale Highway to California State University Bakersfield, as well as along part of Coffee Road, Calloway Drive, Ming Avenue, Panorama Drive, Chester Avenue, Old River Road, Wible Road, and White Lane (City of Bakersfield and Kern County, 2002b). In addition to the bikeways listed above a Class 1 bike path has been constructed that stretches over 12.3 miles through the center of urbanized Bakersfield and is a major component of the Kern River Parkway. Kern River Parkway includes over 6,000 acres of trails, parks, and waterways extending over thirty miles westerly to Interstate 5. The Parkway uses include; bicycling, rollerblading, jogging, hiking, horseback riding, canoeing, kayaking and nature study, including photography and sightseeing, field sports, fishing, picnicking, swimming: and attending outdoor cultural events, such as concerts and theatre.

Level of Service

Level of service (LOS) measures the quality of service provided by a roadway and is used to correlate quantitative traffic-volume data to qualitative descriptions of traffic performance at intersections. LOS criteria for roadways account for numerous variables, including annual average daily traffic, roadway capacity, grade, and environment (urban versus rural). **Table 3.11-1** gives LOS categories "A" through "F" for intersections and highway capacity as defined by the Transportation Research Board (TRB, 2000). In Kern County, county-maintained roads must achieve at least LOS D (Kern County Planning Department, 2004c). The California Department of Transportation (Caltrans) standard for State highways is LOS C-D (Kern County Planning Department, 2004c).

Stockdale Highway is an east-west trending highway maintained by the County. Stockdale Highway experiences Annual Average Daily Traffic (AADT) of 4,800, and has a LOS rating of A in the project vicinity (west of SR-43) (Kern County Traffic Department, 2006).

SR-43/Enos Lane is a north-south trending highway. SR-43 is maintained by Caltrans, experiences AADT of 5,500, and has a LOS rating of A in the project vicinity (south of SR-58/Rosedale Highway) (Caltrans, 2006).

Interstate 5 is a north-south trending highway maintained by Caltrans. I-5 experiences AADT of 32,500 in the project vicinity (Stockdale Highway) and has a LOS rating of A in the project vicinity (Caltrans, 2006).

TABLE 3.11-1
LEVEL OF SERVICE DEFINITIONS

LOS Rating	Description	Signalized Intersections Delay (sec)	Highway Capacity Ratio
A	Free Flow. No approach phase is fully used by traffic and no vehicle waits longer than one red indication. Insignificant delays.	0-16	0.0-0.59
B	Stable Operation. An occasional approach phase is fully used. Many drivers begin to feel somewhat restricted within platoons of vehicles. Minimal delays.	16-22	0.6-0.69
C	Stable Operation. Major approach phase may become fully used. Most drivers feel somewhat restricted. Acceptable delays.	22-28	0.7-0.79
D	Approaching Unstable. Drivers may have to wait through more than one red signal cycle. Queues develop but dissipate rapidly, without excessive delays.	28-35	0.8-0.89
E	Unstable Operation. Volumes at or near capacity. Vehicles may wait through several signal cycles. Long queues form upstream from intersection. Significant delays.	35-40	0.9-0.99
F	Forced Flow. Represents jammed conditions. Intersection operates below capacity with several delays; may block upstream intersections.	greater than 40	N/A

SOURCE: TRB, 2002

3.11.2 Regulatory Framework

The development and regulation of the transportation network in the vicinity of the proposed project primarily involves state and local jurisdictions. All roads within the project area are under the jurisdiction of state and local agencies. Applicable state and local laws and regulations related to traffic and transportation issues are discussed below.

City of Bakersfield

Within the Circulation Element of the Bakersfield General Plan, there are goals that are applicable to the proposed project regarding transportation and traffic:

- Goal 1: Provide a safe and efficient street system that links all parts of the area for movement of goods and people.
- Goal 3: Minimize the impacts of truck traffic on circulation, and on noise sensitive receptors.

County of Kern

The proposed project is located within Kern County and is governed by the Kern County General Plan (Kern County Planning Department, 2004a). The Circulation Element of the County General Plan includes goals and policies for transportation planning and development of facilities to support development in a manner that avoids traffic degradation, reduces environmental effects, and maintains quality of life (Kern County Planning Department, 2004c). The County has set a goal of maintaining a minimum LOS D for all roads throughout the County (Kern County Planning Department, 2004c).

Kern County Dept of Transportation, Transportation Development Division

The Kern County Transportation Development Division has responsibility for growth and transportation planning issues, rural public transportation planning, and development review. This division coordinates with Kern Council of Governments, Caltrans and other agencies to procure project funding. They also review transportation-related issues on land development matters, developer fees and areas of benefit.

Kern County Council of Governments

The Kern County Council of Governments Federal Transportation Improvement Program (FTIP) is responsible for producing documents such as the long-range Regional Transportation Plan. FTIP presents federal funding agencies manageable components for the funding of long-term plans.

California Department of Transportation

Caltrans manages interregional transportation, including management and construction of the California highway system. In addition, Caltrans is responsible for permitting and regulation of the use of state roadways. The project area includes roadways that fall under Caltrans' jurisdiction (e.g., I-5, SR-99, and SR-43).

Caltrans' construction practices require temporary traffic control planning "during any time the normal function of a roadway is suspended" (FHWA, 2003). In addition, Caltrans requires that permits be obtained for transportation of oversized loads and transportation of certain materials, and for construction-related traffic disturbance.

3.11.3 Project Impacts and Mitigation Measures

Significance Criteria

Based on the *CEQA Guidelines,* a project may be deemed to have a significant effect on the environment with respect to transportation and traffic if it would:

- Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume-to-capacity ratio on roads, or congestion at intersections;
- Exceed, either individually or cumulatively, a level-of-service standard established by the county congestion management agency or designated roads or highways;
- Result in a change in air traffic patterns, including an increase in traffic levels or change in location that results in substantial safety risks;
- Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible use (e.g., farm equipment);
- Result in inadequate emergency access;
- Result in inadequate parking capacity; and/or
- Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts or bicycle racks).

Impacts Discussion

Impact 3.11-1: The proposed project would add to the traffic in the project area during construction. Less than Significant.

Construction of the proposed project could require up to 25 construction workers and generate up to 2 heavy-truck trips per day (round trip). Assuming each of the 25 workers drives a separate vehicle to the project site, making one round trip from home to the site and back, project construction would result in an average of 54 vehicle trips per day—up to 27 vehicle trips during each of the peak morning and afternoon traffic periods.

Construction of the proposed project also would include the use of heavy equipment, such as backhoes, scrapers, water trucks, pick up trucks, and front loaders. For this analysis, it is assumed that all heavy equipment would be stored and remain onsite and would not result in a substantial increase in overall daily project trip generation. Construction would not require soil removal from the site.

During project operation, monitoring crews would visit the project site periodically to perform routine inspections of conveyance structures, recharge basins, wells, pumps, and other project facilities. Project monitoring would require minimal visits to the site and would not appreciably affect surrounding roadways.

Project facilities would require occasional maintenance, such as clearing debris and dredging recharge basins, but would not appreciably increase traffic in the project area. Recharge basin maintenance would require transportation of minimal heavy equipment to the project site (e.g., backhoe and front loader), a small maintenance crew, and a few truck trips to haul away debris. Maintenance activities would not substantially affect existing road conditions in the project area.

During construction, traffic would temporarily increase in the project vicinity. This increase in traffic would be due to the transportation of construction equipment, project materials, and workers commute trips. It has been estimated that the construction at the project site would require 54 daily vehicle trips on local roads until construction is completed. The roads in the project vicinity are currently operating at LOS A. According to the Kern County Roads Department, several thousand vehicles would need to be added to the average daily count to cause LOS on these roads to drop below LOS standards. Therefore, the temporary increase in traffic as a result of the proposed project is not substantial.

During operations, the number of workers used for maintenance would be similar or less than existing conditions. No additional traffic would result from the project.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

3.12 Utilities and Public Services

3.12.1 Introduction

This section describes the existing utilities and public services in the vicinity of the proposed project and determines the potential impacts that would occur with project implementation. The project area evaluated in this section includes the project site, the City of Bakersfield, its designated sphere of influence, and contiguous properties located in the unincorporated portions of Kern County.

3.12.1 Setting

Public Services

Police Protection

The Kern County Sherriff's Department provides police protection services to unincorporated communities of the county. The Department has one main station and sixteen substations. The main station is located at 1350 Norris Road in Bakersfield and is approximately 12.13 miles from the project site. Current response times for the Sherriff's Department are as follows; 4.62 minutes for Priority I, 5.20 minutes for Priority II, and 8.55 minutes for Priority III (City of Bakersfield and Kern County, 2002b).

Fire Protection

The Kern County Fire Department is responsible for providing fire protection and emergency medical services in the project area. The Department provide structural protection, fire prevention service, emergency medical service (designated first responders), rescue service, hazardous materials response, arson investigation, environmental services, and safety education.

The Kern County Fire Department staffs 48 full time stations and one seasonal station. The main station is located at 5642 Victor Street in Bakersfield approximately 11.16 miles from the project site (Kern County Fire, 2007). Battalion 3 provides fire services to the project site. The Kern County Fire Department is a full-service fire protection agency, providing wildland, structure, vehicle, petroleum, and other fire protection, hazardous materials mitigation, disaster resolution, emergency medical services, technical rescue, vehicle rescue, arson investigation, and the prevention, training and support functions that facilitate full-service capabilities (City of Bakersfield and Kern County, 2002b).

Emergency Medical Services

The Kern County Emergency Medical Services (EMS) responds to day-to-day emergencies, but also plans and prepares for disaster medical response. EMS services include first response and treatment, private ambulance response, treatment, and transport.

Schools and Parks

The project site is within the Rio-Bravo Greeley Union School District. The closest park to the project site is the Kern River Parkway and Bicycle Path, located 2.5 miles south of Strand Ranch (see Section 3.9, Land Use, Planning and Recreation). The closet county parks are located east of the project site in the City of Bakersfield. Bill Parks Green, Liberty Park, Windsor Park, and Tevis Park are 5.3 miles, 7.1 miles, 7.6 miles, and 8.1 miles away, respectively. The closet state park is the State of California-Tule Elk State Reserve, which is located 6.5 miles west of the project site.

Utilities and Service Systems

Water

The majority of the Metropolitan Bakersfield is served by the California Water Service Company, a privately held public utility, which obtains its water supply principally from wells and is supplemented by the Kern County Water Agency. Currently, all water utilized at Strand Ranch is supplied by on-site wells. Additional information about these wells is provided in **Section 3.8, Hydrology and Water Resources**.

Water supply for the Metropolitan Bakersfield area is provided through both surface water and groundwater, each of which has several sources.

Surface Water

Surface water supply for the Metropolitan Bakersfield areas comes from the Kern River, the California State Water Project (SWP), and the Central Valley Water Project, all of which must be treated prior to distribution (City of Bakersfield and Kern County, 2002b). There are currently two surface water treatment plants in Metropolitan Bakersfield, one facility owned and operated by the Kern County Water Agency Improvement District 4, with a peak capacity of 37.5 mgd, and a 1.5 mgd water treatment plant owned and operated by California Water Service Company. Each plant uses a combination of chemical addition, settling, filtration, and disinfection to produce water of acceptable quality. The plants have produced an average of 24,000 acre-feet of water annually.

Groundwater

The Southern San Joaquin Groundwater Basin and the primary groundwater aquifer below Metropolitan Bakersfield provide a substantial source of potable water to the Metropolitan Bakersfield area. Groundwater resources in the project area are described in greater detail in **Section 3.8, Hydrology and Water Resources**.

Sewer

The planning area is served by five major wastewater treatment facilities: the City of Bakersfield's Treatment Plant No. 2, the City's Treatment Plant No. 3, the North of River Sanitary District (NORSD) plant, Mount Vernon/Panorama District plant, and the Lamont Public

Utility District plant, which is located outside the planning area. The North of River Sanitation District is planning to increase its plant capacity from six to twelve million gallons per day over the next two to five years. The Strand Ranch is not connected to a local sewer system.

Solid Waste

Solid waste collection services (residential and commercial) are provided within the City of Bakersfield by the City Sanitation Division and contracted private haulers and, in the unincorporated area, by a county franchise hauler. All solid waste generated within the Metropolitan Bakersfield is disposed of in county-operated landfills. Currently two County landfills are in operation to dispose of waste generated within Metropolitan Bakersfield: Bena and Shafter-Wasco. The landfills are located outside of City limits within Kern County.

Bena Landfill- the landfill is located approximately 18 miles east of Bakersfield and is the primary landfill that serves Bakersfield. Currently the landfill has a maximum capacity of 70 million cubic yards and the current daily limits are 4,500 tons per day. In 2000, 337,000 tons if waste were disposed of at this facility.

Shafter-Wasco Landfill- This landfill is located one mile north of Lerdo Highway on Scofield Avenue in Kern County. In 2000 120,667 tons (334 tons per day) of waste was disposed of at this facility. In 2001 7,642,112 cubic yards of landfill volume remained at this facility. This landfill will go inactive in 2023

3.12.2 Regulatory Framework

State

California Urban Water Management Planning Act

Section 10610 of the California Water Code establishes the Urban Water Management Planning Act. The act states that every urban water service provider that serves 3,000 or more customers or that supplies over 3,000 acre-feet of water annually should prepare an Urban Water Management Plan (UWMP) every five years. The goal of a UWMP is to ensure the appropriate level of reliability in its water service sufficient to meet the needs of its various categories of customers during normal, dry, and multiple dry years. IRWD certified its latest UWMP in November 2005.

State Legislation – SB 610 (Costa) and SB 221 (Kuehl)

To further support and augment the Urban Water Management Planning Act, the state legislature enacted Senate Bill (SB) 610 (Costa) and SB 221 (Kuehl). These two pieces of legislation gave recognition to the importance of land use planning to the state's water supply. SB 610 amended the California Water Code, requiring that water service providers prepare a water supply assessment for certain projects. The water supply assessment for a project must include a discussion of whether the project's water demand was accounted for in the most recent UWMP. If the project's water demand was not accounted for in the UWMP, the water supply assessment must discuss whether the water service provider's total water supplies would be adequate to meet the projected water demand during normal, single dry, and multiple dry water years during a 20-year period. Additionally, under SB 610, the water supply assessment must be incorporated within an environmental document (i.e., EIR) prepared for the project pursuant to CEQA. SB 221, the companion bill to SB 610, sets forth similar requirements pertaining to new projects requiring a tentative tract map.

Local

Metropolitan Bakersfield General Plan EIR

The Metropolitan Bakersfield General Plan Update EIR provides background information on utilities and public services dealing with the present and planned land uses in the area, probable need for public facilities and services in the area, and the present capacity of public facilities and adequacy of public services.

The Metropolitan Bakersfield General Plan Update provides background information on utilities and public services dealing with the present and planned land uses in the area, probable need for public facilities and services in the area, and the present capacity of public facilities and adequacy of public services.

3.12.3 Project Impacts and Mitigation Measures

Significance Criteria

The *CEQA Guidelines Appendix G* provides guidance for assessing the significance of potential environmental impacts. Relative to utilities and public services, a project will normally have a significant effect on the environment if it will:

- Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:
  - Fire protection;
  - Police protection;
  - Schools; and
  - Other public facilities
- Exceed wastewater treatment requirements of the applicable Regional Water Quality Board;
- Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects;

- Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects;
- Require new or expanded water supply resources or entitlements;
- Result in a determination by the wastewater treatment provider which serves or may serve the project that it has inadequate capacity to serve the projects projected demand in addition to the provider's existing commitments;
- Be served by a landfill with insufficient permitted capacity to accommodate the project solid waste disposal needs; or
- Not comply with federal, state, and local statutes and regulations related to solid waste.

The methodology for this analysis included corresponding with the various public services agencies with jurisdiction over the project area to request current information about service ratios, response times, performance objectives, number of apparatus devoted to the project vicinity, etc. and reviewing web-based information about these agencies. Additionally, federal, state, and local regulations were reviewed for project applicability.

Impacts Discussion

Impact 3.12-1: The proposed project would construct infrastructure to enhance water supply reliability. Less than Significant.

Implementation of the proposed project would not increase demand for public services. The proposed project is a public utility project that would increase groundwater storage in the regional Kern County aquifer. The proposed project involves alteration of the project site, including site drainage. New storm water drainage facilities at the project site would not require the expansion of existing storm water service systems. Construction of the recharge basins would not create significant amount of solid waste or increase demand for water supplies or wastewater treatment systems. Impacts to public services or utilities would be less than significant.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Impact 3.12-2: The proposed project would require new or expanded water supply resources. Less than Significant.

The proposed project does not require a new water supply. IRWD would secure entitlements for excess water otherwise not being used, subject to the conditions established by the water supplier and availability ~~during wet hydrologic periods~~. The water would be conveyed to the Strand Ranch via the CVC through turn-outs constructed for that purpose. The source for recharge waters for the proposed project could potentially include federal, state, and local sources. Similar to Rosedale's existing Conjunctive Use Program, water sources could include Metropolitan Water District of Southern California, the State Water Project, pre-1914 water rights, the Central Valley Project, and high-flow Kern River water depending on availability. Each of these sources would be available only during certain conditions and subject to the requirements of SWRCB and the water rights' holders. No impacts to water rights holders, other water suppliers, or other public utilities would occur from the purchase of water from the sources identified in Section 2.5.3. The high flow Kern River water captured under the project for recharge would consist of water that would otherwise have left Kern County. Should water from other sources not suggested in Section 2.5.3 of this EIR be acquired for recharge, additional analysis may be required subject to the discretion of Rosedale and IRWD.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

CHAPTER 4
Cumulative Impacts

4.1 Introduction

CEQA Analysis Requirements

CEQA requires that an EIR assess the cumulative impacts of a project with respect to past, current, and probable future projects within the region. *CEQA Guidelines* (Section 15355) define cumulative effects as "two or more individual effects that, when considered together, are considerable or which compound or increase other environmental impacts. The cumulative impact from several projects result from the incremental impacts of the proposed project when added to other closely related, and reasonably foreseeable, future projects." Pertinent guidance for cumulative impact analysis is given in Section 15130 of the *CEQA Guidelines*:

- An EIR shall discuss cumulative impacts of a project when the project's incremental effect is "cumulatively considerable", (i.e., the incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of current projects, and the effects of probable future projects, (including those outside the control of the agency, if necessary).

- An EIR should not discuss impacts that do not result in part from the project evaluated in the EIR.

- A project's contribution is less than cumulatively considerable, and thus not significant, if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact.

- The discussion of impact severity and likelihood of occurrence need not be as detailed as for effects attributable to the project alone.

The analysis of cumulative effects in this chapter focuses on the effects of concurrent construction and operation of the proposed project with other spatially and temporally proximate projects as described below. As such, this cumulative analysis relies on a list of related projects that have the potential to contribute to cumulative impacts in the project area.

4.2 Related Projects

4.2.1 Geographic Scope

Cumulative impacts are assessed for related project within a similar geographic area. This geographic area may vary, depending upon the issue area discussed and the geographic extent of the potential impact. For example the geographic area associated with construction noise impacts is limited to areas directly adjacent to construction sites, whereas the geographic area that is affected by construction-related air emissions may include the larger airshed. Construction impacts associated with increased noise, dust, erosion, and access limitations tend to be localized and could be exacerbated if other development or improvement projects are occurring within the same or adjacent locations as the proposed project.

Geographically, the proposed project is located in western Kern County, approximately six miles west of the City of Bakersfield and 10 miles south of the City of Shafter. For the purposes of this analysis, we considered related projects within a five-mile radius around the project site when evaluating potential cumulative impacts due to construction of the proposed project. These projects are listed in **Table 4-1**. To determine potential cumulative impacts due to operation of the proposed project, we considered existing and future water banking programs for the water districts in the Kern Fan area (**Figure 4-1**). These projects are listed in **Table 4-2**. Given this, the geographic scope for each issue area also may vary depending on the nature of the cumulative impacts.

4.2.2 Project Timing

In addition to the geographic scope, cumulative impacts also take into consideration the timing of related projects relative to the proposed project. The implementation schedule is particularly important for construction-related impacts; for a group of projects to generate cumulative construction impacts, they must be temporally as well as spatially proximate. The related projects described below may or may not occur simultaneously with the proposed project. However, this analysis assumes these projects would be implemented concurrently with construction of the Strand Ranch Integrated Banking Project, between 2008 and 2014.

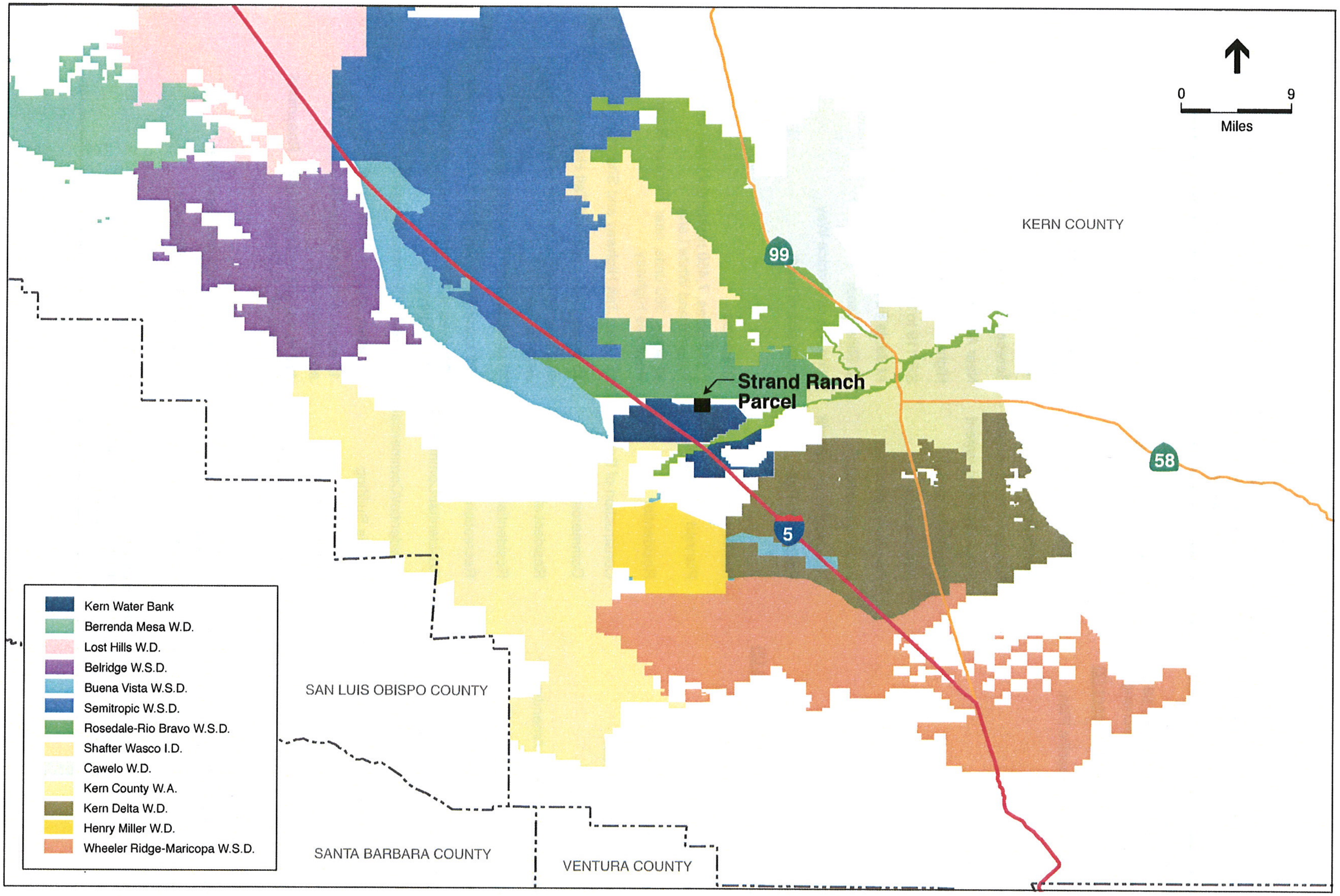
4.2.3 Type of Projects Considered

As described in **Chapter 3** of this EIR, the impacts associated with implementation of the proposed project include both short-term, temporary construction-related impacts and long-term impacts related to project operation. Therefore, cumulative effects could result when considering the effects of the proposed project in combination with the effects of other construction projects in the area and the effects of operating other water banking projects in Kern Fan area. For this analysis, other past, present, and reasonably-foreseeable future construction projects, particularly other capital improvement and development projects, in the area have been identified (Table 4-1). In addition, other past, present, and reasonably-foreseeable future water banking projects in the Kern Fan area have been identified (Table 4-2).

TABLE 4-1
CAPITAL IMPROVEMENT AND DEVELOPMENT PROJECTS

Project	Project Type	Location/Area Affected
Caltrans District 6 Projects (1)		
Caltrans District 6: State Route 99 and Seventh Standard Road Interchange Update	Roadway Improvement	Seventh Standard Road
Kern County Roads Department (2)		
Kern River Freeway Specific Plan	Roadway Improvement	Bakersfield and Kern County near Kern River and Stockdale Highway
Allen Road	Roadway Improvement	Hageman Rd to Snow Rd
Jenkins Road	Roadway Improvement	Between Brimhall and Spring Mtn Rds
Meacham Road	Roadway Improvement	Near Allen Rd
Old Farm Road	New traffic signal	Highway 58 intersection
Old River Road	New shoulder	SR 119 to I-5
Renfro Road	Roadway relocation	At Santa Fe Way
Fishering Drive	Pedestrian bridge	At Stine Canal
Wible Rd	Roadway Improvement	Ming Ave to Terrace Way
Belle Terrace	Pedestrian Path	North side of road
Kern County Planning Department (3)		
Beech Street Development (a)	Residential	129 acres
West Ming Specific Plan	Planned Community	2,182 acres, 7,450 residential units, Buena Vista Rd and White Lane
Greeley Road Development (a)	Residential	67 acres, 360 units, near Johnson Rd and Rosedale Highway
McKee Elementary School	Construction of School	15 acres, Taft Highway and Shannon Rd
Taft Development (b)	Commercial	15 acres, Enos Lane and Taft Highway
Bakersfield General Plan Amendment	Residential	14 acres, 56 residential lots, Hageman Rd and Jewatta Ave
Rosedale Neighborhood Development	Residential/Commercial	78 acres, Driver Rd and Rosedale Hwy
CUP for Bakersfield Vehicle Park	Recreational Park	120 space park, Allen and Santa Fe Roads
Grand Bakersfield Project (a, b)	Residential/Commercial	490 acres, 4,382 residential units, Houghton Rd and Stine Rd
Blackhawk II Development & Northwest Land (a,b)	Residential/Commercial	97 acres, 279 units, Noriega and Rudd Road
Private Lake Construction – Bakersfield (a)	Private Building	16 acres, south of Panama Ln
Leib Lane Residential Lots	Residential	12 acres, 4 residential units, Gateway Blvd and Kendall Ave
Rosamond Development	Residential/Commercial	167 acres, 158 residential units, Rosamond Blvd and 10th St West
Water District Projects (3)		
Improvement District 4 Cross River Pipeline	Water conveyance pipeline	Golden State Ave and Kern River
Friant-Kern/Cross Valley Canal Intertie Project	Canal Connection	Coffee and Brimhall Roads

SOURCE: (1) Caltrans 2007; (2) Kern County Planning Department, 2007b; (3) California OPR, CEQAnet database, 2007.
(a) Project requires county-approved exclusion from agricultural preserve.
(b) Project requires cancellation of Williamson Act contract.



SOURCE: CASIL, 2007; Kern County, 2007; ESA, 2007.

Irvine Ranch Water District . 205426

Figure 4-1
Kern County Water Districts

TABLE 4-2
GROUNDWATER BANKING PROGRAMS IN KERN COUNTY

PROJECT	TYPE	Gross Area of District
Semitropic WSD	In Lieu/Direct Recharge Projects	221,000
Arvin Edison WSD	In Lieu/Direct Recharge Projects	130,000
Rosedale Rio Bravo WSD	In Lieu/Direct Recharge Projects	40,000
Buena Vista WSD	In Lieu/Direct Recharge Projects	50,000
Kern Delta WD	In Lieu/Direct Recharge Projects	125,000
Cawelo WD	In Lieu/Direct Recharge Projects	45,000
Berrenda Mesa	Direct Recharge Projects	369
City of Bakersfield, 2800 Acres	Direct Recharge Projects	2,760
Kern Water Bank	Direct Recharge Projects	20,500
West Kern WD/Buena Vista WSD	Direct Recharge Projects	2,000

SOURCES: Kern County Water Agency, Buena Vista Water Storage District, Rosedale Rio Bravo Water Storage District, Kern Delta Water District.

In addition to the related projects listed in Tables 4-1 and 4-2, additional development that has not yet been identified, could occur within the project area and may contribute to cumulative impacts. In addition, each of the implementing agencies is planning numerous small-scale projects that have not been included in the list. This analysis assumes that in the vicinity of the proposed project, there will be on-going construction projects throughout the implementation period.

4.2.4 Description of Future Water Banking Projects

The water banking programs listed in Table 4-2 are either well established or newly implemented. Brief descriptions of planned future projects by some of these neighboring water storage districts in the immediate vicinity of the proposed project are provided below.

Semitropic Expansion

Semitropic Water Storage District, established in 1958, is the largest water storage district in Kern County covering an area of more than 220,000 acres. The district delivers water to nearly 300 customers for the irrigation of approximately 140,000 acres for agricultural uses. Semitropic also provides groundwater banking and storage services. Semitropic's groundwater banking consists of what is known as in-lieu recharge which refers to a reduction in agricultural pumping through importation of surface water for irrigation. Semitropic currently banks approximately 700,000 af of water in a groundwater storage bank with a capacity of 1.65 million acre-feet. Semitropic is currently planning to expand their groundwater banking operations by adding on additional partners, installing additional wells and coming closer to realizing their potential 1.65 million af storage capacity potential.

Rosedale-Rio Bravo

Rosedale has a seven well project (35 cfs) with Improvement District #4 (ID-4) that involves recharge near Allen Road and up to 17,500 af of extraction in dry years. As part of this project, the Kern-Tulare & Rag Gulch Water District and Arvin Edison Water Storage District bank water with Rosedale and ID-4 returns banked water to the districts either by extraction or exchange. In addition, Rosedale is looking at a potential banking program with Buena Vista that would involve new recharge grounds and up to 10,000 af of extraction. Rosedale also is looking at installing three extraction wells for the Castaic Lake Banking Program.

Buena Vista

Buena Vista Water Storage District is currently developing a program to provide additional groundwater banking operations. Details of this program are unspecified and may or may not include the installation of additional wells and recharge ponds.

Kern Delta

The Kern Delta Water District is currently developing two different groundwater banking projects. The first project involves the Greenfield Water District but is relatively small at 3,000 to 5,000 af per year. This project is a long term agreement that may eventually include the installation of six to eight recovery wells. The other project that is being considered is a groundwater banking project that will primarily involve recharge of approximately 30,000 af on 200 acres of recharge ponds. In addition, this project may include some recovery wells but has not been determined at this point.

4.2.5 Kern River Freeway Specific Plan

Kern County and the City of Bakersfield are planning to construct the Kern River Freeway, which would run on an east-west axis connecting Highway 99 in Bakersfield to Interstate 5. The Kern River Freeway Specific Plan is still largely in the design phase and is expected to be built sometime in the next 30 to 60 years.[1] However, construction of portions of the freeway in the City of Bakersfield, between Highway 99 and Heath Road, are scheduled to begin during the 2008-09 fiscal year.[2] The Specific Plan line for the freeway currently runs west from Highway 99 through Bakersfield and ends in the middle of Strand Ranch, as indicated on Kern County Zone Map 121. The Specific Plan line will continue west to Interstate 5; however, the design for this portion of the freeway is not yet available. Given long-term planning horizon for the freeway and the speculative nature of the freeway design and location in and around the project area, the cumulative impacts associated with this project are not evaluated further in this EIR. It is possible that the proposed project could encounter land use compatibility issues in the future if the freeway does get designed and built through the middle of Strand Ranch. Kern County will reserve the right-of-way path for the Specific Plan line through all properties along the route, including Strand Ranch.

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1 Lorelie Oviatt, Kern County Planning Department. Personal Communication, September 24, 2007.
2 Todd Woods. Kern County Roads Department, Personal Communication, October 2, 2007.

4.3 Impacts and Mitigation Measures

Project Construction

Impact 4-1: Concurrent construction of several projects in the vicinity of Strand Ranch could result in cumulative short-term impacts associated with construction activities. These include short-term impacts associated with air quality, biological resources, noise, traffic, and water quality. Less than Significant.

Construction of the Strand Ranch Integrated Banking Project is scheduled to begin in early 2008. The construction schedule for the proposed facilities would depend on funding. For the purposes of this analysis, the related projects identified in Table 4-1 are all presumed to be implemented concurrently within the 2008-2014 timeframe. These related projects, which include capital improvement and development projects in the vicinity of Strand Ranch, may contribute to certain types of cumulative construction impacts to air quality, biological resources, noise, traffic, and water quality, as described below. There would be no cumulative impacts to aesthetics; cultural resources; geology, soils and seismicity; hazards and hazardous materials; land use and recreation; or utilities and public services. Due to the nature of these resources as geographically confined and/or distinct, any impacts to these resources can be mitigated for individual projects and collectively do not compound to create cumulatively considerable impacts.

Air Quality

Construction of the proposed project would generate emissions that would affect air quality conditions in the San Joaquin Valley Air Basin. According to the SJVAPCD, any project that would individually have a significant air quality impact could also be considered to have a significant cumulative air quality impact. With implementation of **Mitigation Measure 3.3-1**, construction-related air quality emissions would be reduced such that the proposed project would not have a significant impact on air quality. Although the San Joaquin Valley Air Basin has been designated a federal non-attainment area for eight-hour ozone, PM-10, and PM-2.5, emissions associated with the proposed project would not be cumulatively considerable. Construction emissions would be temporary and typical of construction projects necessary to accommodate planned development; thus, construction emissions would be consistent with the existing Air Quality Management Plan. With implementation of **Mitigation Measure 3.3-1**, the proposed project would not conflict with regional air quality plans and policies, which are intended to bring the air basin into attainment for all criteria pollutants. The regional cumulative air quality impacts due to the proposed project would be less than significant.

Construction emissions would temporarily contribute carbon dioxide (CO_2) emissions from vehicle exhaust that could contribute to the cumulative emissions of greenhouse gases that are suspected of contributing to global warming. The emissions would be small and considered less than significant based on local thresholds of significance; therefore, the contribution to a global warming effect by the project is considered negligible.

Biological Resources

Construction of facilities in and around open space areas could result in destruction and/or disturbance of natural habitat. Habitat destruction/disturbance would contribute to the overall impacts to natural habitat in the vicinity of Strand Ranch resulting from cumulative development. Strand Ranch is characterized primarily by agricultural land use; no designated open space areas would be disturbed as a result of the proposed project. The proposed project would avoid potential natural habitat areas such as the Pioneer Canal and the slough. In addition, with implementation of **Mitigation Measures 3.4-1** through **3.4-5,** the proposed project would not result in significant impacts to special-status species or their habitat. Therefore, the proposed project would not contribute significantly to cumulative habitat loss or degradation in Kern County.

Noise

The primary sources of noise in rural agricultural areas such as the project site are roadway traffic and farm machinery on a seasonal basis. Construction of the proposed project would generate noise that is different from typical background noise in the project area. Related projects in the surrounding area would also temporarily generate noise associated with construction activities. Construction noise impacts would be localized, affecting areas in the immediate vicinity of the construction site. As described in **Section 3.10, Noise**, the proposed project would not result in significant noise impacts. The closest sensitive receptors to the project site are 1,250 feet away and would not be subjected to noise levels that exceed acceptable levels per the Kern County Noise Element. In addition, construction noise would occur only during daytime hours in accordance with applicable noise ordinances. Therefore, the proposed project would not contribute significantly to cumulative ambient noise conditions.

Traffic

Concurrent construction of the proposed project with other related projects would temporarily increase traffic due to increases in vehicle trips by construction workers and construction vehicles on area roadways, increase potential traffic safety hazards for vehicles, bicyclists and pedestrians on public roadways, and damage road pavement. As described in **Section 3.11, Transportation**, roadways in the vicinity of Strand Ranch are operating at LOS A. According to the Kern County Roads Department, several thousand vehicles would need to be added to the average daily count to cause LOS on these roads to drop below LOS standards. It is unlikely that the proposed project, together with related projects, would contribute enough vehicles to affect LOS on roadways in the project vicinity. In addition, if necessary, related projects would incorporate project-specific mitigation measures to reduce their respective impacts related to construction traffic, including the preparation and implementation of traffic control plans. Therefore, cumulative construction related traffic impacts would not be significant.

Water Quality

Concurrent construction of the proposed project with other related projects in the Kern Fan could result in temporary impacts to hydrology and water quality in the project area. Concurrent construction activities could result in increased erosion and subsequent sedimentation, with impacts to water quality in downstream water bodies and/or storm drain capacity. Additionally, surface water quality could be affected by construction activities that result in the release of fuels or other hazardous materials to stream channels or storm drains, or discharge from excavation dewatering activities. The Kern River is not listed as an impaired water body in the Basin Plan. Implementation of SWPPPs for the proposed project and other related projects greater than one acre would minimize the potential for impacting water quality in compliance with the General Construction Permit discharge conditions (see **Section 3.8, Hydrology**). In addition, the introduction of higher water quality surface waters into the underlying groundwater aquifer would increase water quality of the aquifer (Crewdson, 2007b). Therefore, the proposed project's contribution to construction-related and operational water quality impacts would not be cumulatively considerable.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Project Operation

Operation of the proposed project involves groundwater recharge and extraction activities. When considered together with other groundwater recharge programs listed in Table 4-2, the proposed project could result in cumulatively considerable impacts to groundwater resources and agricultural land use as described below. Operation of the proposed project would not result in cumulatively considerable impacts to other resources evaluated in Chapter 3 of this EIR.

Impact 4-2: The proposed project and related projects could result in cumulative long-term impacts to groundwater resources. Less than Significant.

Kern County has a long history of reliance on groundwater resources as a source of water supply for agriculture, drinking water, and industrial uses. The combination of very thick coarse grained sediments of the Kern Fan and the high recharge from the Kern River have created a very large groundwater resource. However, uncontrolled groundwater pumping beginning in the 1920s eventually caused great declines in groundwater levels and subsequent land subsidence in the region. Although Bakersfield did not experience as much subsidence as elsewhere in the San Joaquin Valley, the underlying groundwater resources were threatened. With the advent of improved groundwater management practices including groundwater banking or Aquifer Storage and Recovery (ASR) projects, the groundwater basins began to recover. ASR programs are typically designed to hydraulically transfer surface waters into the available storage capacity of the underlying aquifer. Years of high precipitation/snow pack provide opportunities to divert high flows from the Kern River into recharge facilities for future use thereby bolstering available groundwater supplies. The ASR programs of Kern County represent the largest operations of this kind in the United States. The various entities or water districts that operate in the Kern Fan area include Rosedale, KWBA, Pioneer Project, Berrenda Mesa, and City of Bakersfield's 2800 Acres Project (Figure 4-1). Other districts outside the fan include Semitropic Water Storage District, North Kern Water Storage District, West Kern Water District, Improvement District No. 4, Rosedale Ranch ID, Buena Vista Water Storage District, Henry Miller Water District, and Cawelo Water District although not all of these entities are actively involved in groundwater banking operations. However, as described above many of these districts are either currently developing ASR projects or have plans to expand operations in the future.

Groundwater banking projects are designed to maintain a positive project balance such that no net water would be removed from the basin. The projects operate by recharging water in wet years and recovering water in dry years. Water banks only recover water up to the amount previously banked minus an amount to account for losses to the basin. The net depletion to the basin resulting from the recovery operations is compensated if not exceeded by recharge.

Long term trends have shown improvements on groundwater levels; however even with the overall benefits seen with ASR programs, temporary effects can be experienced. For example, 2001 was a year where recovery operations far exceeded recharge operations (176,998 af). As a result, drawdowns in monitoring wells during 2001 were observed to be as much as 165 feet. Likewise, recovery operations for 2007 are projected to be even greater than that of 2001 with over 350,000 af of water recovered from storage (KFMC, 2005). In both cases, however, the years of heavy recovery were preceded by years of predominant recharge activity. In addition, for the year 2001, groundwater levels rebounded following their lowest levels in August to recover within approximately 67 percent of the levels at the beginning of the year on average through natural recharge (KFMC, 2005). Cumulative storage calculated for all the project entities, as reported by the Kern Fan Monitoring Committee, has grown from 90,995 af in 1981 to 2,657,094 af for 2007 assuming a projected total recovery of 355,000 af and no additional recharge.

All of these ASR projects operate under MOUs which have been developed in order to protect the underlying groundwater resources and avoid adverse affects to neighboring entities. Under the MOUs, groundwater banking operations are to be "consistent with avoiding, mitigation or eliminating to the greatest extent practicable, significant adverse impacts" (KCWA, 2004). These ASR projects are designed to recover only the amounts that have been stored through recharge activities minus the accounting of factored losses (from 6 to 15 percent per the MOU). These losses are not recoverable by any of the water districts and become additions to the aquifer. The losses are derived from a 3 percent surface recharge loss, an additional 3 percent loss for water recharged and subsequently extracted for out-of-district use, an additional 5 percent loss for water banked by out-of-County entities, and a potential 4 percent loss for water banked if purchased by adjoining entities within 3 years. (See Appendix E for additional details.) The Department of Water Resources developed an approach to calculating actual recharge losses that occur due to pond surface evaporation, phreatophyte evapotranspiration, and soil evaporation (DWR, 1990 as referenced in KWBA, 2007). This analysis predicted that total losses would probably range from 4 percent in the winter to 7 percent in the summer. Given the results of this analysis, the MOU established a conservative 6 percent (the combination of the surface recharge loss and the out-of-district loss mentioned above) loss factor to all surface water recharged on the Kern Water Bank. An analysis of recharge activities from 1995 through 1999 indicated that cumulative losses were actually about 4.2 percent (KWBA, 2007).

Therefore, the proposed project would not have an adverse effect on the underlying groundwater resources. The contribution of the proposed project to cumulative impacts to groundwater resources is not cumulatively considerable.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

Impact 4-3: The proposed project and related projects could result in cumulative long-term impacts to agricultural resources. Less than significant.

As described in **Section 3.2, Agricultural Resources**, the proposed project would be built on lands designated as Prime and Unique Farmland by the California Department of Conservation (CDC) Farmland Mapping and Monitoring Program (FMMP). The component of the proposed project that would have the greatest impact to agricultural resources due to farmland conversion is the recharge facilities, which would occupy 502 acres of the Strand Ranch site. However, the proposed recharge facilities would continue to be used for agricultural uses, such as organic farming or grazing, for at least eight months per year. Only six percent of Strand Ranch would be converted to facilities that are considered a non-agricultural use. This effect is considered to be negligible, and therefore the impact of the proposed project to agricultural resources is considered less than significant.

The cumulative impact of the proposed project on agricultural resources is dependent on the past, present, and reasonably-forseeable future conditions of development and land use in the project vicinity. There have been documented losses of farmland in Kern County over the past ten years. According to the CDC FMMP, in Kern County there were 1,034,808 acres of farmland in 1994; 990,422 acres of farmland in 2000, and 969,565 acres of farmland in 2004 (CDC, 2007). Specifically, Prime and Unique Farmland in Kern County declined from 550,480 acres and 56,601 acres, respectively, in 1994 to 518,804 acres and 51,095 acres, respectively, in 2004 (CDC, 2007). This equates to a six percent loss of Prime Farmland (31,676 acres) and a ten percent loss of Unique Farmland (5,506 acres) over ten years.

There is an abundance of land in the vicinity of Strand Ranch that is categorized as Prime Farmland, Unique Farmland, and Farmland of Statewide Importance (see Figure 3.2-1). In addition to the proposed project, other related projects in the area could result in the conversion of agricultural lands. Table 4-1 lists planned development projects in the vicinity of the proposed project. All projects listed have published CEQA documents in 2007 (California OPR, 2007) and/or have requested building permits or other actions from the Kern County Planning Department. Some development projects require cancellation of Williamson Act contracts and exclusions from agricultural preserves (numbers 9, 10, 11) as designated by Kern County. These projects include Beech Street Development, Greeley Road Development, and Grand Bakersfield Project, among others. Therefore, planned development in the vicinity of the proposed project would likely result in the loss of farmland. In addition, other planned water banking projects in the project area could include construction of new facilities on lands currently used for agriculture.

The proposed project would not contribute to cumulative farmland conversion. As described in **Section 3.2, Agricultural Resources**, the proposed project would provide benefits to agriculture in the project vicinity by preventing the conversion of Strand Ranch from farmland to residential or commercial development and preventing overdraft conditions in the underlying groundwater basin, upon which regional farmers depend for irrigation water. The proposed project would also benefit agricultural resources in IRWD's service area, which provides approximately 8,000 af of water per year to meet the demands of agricultural production. The contribution of the proposed project to cumulative impacts to agricultural resources is not cumulatively considerable.

Mitigation Measures

Mitigation Measure: No mitigation measures are required.

CHAPTER 5
Growth Inducement Potential

5.1 Overview

The *CEQA Guidelines* (Section 15126.2(d)) require that an EIR evaluate the growth-inducing potential of a proposed action. Growth inducing potential is defined by the *CEQA Guidelines* as:

> ...the ways in which a proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Included in this definition are public works projects, which would remove obstacles to population growth.... It must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment.

A project can have direct and/or indirect growth inducement potential. Direct growth would result if a project involved construction of new housing. A project can have an indirect growth inducement effect if it would establish substantial, new, or permanent employment opportunities and indirectly stimulate the need for additional housing and services. Similarly, a project would have an indirect growth inducement effect if it would remove an obstacle to additional growth and development, such as providing urban services, such as water supply, to un-served or underserved areas.

This section reviews the population growth projections for Rosedale and IRWD service areas and describes the existing and projected water demand and water supply conditions. It provides a description of both districts' role in providing potable water to customers within their service areas. Finally, the section reviews the potential secondary effects associated with the land uses and growth planned by the local land use jurisdictions within both service areas. These entities have analyzed the potential environmental effects of their adopted General Plans and have identified potential impacts and mitigation measures to address the effects of planned growth.

5.2 Population

IRWD Service Area

Population within IRWD's service area is projected to increase 47 percent by 2030, from 316,000 in 2005 to approximately 465,000 in 2030 (IRWD, 2005). A significant portion of this growth is due to development by The Irvine Company, Tustin Legacy (former MCAS Tustin) and development of Heritage Fields at the Orange County Great Park. Water demand is expected to increase as a direct function of the planned growth in population, as well as related planned housing and employment markets.

The northern portion of Orange County was extensively developed in the 1970s and 1980s and continues to increase in population density. Since 1990, Orange County's population has increased by an average 1.7 percent annually, compared with a 1.46 percent increase in Southern California as a whole (SCAG, 2001). As shown in **Table 5-1**, the Southern California Association of Governments (SCAG) projects that Orange County's population will increase to 3.49 million by the year 2025, just over 12 percent. SCAG estimates that most of the projected growth in Southern California will result from local birth rates rather than immigration, which accounted for most of the growth in the 20th Century (SCAG, 2001). Based on SCAG's review of growth trends, much of the future growth in the county will occur in the portion of the county that is already developed.

IRWD has derived population estimates specific to its service area by multiplying the number of dwelling units in each density category by the number of persons per dwelling unit for that category.

TABLE 5-1
IRWD POPULATION PROJECTIONS

	2005	2010	2025	2030
Orange County [a]	3,100,000	3,290,000	3,490,000	3,550,000
IRWD[b]	316,000	366,192	423,914	465,000

SOURCES: (a) SCAG Growth Forecasting, City Projections (http://www.scag.ca.gov/forecast/downloads/2004GF.xls);
(b) IRWD, UWMP, 2005.

Rosedale Service Area

The Rosedale service area consists predominately of rural agricultural land uses. However, its eastern portions are within the Metropolitan Bakersfield planning area and are experiencing rapid development and population growth. The City of Bakersfield was ranked 51st on the nationwide list of fastest growing cities compiled during the 2000 census. The City of Bakersfield in coordination with the Kern County prepared a General Plan in 2002 evaluating growth in the Bakersfield sphere of influence (City of Bakersfield and Kern County, 2002a). The designated boundary of this planning area actually bisects the Strand Ranch, the eastern half section within the planning area, and the western half-section outside the planning area (see **Section 3.9 Land Use**). The Metropolitan Bakersfield Planning Area predicts a 29 percent growth rate to the year 2020 (**Table 5-2**). The population of the City of Bakersfield was 254,368 in 2001, approximately 63 percent of the General Plan Planning Area population of 402,100.

TABLE 5-2
ROSEDALE POPULATION PROJECTIONS

	2001	2010	2020
Kern County	685,811	871,600	NA
Metropolitan Bakersfield General Plan Planning Area	402,100	NA	520,500

SOURCES: Metropolitan Bakersfield General Plan Update EIR, 2002b

5.3 Water Supply and Demand

IRWD

Approximately 30 percent of IRWD water demands are met with water imported from Northern California and from the Colorado River by MWD and MWDOC. Approximately 77 percent of the supply is from local sources including surface water within the Santiago Creek watershed, the Orange County Groundwater Basin managed by the Orange County Water District (OCWD) and by recycled water resources produced by IRWD. OCWD replenishes the groundwater basin largely by recharging Santa Ana River water into the aquifer and by importing some additional water from MWD for recharge as well.

MWD manages and coordinates the delivery of imported surface water supplies from the Colorado River and from Northern California through the State Water Project with six southern California counties including Orange County. MWDOC, a member agency of MWD, is a water wholesale agency that does not provide water directly to customers but rather purchases it from MWD and sells it to its approximately 30 member agencies, comprising cities and water districts throughout the county. These member agencies, including IRWD, are the local water retailers, selling water directly to their local customers.

MWD provides approximately 50 percent of the water supply for Orange County, on average. **Table 5-3** summarizes MWD's single dry-year supply portfolio through 2030, identifying existing supplies and the supplies under development both for additional import as well as locally within MWD's service area. As shown in the table, MWD has developed a multiple supply portfolio to meet current demands and to accommodate growth demands within its service area without increasing pressure on groundwater production. MWD's supply forecasts provide estimations of supply reliability for local member agencies to base future supply requirements. Actual reliability of supplies could vary depending on implementation of proposed projects.

TABLE 5-3
MWD'S SINGLE DRY-YEAR SUPPLY CAPABILITY AND TOTAL DEMAND (AFY)

	2010	2020	2030
Current Supplies			
Colorado River	722,000	699,000	699,000
California Aqueduct	777,000	777,000	777,000
In-Basin Storage	1,149,000	1,113,000	1,017,000
Supplies Under Development			
Colorado River	95,000	400,000	400,000
California Aqueduct	330,000	350,000	350,000
In-Basin Storage	78,000	103,000	103,000
Transfers to Other Agencies	0	(35,000)	(35,000)
MWD Supply Capability (with Colorado River Aqueduct at 1.25 million afy)	3,151,000	3,309,000	3,203,000
Firm Demands on MWD	2,348,000	2,275,000	2,511,000
Potential Reserve & Replenishment Supplies	803,000	1,034,000	692,000

SOURCE: MWD, Regional Urban Water Management Plan, November 2005.

In recent years, MWD's primary water supplies have come under pressure. As Arizona approaches full use of its Colorado River entitlement, MWD's diversion of Colorado River water will decrease. This decrease in diversion is accounted for in MWD's most recent Regional Urban Water Management Plan. To make up for the decrease, MWD has identified local projects and conservation measures to meet increasing demand. Supply availability from the Sacramento-San Joaquin Delta may also be constrained by as much as 30 percent in the next year. The curtailments would be the result of a recent court ruling addressing the declining populations of the endangered Delta smelt. If the curtailments continue, the reduced pumping of water from the Delta would reduce the reliability of MWD's supplies in the future.

IRWD's system is quite reliable due to its interdependent sources of supply. Projected water supplies are shown to be sufficient to meet customer needs through 2030. This assumes that there will be an increase in recycled water use and local groundwater production. New potable groundwater supplies are expected to be built, reducing the IRWD's reliance on imported water from MWD. With the exception of the agriculture sector, demand is expected to increase as the population grows.

IRWD's UWMP evaluates multiple dry-year drought supplies and identifies sources of supply to meet actual demands. Generally, during periods of drought, should MWD's sources be stressed through multiple dry years, or suffer catastrophic failure, IRWD could augment water supplies through increased local groundwater pumping coupled with conservation incentives. The proposed project would augment this multiple dry-year supply portfolio, reducing the overall demand on the local groundwater basin.

Redundant water sources also enhance the system's overall reliability for potential scenarios such as catastrophic failures of water conveyance infrastructure, a shut-down of Delta water supplies, or water quality issues in the SWP. To plan for these contingencies, a diverse water supply portfolio provides the highest degree of reliability.

Table 5-4 summarizes IRWD's water supply portfolio projected to the year 2030. The proposed project is not included in this portfolio because it is being developed as a dry-year supply only.

Rosedale

Rosedale estimates that the groundwater basin within its boundaries has an aquifer storage capacity of more than 900,000 af, based on field studies performed in 2003 (Crewdson, 2003). Groundwater is used to irrigate agriculture throughout the service area. As urban land uses radiate outward from the City of Bakersfield into the unincorporated areas of the county and within the Rosedale service area, water demands will shift from agricultural to residential. **Table 5-6** summarizes consumptive use within the Rosedale service area since 1976. As shown in the table, average urban use has nearly doubled since 1990 as crop use has been decreased slightly. This trend is expected to continue.

TABLE 5-4
IRWD CURRENT AND PLANNED WATER SUPPLIES (AFY)

	2010	2015	2020	2025	2030
Potable Supplies:					
Groundwater	36,900	36,900	36,900	36,900	36,900
Treated Groundwater	5,640	5,640	5,640	5,640	5,640
MWD Imported	41,929	41,929	41,929	41,929	41,929
Future Groundwater	18,000	33,400	33,400	33,400	33,400
Non-potable Supplies:					
Imported untreated	20,380	20,380	20,380	20,380	20,380
Recycled Water	18,657	18,657	18,657	18,657	18,657
Native Water	4,000	4,000	4,000	4,000	4,000
Nonpotable Groundwater	3,898	3,898	3,898	3,898	3,898
Future Recycled Water	10,100	10,100	10,100	10,100	10,100
Total Planned Water Supply:	159,504	174,904	174,904	174,904	174,904
Build-out Demand potable:	65,949	84,860	91,023	95,297	95,440
Build-out Demand nonpotable:	40,764	38,645	39,526	40,939	40,996

SOURCE: IRWD Water Resources Master Plan

TABLE 5-5
AMOUNT OF GROUNDWATER PROJECTED TO BE PUMPED (AFY)

Location	2010	2015	2020	2025	2030
Orange County Groundwater Basin	53,900	69,300	69,300	69,300	69,300
Irvine Subbasin (Irvine Desalter)	10,538	10,538	10,538	10,538	10,538
Total	64,438	79,838	79,838	79,838	79,838

SOURCE: IRWD Water Resources Master Plan.

TABLE 5-6
HISTORIC CONSUMPTIVE USE WITHIN ROSEDALE DISTRICT (AFY)

Period	Crop Use	Urban Use	Subtotal
1976-1990	86,968	3,772	90,740
1991-2005	84,311	6,920	91,231

SOURCE: Rosedale Rio-Bravo Water Storage District

5.4 Growth Inducement Potential

The proposed project to bank water within Rosedale's Conjunctive Use Program to enhance the reliability of IRWD's water supplies would not have a direct growth-inducing effect within the

IRWD service area or the Rosedale district boundaries. The project does not involve construction of new housing and would not substantially expand or establish new employment opportunities that, in turn, would generate housing development. Nor would the project provide water supply infrastructure to a previously undeveloped or underserved region.

The project provides water supply reliability to IRWD that diversifies water delivery options available in future years. IRWD has more than adequate water supplies (existing and under development) to meet projected demands to the year 2030. This project does not increase water supplies but provides a cost effective means of managing contingency and drought planning needs. The proposed project would not be capable of providing water every year and therefore could not support the continuous demands associated with population growth. The Urban Water Management Planning Act of 1993 requires major water suppliers to identify sources of water to meet three-year drought scenarios. Options to show that water would be available for such a drought include providing drought-proof water supplies such as desalinated water and recycled water or constructing substantial storage capacity. The proposed project provides drought supply storage to augment the district's drought planning requirements. Drought planning provides for system reliability but does not accommodate additional demand.

Neither IRWD nor Rosedale has authority or responsibility for approving land use designations. Neither district makes decisions about approving new development that would require connections to potable water supplies. Planning in the IRWD service area is the responsibility of all municipalities within IRWD's service area. Cities within the IRWD service area include Irvine, Tustin, Orange, Newport Beach, Lake Forest, and Costa Mesa. Some unincorporated areas of the County of Orange are also within IRWD's service area boundary. Rosedale encompasses several cities, but the City of Bakersfield sphere of influence dominates the growth projections. The cities and the counties are responsible for identifying and accommodating growth within their boundaries. Each city and county has prepared a General Plan that identifies growth projections specific to their areas. Each of the cities and counties acknowledge that population is increasing and each entity has identified significant impacts associated with the growth. Each entity has adopted overriding considerations pursuant to CEQA requirements, acknowledging that growth results in secondary impacts that may be significant and unavoidable. These impacts include increased air pollution, traffic congestion, and loss of open space and farmland.

Water banking provides for effective groundwater management within the Rosedale service area that benefits overlying groundwater users and banking entities. Water banking does not promote or induce growth within the Rosedale service area. Use of property for recharge basins prevents other development on the site and is compatible with existing agricultural land uses in the area.

The proposed project neither supports nor encourages growth within the IRWD or Rosedale service areas to a greater degree than presently estimated by the agencies with land use jurisdiction within their service areas. The proposed project is not inherently growth-inducing.

5.5 Resource Management Plans

IRWD Water / Wastewater Urban Water Management Plans

As part of IRWD's planning efforts to meet future demands resulting from projected growth, the Water Resources Master Plan and Wastewater Treatment Master Plan are periodically updated to reflect changes in land use plans developed by the County and Cities within the IRWD service area. The Plans are complementary and rely on the same growth projections and assumptions. The Water Resources Master Plan encompasses a district-wide planning effort, incorporating interrelation and analysis of Land Use Elements from adopted General Plans, considering land use, development intensity and population density.

IRWD's Water Resources and Wastewater Treatment Master Plans integrate local land use decisions, and focus on where and how water and wastewater service will need to be provided based on the growth that is projected to occur. The objectives of the Water Resources Master Plan include compiling projections for future land use and demands for potable and non-potable water as a basis for water resources planning.

Urban Water Management Plans

UWMPs are required to identify and quantify existing and future water supplies. MWD, MWDOC, and IRWD have each adopted an UMWP, as required under state law. Each of these plans identifies water transfers as potentially increasing water supply reliability to meet increasing water demands. IRWD's UWMP identifies that 17,500 AFY is currently being considered for water banking. Rosedale is not required to prepare an UWMP.

Regional Resource Management Plans

Local planning jurisdictions rely largely on regional resource management agencies to mitigate the direct and cumulative effects of growth on the environment. It is the responsibility of regional resource managers to evaluate effects of growth and prepare plans to mitigate identified effects where possible. Several regional agencies including SCAG, SCAQMD, SAWPA, MWDOC, and MWD evaluate impacts of projected growth on regional resources and have each prepared resource management plans to mitigate potential significant impacts. Some of these regional resource management plans are summarized below.

The SCAG Regional Comprehensive Plan and Guide (RCPG) completed in 1996 combines regional planning efforts into a single focused document, addressing several core elements including transportation, air quality, water quality, and hazardous waste management. These elements provide a basis for regional conformity review for state and federal resource management regulations. The RCPG also addresses as ancillary or advisory guidance the following elements: economic issues, housing, human resources, public finance, open space and conservation, water resources, energy resources, and integrated solid waste management.

In 2004, SCAG prepared an EIR on its Regional Transportation Program (RTP). The RTP acts as a long-term planning and management plan for the regional transportation system, providing mitigation measures to offset the impacts of growth. SCAG updates growth projections for counties and cities annually. The most recent population projections are from the 2004 RTP PEIR. SCAQMD updated the SCAB Air Quality Management Plan (AQMP) in 1997. The AQMP analyzes air quality impacts of projected growth and provides measures to offset those impacts. The AQMP relies on short term and intermediate term attainment measures which were to be adopted by 2000, and long-term attainment measures utilizing advances in technology reasonably expected to be available by the year 2010. On January 12, 1999, the U.S. EPA proposed a partial disapproval of the ozone portion of the 1997 AQMP. In response, the SCAQMD prepared the 1999 Ozone State Implementation Plan revision.

SAWPA completed the Integrated Watershed Plan in 2002 for the Santa Ana River watershed. The plan identifies water quality concerns within the entire watershed and identifies projects to remediate poor water quality. MWD and MWDOC each have prepared UWMPs that identify projected water demand for the region and identify water supply sources to meet the demand. These plans are exempt from CEQA evaluation.

Other agencies such as the SARWQCB, CDFG, USFWS, and USACE have instigated permitting programs to assist in developing mitigation monitoring and reporting plans for projects potentially impacting natural resources. OCWD implements several programs that mitigate potential growth effects as described below. Kern County, Orange County, and local cities also manage local resources through long-range planning processes and development permitting programs. **Table 5-7** lists agencies in the Southern California region that have the authority to implement major mitigation measures for growth-related impacts. The secondary effects of growth in Kern County and Orange County are evaluated and mitigated through these regional authorities.

TABLE 5-7
KEY REGIONAL RESOURCE MANAGEMENT AND/OR PROTECTION AGENCIES WITH A ROLE IN ADDRESSING SECONDARY EFFECTS OF PLANNED GROWTH IN ORANGE COUNTY

Agency	Authority
US Environmental Protection Agency	Responsible for enforcing environmental protection laws including Clean Air Act, Clean Water Act, hazardous waste regulations, and solid waste regulations.
US Fish and Wildlife Service	Responsible for protecting wildlife. Enforces Endangered Species Act and issues Biological Opinions for projects that could affect endangered species.
US Army Corps of Engineers	Responsible for providing flood protection. Administers Section 404 of the Clean Water Act for projects impacting "Waters of the US".
California Department of Fish and Game	Responsible for protection of wildlife in California. Enforces California Endangered Species Act and issues Streambed Alteration Agreements for projects impacting wetland areas.
State Department of Health	Responsible for the purity and portability of domestic water supplies for the state.
California Air Resources Board	Responsible for adopting and enforcing standards, rules, and regulations for the control of air pollution from mobile sources throughout the state.

TABLE 5-7 (CONT.)
KEY REGIONAL RESOURCE MANAGEMENT AND/OR PROTECTION AGENCIES WITH A ROLE IN ADDRESSING SECONDARY EFFECTS OF PLANNED GROWTH IN ORANGE COUNTY

Agency	Authority
Local Agency Formation Commission	Empowered to approve or disapprove all proposals to incorporate cities to form special districts or to annex territories to cities or special districts. Also empowered to guide growth of governmental service responsibilities.
Southern California Association of Governments	Formed to provide more effective regional planning in southern California. Responsible for developing regional plans, including: Regional Comprehensive Plan and Guidelines, Regional Transportation Plan, Regional Housing Needs and Employment Assessment, and Air Quality Management Plan.
South Coast Air Quality Management District	Adopts and enforces local regulations governing stationary sources of air pollutants. Develops the regional Air Quality Management Plan with SCAG.
County of Orange	Responsible for planning, land use, and environmental protection of unincorporated areas. The Orange County Board of Supervisors revised the Growth Management Element of its County General Plan on October 19, 1993.
Orange County Flood Control District	Responsible for providing regional flood control facilities within Orange County. Plan storm drainage and flood control facilities on a countywide, regional basis.
Regional Water Quality Control Board, Santa Ana Region	Responsible for maintaining water quality. Formulates and adopts water quality control plans for the District's service area. Implements portions of the CWA.
Metropolitan Water District of Southern California	Responsible for the development, storage, transportation and wholesaling of water to member agencies for domestic and municipal purposes. Obtains water from California State Water Project and Colorado River Aqueduct.
Municipal Water District of Orange County	Provides imported water for service area. Responsible for preparing a Regional Urban Water Management Plan that assesses the availability of water.
Orange County Sanitation District	Collects, treats, and disposes wastewater within northern Orange County.
Orange County Water District	Manages Orange County groundwater basin. (See following sections).
Local cities (within the Districts' service area)	Responsible for adoption of local general plans and various planning elements and local land use regulations. Adopt and implement local ordinances for control of environmental impacts.

SOURCE: Environmental Science Associates.

CHAPTER 6
Alternatives Analysis

6.1 Introduction

This section summarizes the CEQA requirements for assessing alternatives to a proposed project that could lessen or avoid significant impacts while still meeting most of the project objectives. This section restates the project objectives and significant impacts identified in Chapter 3, and then describes and compares feasible alternatives to the proposed project.

6.1.1 CEQA Requirements for Alternatives Analysis

CEQA requires that an EIR describe and evaluate a reasonable range of feasible alternatives to a project, or to the location of a project that would attain most of the project objectives and avoid or substantially lessen significant project impacts. CEQA Guidelines (§15126.6) set forth the following criteria for alternatives:

- Identifying Alternatives. The range of alternatives is limited to those that would avoid or substantially lessen any of the significant effects of the project, are feasible, and would attain most of the basic objectives of the project. Factors that may be considered when addressing the feasibility of an alternative include site suitability, availability of infrastructure, general plan consistency, other plans or regulatory limitations, jurisdictional boundaries, economic viability, and whether the proponent can reasonably acquire, control or otherwise have access to the alternative site. An EIR need not consider an alternative whose impact cannot be reasonably ascertained and whose implementation is remote and speculative. The specific alternative of 'no project' shall also be evaluated along with its impact.
- Range of Alternatives. An EIR need not consider every conceivable alternative, but must consider a reasonable range of alternatives that will foster informed decision-making and public participation. The "rule of reason" governs the selection and consideration of EIR alternatives, requiring that an EIR set forth only those alternatives necessary to permit a reasoned choice.
- Evaluation of Alternatives. EIRs are required to include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the project. Matrices may be used to display the major characteristics of each alternative and significant environmental effects of each alternative to summarize the comparison. If an alternative would cause one or more significant effects in addition to those that would be

caused by the project as proposed, the significant effects of the alternative must be discussed but in less detail than the significant effects of the project.

6.1.2 Project Objectives

The proposed project would develop groundwater recharge and recovery facilities on Strand Ranch and integrate Strand Ranch into Rosedale's Conjunctive Use Program. The objectives of the proposed project include the following:

- Provide additional groundwater recharge, storage, and recovery capacity in the Kern Fan region to augment Rosedale's existing and future programs;
- Integrate IRWD's participation in Rosedale's Conjunctive Use Program through the use of Strand Ranch and other Rosedale facilities to the extent they are not obligated to meet Rosedale's existing banking program contracts;
- Allow the storage of water ~~during wet hydrologic periods~~ subject to the conditions established by the water supplier and availability for recovery and use during dry periods to provide IRWD customers with increased water supply reliability through redundancy and diversification.

6.1.3 Key Impacts of the Proposed Project

Chapter 3 of this EIR identifies potential impacts associated with the proposed project for each environmental issue area including long-term and short-term impacts. Mitigation measures were identified to render impacts less than significant. No significant unavoidable impacts would result from implementation of the proposed project.

6.2 Alternatives to the Project

6.2.1 No Project Alternative

According to Section §15126.6(e) of the CEQA Guidelines, discussion of the No-Project Alternative must include a description of existing conditions and reasonably-foreseeable future conditions that would exist if the project were not approved. Under the No Project Alternative, IRWD would not implement construction of the recharge and recovery facilities identified under the proposed project, and Strand Ranch would not be annexed or integrated into Rosedale's Conjunctive Use Program. Under the No Project Alternative, the water demand in IRWD's service area during dry years would continue to grow and would be met with increased quantities of imported water, local water (groundwater, recycled water), and/or increased conservation measures. Rosedale would continue to explore and develop partnerships with other water districts within or outside of the Kern Fan to expand its Conjunctive Use Program.

Ability to Meet Project Objectives

Implementation of the No Project Alternative would not provide the benefits of enhanced water supply reliability for IRWD customers and would not provide additional recharge and recovery capacity for Rosedale's Conjunctive Use Program at Strand Ranch. Implementation of the No Project Alternative would not meet any of the stated project objectives and would not address IRWD's need for water supply reliability, redundancy, and diversification.

Impact Analysis

Under the No Project Alternative, the identified impacts associated with constructing and operating the proposed project would be avoided. Short-term construction impacts to air quality, noise, and traffic would be avoided. Potentially-significant long-term project impacts to biological resources, cultural resources, soils, groundwater quality, and groundwater quantity also would be avoided.

Under the No Project Alternative, during extended periods of drought, water demand in the IRWD service area would continue to be met with imported water and local water supplies, resulting in greater pressure on local groundwater resources. Greater pressure on groundwater extraction could result in a reduction in safe yield for basin pumping and higher water production and treatment costs. During periods of catastrophic supply interruption and multi-year drought conditions IRWD's water supply would be less reliable Under the No Project Alternative. IRWD would not benefit from the water supply redundancy and diversification provided by the proposed project. IRWD would be more vulnerable to water supply disruptions caused by drought or other catastrophic water supply interruptions due to infrastructure failures, Delta water supply reductions, or reductions in other imported water deliveries from MWD. During such water supply disruptions, IRWD may need to impose water restrictions under its Water Shortage Contingency Plan, which include mandatory demand reduction measures (UWMP, 2005).

Under the No Project Alternative, Rosedale would not have access to the recharge and recovery facilities proposed for Strand Ranch. Rosedale would be limited to the recharge capacity of its existing recharge basins.

6.2.2 Recharge Basin Location Alternative

Under the Recharge Basin Location Alternative, Rosedale and IRWD would identify alternative locations other than Strand Ranch to construct recharge basins. The Strand Ranch would not be annexed into the Rosedale service area. IRWD would purchase other property to be annexed by Rosedale. Conveyance and extraction facilities would be designed to accommodate the alternative location.

When developing the proposed project, other properties were considered in addition to Strand Ranch. All potential project locations were evaluated based on a list of criteria that defined the ideal conditions for implementation of the proposed project. The criteria included the following:

- The property is available for purchase;

- Soil permeability conditions and infiltration rates are adequate for groundwater recharge;
- There is an unconfined aquifer below the property (i.e. no clay layers that could impede long term recharge and storage);
- There is adequate storage space in the aquifer below the property;
- Groundwater quality is compatible with pump-in requirements of the California aqueduct;
- Existing conveyance facilities are proximate to the property; and
- Other environmental constraints such as soil quality and existing land use are compatible with a groundwater banking project.

The properties that were available for purchase and therefore considered in addition to Strand Ranch are indicated on **Figure 6-1**. The Fanucchi Property is 305 acres and directly north of Strand Ranch within the Rosedale service area. The Schallberger Property is 188 acres located southeast of Strand Ranch, approximately five miles south of Bakersfield within the boundaries of the Kern Delta Water District.

Ability to Meet Project Objectives

Under the Recharge Basin Location Alternative, the project objectives are identical to those listed above in Section 6.1.2, but the objectives are applied to the alternative properties rather than Strand Ranch.

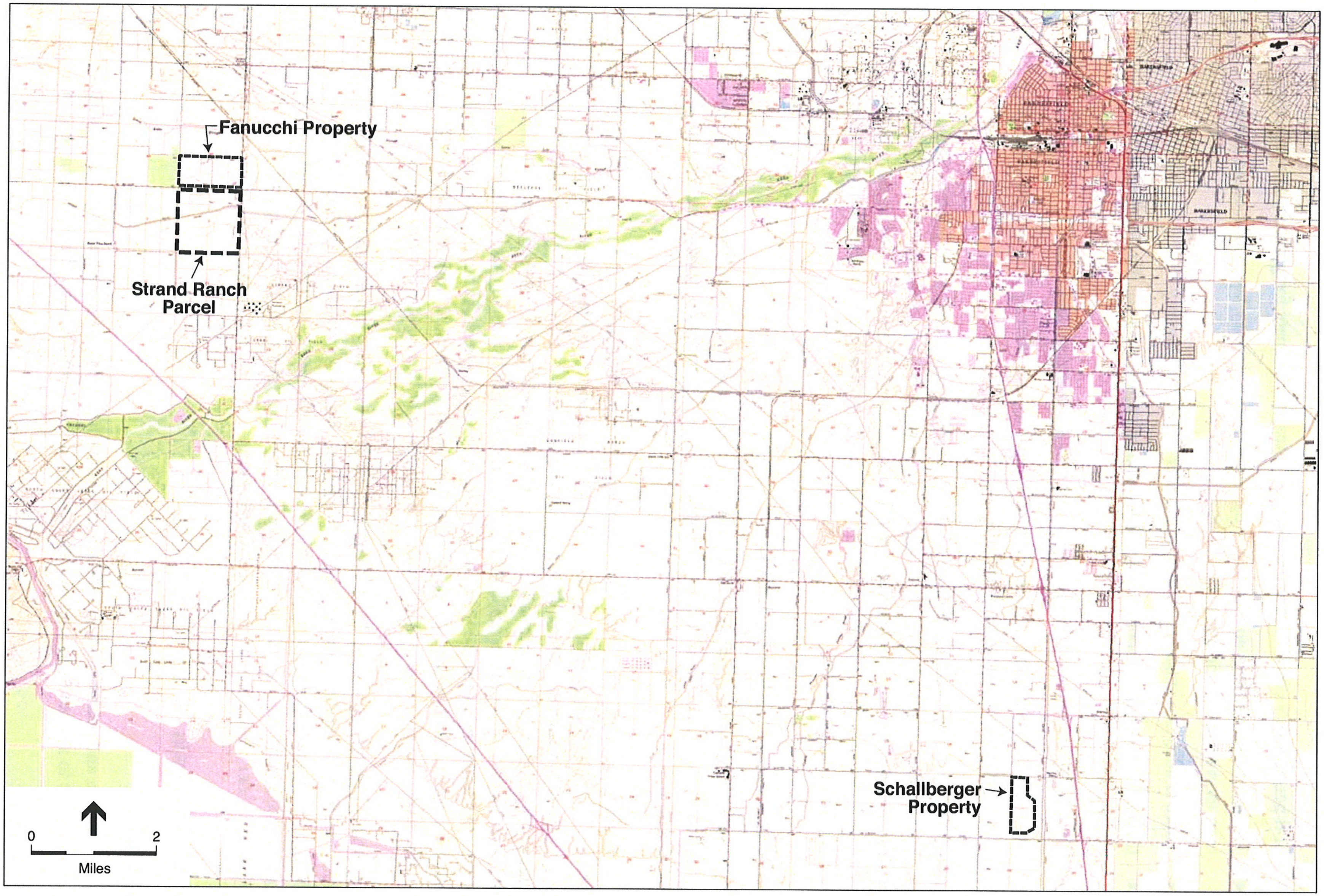
The Schallberger Property was eliminated from consideration because it did not meet all the project objectives. The Schallberger Property was too small to support a banking project capable of recharging enough water to provide IRWD customers with sufficient added dry-year water supply redundancy and reliability. In addition, the property was located within the boundaries of the Kern Delta Water District service area and could not be annexed into Rosedale. Also, preliminary geotechnical studies indicated the Schallberger Property had physical characteristics that would potentially impede effective percolation of groundwater due to perched water (WDS, 2007). As a result, the Schallberger Property is not evaluated further as an alternative project location.

The Fanucchi Property is already located within Rosedale's service area and therefore easily incorporated into Rosedale's Conjunctive Use Program. This property meets all the project objectives. Preliminary studies conducted by Western Development and Storage, Inc. (WDS) to evaluate the feasibility of implementing the proposed project on the Fanucchi property (WDS, 2003) identified constraints summarized below.

Impact Analysis

Aesthetics

The construction and operation of groundwater banking facilities on the Fanucchi property would result in impacts to aesthetics similar to those identified for Strand Ranch. The Fanucchi property



SOURCE: USGS; ESA, 2007.

Irvine Ranch Water District . 205426

Figure 6-1
Alternative Project Locations

is directly adjacent to the northern boundary of Strand Ranch. There are no designated scenic roadways or scenic vistas in the area. The Fanucchi property is currently used for agricultural production, and therefore converting the land to grass-covered recharge basins would not substantially alter the visual character of the landscape. There would be no nighttime lighting to affect nighttime views or introduce new sources of light or glare. The impact of the proposed alternative to aesthetics would be less than significant, similar to the proposed project.

Air Quality, Noise, Traffic

The construction and operation of groundwater banking facilities on the Fanucchi property would result in short-term environmental impacts to air quality, noise, and traffic, similar to those identified for the proposed project on Strand Ranch. Similar recharge basins and recovery wells would be constructed on the Fanucchi property. Impacts due to construction would be temporary and limited to the period of construction activity and therefore considered less than significant, similar to the proposed project.

Agricultural Resources

The Fanucchi property is classified as Prime Farmland and therefore impacts to agricultural resources would be similar to the proposed project. The recharge basins and berms constructed on site would be seeded with native grasses and used for grazing. The only portion of the property converted to non-agricultural use would be the recovery well pads and the dirt roadways. Therefore impacts due to farmland conversion would be less than significant. The Fanucchi property is not under Williamson Act contract.

Biological and Cultural Resource

The Fanucchi property is characterized by agricultural fields. The potential for special-status species to occur on and around the Fanucchi property are similar to those identified for Strand Ranch. The potential impacts to biological resources would be similar to those identified for Strand Ranch.

In addition, the Fanucchi property would have the same archeological and paleontological historical background and setting as the Strand Ranch property. No previously recorded historical resources or unique archaeological resources have been identified in the project area. The potential impacts of the proposed alternative on cultural resources would be similar to those for the proposed project.

Geology, Soils and Mineral Resources

The Fanucchi property is adjacent to Strand Ranch and therefore characterized by the same regional geologic setting and is likely to have soils with similar properties. The soils permeability at the proposed alternative site is estimated to support infiltration rates of up to 9,500 afy or 0.23 feet per day (WDS, 2003), which is adequate for a groundwater recharge project. The project alternative would be considered to have similar environmental impacts to the proposed project. Implementation of a SWPPP would be required, which would include BMPs and measures to control soil erosion and loss of topsoil. All facilities would be built in accordance with CBC seismic standards to reduce impacts due to strong ground shaking. In addition, similar to the proposed project, the project alternative would not be able to extract any groundwater beyond that which has been recharged into the groundwater table and therefore hydrocompaction and subsidence is not likely to occur.

Hazards and Hazardous Materials

The Fanucchi property is part of the same rural, agricultural region as Strand Ranch and is therefore subject to similar potential hazards due to past and current land uses. Agricultural uses can result in contamination from pesticides, herbicides, pathogens, and high levels of nitrates from fertilizers and animal waste. The preliminary feasibility study of the Fanucchi property identified potential sources of soil contamination that could hinder the use of the property for groundwater recharge. Similar to the proposed project, the project alternative would require a Phase II Environmental Site Assessment to identify hazardous waste and contaminated areas, and would require clean-up or avoidance of contaminated areas. The impact of hazardous materials to the proposed alternative would be similar to the proposed project.

Hydrology and Groundwater Resources

The Fanucchi property is adjacent to Strand Ranch and therefore is characterized by similar hydrological conditions and is part of the same groundwater basin. The preliminary feasibility study of the Fanucchi property determined there is a low probably of continuous lateral clay layers above the water table to confine the aquifer and prevent recharge. Therefore, the proposed alternative meets the screening criteria for an unconfined aquifer below the property. However, the property covers only 300 acres and is insufficient in size to achieve project objectives.

Land Use, Planning and Recreation

The impacts to land use and recreation for the proposed alternative would be similar to the proposed project. Existing land use at the Fanucchi property is characterized by agricultural production. The land use designations at the Fanucchi property is Intensive Agriculture, similar to the land use designation at Strand Ranch with half the property located within the Metropolitan Bakersfield sphere of influence and half the property located within unincorporated Kern County. A small portion of the southeast corner of the Fanucchi property is designated as Commercial, and the proposed alternative location is adjacent to land designated as Industrial to the north. The recreational resources in the vicinity of the Fanucchi property are similar to the proposed project. The Intensive Agriculture land use designation is compatible with groundwater banking projects. The Commercial land use designation does not include groundwater banking projects as a compatible use, and therefore, the proposed alternative could require a conditional use permit or general plan amendment to change the land use classification. A general plan amendment would be required to eliminate the mid-section lines from the Fanucchi property, similar to the proposed project.

Utilities and Public Services

The impacts to utilities and public services for the proposed alternative would be similar to the proposed project. Implementing the proposed alternative would require IRWD to secure additional water entitlements for proposed recharge activities. Obtaining these entitlements may require additional environmental evaluation depending on their source. No water would be available to the proposed alternative without approval from the SWRCB or DWR. Once entitlements for water supplies are obtained, no adverse impacts to the water supply utilities would occur. The proposed alternative would not have direct impacts on other public utilities, such as wastewater and solid waste systems, and would not result in the need for additional public services, such as schools and police and fire protection.

6.2.3 Injection Well Alternative

Under the Injection Well Alternative, Rosedale and IRWD would construct injection wells on Strand Ranch to inject water into the groundwater basin rather than construct recharge basins on the surface. This proposed alternative would require approximately 15 to 20 injection wells to provide the equivalent recharge of the proposed recharge basins. This proposed alternative would include construction of large water storage facilities on site at Strand Ranch to hold water for injection. The other components of the project, including conveyance and extraction facilities, would be similar to the proposed project.

Ability to Meet Project Objectives

The Injection Well Alternative would meet all of the project objectives. This proposed alternative would allow Strand Ranch to be annexed into Rosedale and would implement a groundwater banking program in the Kern Fan region that would augment Rosedale's existing Conjunctive Use Program. This proposed alternative would allow IRWD to store water during wet years for recovery during dry years to provide its customers with increased water supply reliability.

Impact Analysis

The Injection Well Alternative would result in additional environmental impacts relative to the proposed project, as described below. In addition the Injection Well Alternative would require greater financial investment in construction, operation, and maintenance of above-ground water storage facilities.

Aesthetics

The Injection Well Alternative would require construction and operation of large above-ground storage tanks on Strand Ranch that would serve as holding facilities for injection water. Although there are no designated scenic roadways or scenic vistas in the area, converting existing farmland to storage tanks, rather than low-lying grass-covered recharge basins, would result in a substantial change in the local viewsheds and visual character of the area around Strand Ranch. The effect of the proposed alternative on aesthetics would be greater than the effect of the proposed project.

Air Quality, Noise, Traffic

The Injection Well Alternative would include construction and operation of injection wells, storage tanks, and recovery wells and conveyance facilities on Strand Ranch. Construction of these facilities would result in short-term environmental impacts to air quality, noise, and traffic, similar to those identified for the proposed project on Strand Ranch. Impacts due to construction would be temporary and limited to the period of construction activity and therefore considered less than significant. Operation of the injection well facilities would not result in additional impacts to air quality, noise, or traffic.

Agricultural Resources

The Injection Well Alternative would result in the conversion of Prime and Unique Farmland to injection wells and storage tanks instead of grass-covered recharge basins. The portion of Strand Ranch occupied by the injection wells and storage tanks would constitute a conversion of farmland to a non-agricultural use. This farmland conversion could potentially be considered a significant impact, depending on the total acreage as a percentage of Strand Ranch. In addition, Strand Ranch is under Williamson Act contract. Kern County's *Agricultural Preserve Standard Uniform Rules* determine the permissible compatible uses on lands under Williamson Act contract in the county. Similar to the proposed project, in order for this proposed alternative to comply with the Williamson Act, the land must be used for agriculture (e.g., crop cultivation or grazing) for a minimum of eight months each year. It is possible the footprint of the storage tanks would be large enough to preclude the majority of Strand Ranch from being used for agriculture. This would cause a conflict with the Williamson Act contract. In general, the Injection Well Alternative could result in greater impacts to agricultural resources when compared to the proposed project.

Biological and Cultural Resource

The Injection Well Alternative would develop groundwater banking facilities on Strand Ranch. The potential for special-status species to occur on and around the project site are similar to those identified for the proposed project. The wetlands identified on Strand Ranch are not jurisdictional wetlands due to the lack of a jurisdictional water source. The potential impacts to biological resources would be similar to those identified for Strand Ranch.

In addition, the Injection Well Alternative would have the same impact to archeological and paleontological resources as the proposed project. No previously recorded historical resources or unique archaeological resources have been identified in the project area.

Geology, Soils and Mineral Resources

The Injection Well Alternative would have similar environmental impacts to the proposed project due to geology, soils and mineral resources. During construction of the proposed alternative, implementation of a SWPPP would be required, which would include BMPs and measures to control soil erosion and loss of topsoil. All facilities would be built in accordance with CBC seismic standards to reduce impacts due to strong ground shaking. In addition, similar to the proposed project, the project alternative would not be able to extract any groundwater beyond that which has been recharged into the groundwater table and therefore hydro-compaction and subsidence is not likely to occur.

Hazards and Hazardous Materials

The Injection Well Alternative would be subject to the same potential hazards as the proposed project, due to past and current land uses at Strand Ranch. Agricultural uses can result in soil and groundwater contamination from pesticides, herbicides, pathogens, and high levels of nitrates from fertilizers and animal waste. The proposed alternative would reduce the potential for surface soil contamination to be transferred to the underlying groundwater basin due to the use of deep injection wells instead of shallow surface recharge basins. The potential impacts to groundwater quality due to hazardous materials could be reduced with implementation of the Injection Well Alternative.

Hydrology, Groundwater Resources and Water Quality

The Injection Well Alternative would implement a groundwater banking project on Strand Ranch to store water in the underlying basin during wet years and recover water during dry years, similar to the proposed project. The proposed alternative would result in an increase in the amount of impermeable surfaces at Strand Ranch due to the construction of storage tanks. This would result in a slight increase in surface runoff.

The Injection Well Alternative would have a potentially significant adverse impact on water quality. In the project area, the shallow aquifer is of lesser quality and the deep aquifer is of better quality. In order to have sufficient injection capacity the wells would need to be completed across the entire thickness of the aquifer, i.e., across the shallow and deep aquifer zones. Higher TDS-content surface waters would potentially be injected into lower TDS-content aquifer waters causing a water quality degradation to the high-quality deep zone of the aquifer. The alternative would therefore have a greater impact on groundwater quality relative to the proposed project.

Land Use, Planning and Recreation

The impacts to land use and recreation for the Injection Well Alternative would be similar to the proposed project. The land use designation at Strand Ranch is Intensive Agriculture, which allows groundwater recharge projects as a compatible use. Construction and operation of the proposed alternative would be confined to Strand Ranch, similar to the proposed project, and thus would not result in additional impacts to recreational resources in project vicinity.

Utilities and Public Services

The impacts to utilities and public services for the Injection Well Alternative would be similar to the proposed project. Implementing the proposed alternative would require IRWD to secure additional water entitlements for injection activities. Obtaining these entitlements may require additional environmental evaluation depending on their source. No water would be available to the proposed alternative without approval from the SWRCB or DWR. Once entitlements for water supplies are obtained, no adverse impacts to the water supply utilities would occur. The proposed alternative would not have direct impacts on other public utilities, such as wastewater and solid waste systems, and would not result in the need for additional public services, such as schools and police and fire protection.

6.3 Summary of Alternatives Analysis

A summary of the alternatives analysis is provided in **Table 6-1**, which provides a comparison of the proposed project to each alternative with respect to project objectives and project impacts. The alternatives evaluated in this EIR present a tradeoff between achieving project objectives and impacting the environment. The No Project Alternative would avoid all the environmental impacts of the proposed project but would not meet any of the project objectives. The Recharge Basin Location Alternative and the Injection Well Alternative would meet all of the project objectives but could result in additional impacts to the environment.

TABLE 6-1
SUMMARY OF ALTERNATIVES ANALYSIS

Issue Area	Proposed Project	No Project Alternative	Recharge Basin Location Alternative	Injection Well Alternative
Meets Project Objectives?	Yes	No	Yes	Yes
Environmental Impacts				
Aesthetics	LTS	None	Similar	Increased
Agricultural Resources	LTS	None	Similar	Increased
Air Quality	LSM	None	Similar	Similar
Biological Resources	LSM	None	Similar	Similar
Cultural Resources	LSM	None	Similar	Similar
Geology, Soils and Mineral Resources	LSM	None	Similar	Similar
Hazards and Hazardous Materials	LSM	None	Similar	Reduced
Hydrology, Groundwater Resources and Water Quality	LSM	None	Increased	Increased
Land Use, Planning and Recreation	LSM	None	Increased	Similar
Noise	LSM	None	Similar	Similar
Transportation and Traffic	LSM	None	Similar	Similar
Utilities and Public Services	LTS	None	Similar	Similar

SOURCE: ESA 2007.

LTS = less than significant
LSM = less than significant with mitigation

The proposed project and the Recharge Basin Location Alternative would have most of the same environmental impacts because the Fanucchi property is directly adjacent to Strand Ranch and thus has similar physical characteristics. The Recharge Basin Location Alternative could result in an increase in the environmental impacts to water quality and land use. The Recharge Basin

Location Alternative meets the project objectives but does not meet all the screening criteria for the ideal project location.

The Injection Well Alternative meets all the project objectives but would result in an increase in the potential environmental impacts to aesthetics due to the presence of storage tanks on Strand Ranch, agricultural resources due to farmland conversion to non-agricultural use, and surface hydrology due to conversion of farmland to impervious surfaces that would contribute to surface runoff.

6.4 Environmentally Superior Alternative

CEQA requires that an EIR identify the environmentally superior alternative of a project other than the No Project Alternative. Since the proposed project would be compatible with agricultural land uses and benefit the groundwater basin through water recharge, the proposed project is considered the environmentally superior alternative. Construction impacts would be short term and would not result in substantial new development on the site. The relatively low-impact land use would not substantially increase impacts to plants and wildlife that currently use the agricultural site. Some wildlife may benefit from the low-intensity use. Given the potential additional environmental impacts associated with the Recharge Basin Location Alternative and the Injection Well Alternative summarized in Table 6-1, the proposed project is considered the environmentally-superior alternative.

6.5 Alternatives Not Evaluated in This EIR

6.5.1 Orange County Storage

This section identifies other project alternatives that were considered but rejected from further consideration. Water storage facilities could be constructed within Orange County to provide water supply reliability during dry years. IRWD could develop an in-county storage program either by (a) partnering with Orange County Water District (OCWD) to develop a banking program to store water in the Orange County Groundwater Basin or (b) constructing surface storage facilities.

OCWD has approved a groundwater banking project with Metropolitan, which is IRWD contractor for SWP water. OCWD is not partnering with individual retail water agencies to develop groundwater banking programs at this time. Therefore, a groundwater banking program within Orange County is not feasible.

IRWD could construct surface storage facilities within its service area, such as reservoirs and tanks, to store water during wet years for use during dry years and multiple-drought years. Implementing an in-county surface storage program would require IRWD to purchase a substantial amount of land that could accommodate enough storage reservoirs and tanks with a combined maximum capacity of 50,000 af. Environmental impacts associated with constructing a surface reservoir would likely be significant. In order to store a cumulative volume of water equivalent to the proposed project, the land acquisition required and implementation process is cost prohibitive for IRWD at this time.

6.5.2 Conservation

IRWD manages a water conservation program to reduce water demand in its service area. IRWD is a signatory to the Memorandum of Understanding Regarding Water Conservation in California (MOU) (August 1991). The MOU requires IRWD to implement a prescribed set of urban water conservation Best Management Practices (BMPs) (IRWD, 2005). The BMPs are intended to reduce long-term urban water demand. IRWD's conservation program includes the following elements:

- A five-tiered rate structure, based on water budget allocations, that encourages conservation;
- Enforcement of the California Plumbing Code that requires low-flow fixtures in new or remodeled homes;
- Enforcement of ordinances that require efficient landscape irrigation systems;
- Free distribution and/or installation of water-saving devices (e.g., low-flow showerheads);
- Free distribution of IRWD's Lawn Watering Guide;
- A free home water audit program;
- A public education program that focuses on encouraging voluntary water conservation measures; and
- Incentive pricing that makes recycled water less expensive than potable water.

As an alternative to the proposed project, IRWD could augment its existing conservation program with a goal to further reduce water demand in its service area during periods of drought to free up 17,500 af of water per year. However, IRWD has determined that conservation alone could not achieve the objective of 17,500 afy during drought years. Conservation efforts combined with drought reliability supplies provided by the proposed project provide the most effective and diverse water supply alternative. Therefore, conservation by itself was not considered feasible to achieve the project objectives.

6.5.3 Recycled Water

IRWD has an extensive water recycling program, which began in 1967, with infrastructure that produces and delivers approximately 15,000 af of recycled water each year (IRWD, 2005). Recycled water is used for agricultural and nonagricultural irrigation and other non-potable uses, such as interior flushing in nearly 37 dual plumbed buildings. Currently, recycled water is used for 95 percent of all irrigation in IRWD's service area and meets over 20 percent of IRWD's total water resource demand (IRWD, 2005). IRWD has a dual distribution system that delivers recycled water from the Michelson Water Reclamation Plant (MWRP) (secondary treatment) and the Los Alisos Water Reclamation Plant (LAWRP) (tertiary treatment) to non-potable end users (IRWD, 2005). Recycled water that is produced during winter months, when irrigation demand is typically low, is delivered to storage reservoirs for later use during dry months.

The quality of recycled water effluent used for landscape irrigation and agriculture complies with Title 22, Division 4 of the California Administrative Code, Department of Public Health (formerly Department of Health Services). The MWRP has permitted treatment capacity of 18 mgd and LAWRP has permitted capacity of 7.5 mgd for secondary treatment and 5.5 mgd for tertiary treatment. IRWD plans to expand the capacity of the MWRP in phases to 33 mgd as population grows and wastewater effluent volumes increase (IRWD, 2005)

Recycled water production is considered "drought-proof" because sewage flow typically remains constant even during dry years (IRWD, 2005). Currently, recycled water is not widely used to meet potable water demand, however. Additional recycled water programs could not be implemented as an alternative to the proposed project because IRWD has already extensively used recycled water to reduce potable demands that can be served with recycled water and needs potable water supply reliability. Therefore, recycled water was not considered as a feasible project alternative.

CHAPTER 7
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CHAPTER 8
Report Preparers

8.1 Project Sponsor / Lead Agency

Rosedale-Rio Bravo Water Storage District

849 Allen Road
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Irvine Ranch Water District

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Paul Weghorst, Principal Water Resources Manager
Kellie Welch, Water Resources Planner

8.2 EIR Authors and Consultants

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CHAPTER 9
Introduction to Response to Comments

This Chapter 9 and the following chapters (Chapters 10, 11, and 12) have been added to the Environmental Impact Report (EIR) (State Clearinghouse No. 2007041080) and together with the revised Draft EIR constitute the Final EIR prepared by the Rosedale Rio-Bravo Water Storage District (Rosedale) in consultation with the Irvine Ranch Water District (IRWD) for the Strand Ranch Integrated Water Banking Project (project).

Before Rosedale may approve the project, it must certify that the Final EIR: a) has been completed in compliance with CEQA; b) was presented to the Rosedale Board of Directors who reviewed and considered it prior to approving the project; and c) reflects Rosedale's independent judgment and analysis.

CEQA Guidelines specify that the Final EIR shall consist of the following:

- the Draft EIR or a revision of that draft;
- comments and recommendations received on the Draft EIR;
- a list of persons, organizations, and public agencies commenting on the Draft EIR;
- the response of the Lead Agency to significant environmental points raised in the review and consultation process; and
- any other information added by the Lead Agency.

This Final EIR for the Strand Ranch Integrated Water Banking Project presents:

- A list of persons, organizations, and public agencies commenting on the Draft EIR;
- The written comments received on the Draft EIR along with a response to each comment;
- A compilation of revisions to the text of the Draft EIR.

Comments on the Draft EIR and Responses to Comments

The Draft EIR was circulated for public review from January 24, 2008 through March 10, 2008. During this period, Rosedale held a public meeting to provide interested persons with an opportunity to comment orally or in writing on the Draft EIR and the project. The public meeting was held at the Kern County Water Agency offices in Bakersfield on February 20, 2008. No comments were offered from the audience during the public meeting.

Table 9-1 lists the agencies that submitted written comments on the Draft EIR during the public review and comment period. Comment letters are included in Chapter 10. Responses are included in Chapter 11. A compilation of the revisions made to the Draft EIR is included in Chapter 12. The responses to comments are numbered to correspond to the comment numbers that appear in the margins of the comment letters.

TABLE 9-1
PERSONS, ORGANIZATIONS, AND PUBLIC AGENCIES COMMENTING IN WRITING

Commenter No.	Comments Received From	Date
1	California Department of Conservation	March 6, 2008
2	Kern County Water Agency	March 10, 2008
3	Kern Water Bank Authority	March 10, 2008
4	Arvin-Edison Water Storage District	March 10, 2008

Corrections and Additions to the Draft EIR

Revisions to the Draft EIR (Chapter 12) were developed in response to comments received during the public review period. The revisions appear as indented text in the responses. This Final EIR is a reprinted version of the Draft EIR that includes the revisions. Where the responses indicate additions or deletions to the text of the EIR, additions are indicated in underline, deletions in ~~strikeouts~~.

Public Participation Process

Two public scoping meetings were held on April 24, 2007 at the IRWD office and May 8, 2007 at the Rosedale office. A public meeting concerning the Draft EIR was held on February 20, 2008. During these meetings and presentations, information about the project was presented. At each meeting/hearing, members of the public had the opportunity to ask questions and express their concerns and interests over the environmental review of the proposed project. The Notice of Preparation and the Notice of Availability of an EIR were posted with the County clerks in both Kern County and Orange County as well as the State Clearinghouse. The documents were also distributed to affected public agencies, community groups, and other interested parties.

CHAPTER 10
Comments Received on the Draft EIR

This chapter contains the comment letters received during the public review period for the Draft EIR. The letters have been bracketed and numbered and are presented in the order listed in Table 9-1. The responses to comments are numbered to correspond to the comment numbers that appear in the margins of the comment letters.

ARNOLD SCHWARZENEGGER, GOVERNOR

DEPARTMENT OF CONSERVATION

DIVISION OF LAND RESOURCE PROTECTION

801 K STREET • MS 18-01 • SACRAMENTO, CALIFORNIA 95814

PHONE 916 / 324-0850 • FAX 916 / 327-3430 • TDD 916 / 324-2555 • WEBSITE conservation.ca.gov

March 6, 2008

Mr. Hal Crossley
Rosedale-Rio Bravo Water Storage District
849 Allen Road
PO Box 867
Bakersfield, CA 93302

Subject: Strand Ranch Integrated Banking Project Draft Environmental Impact Report (Kern County)
SCH# 2007041080

Dear Mr. Crossley:

The Department of Conservation's (Department) Division of Land Resource Protection (Division) has reviewed the Draft Environmental Impact Report (DEIR) for the referenced project. The Division monitors farmland conversion on a statewide basis and administers the California Land Conservation (Williamson) Act and other agricultural land conservation programs. We offer the following comments and recommendations with respect to the project's impacts on agricultural land and resources.

Project Description

The purpose of the Strand Ranch Integrated Banking project is to develop groundwater banking facilities on the Strand Ranch for use by the Rosedale and Rio Bravo Water Districts. Strand Ranch is located in unincorporated Kern County (County) approximately six miles west of the City of Bakersfield. Strand Ranch is zoned as Exclusive Agriculture, which includes groundwater recharge facilities as a permitted use (County Zoning Ordinance, Section 19.12.020 (F)). The entire Strand Ranch is within a County-designated agricultural preserve and considered Prime Agricultural Land under an existing Williamson Act contract. The proposed project would convert 502 acres of existing farmland to recharge facilities that would be made available for organic farming or livestock grazing for a minimum of eight months per year. An additional 36 acres of farmland in the project area would convert existing farmland to non-agricultural use to support the recharge facilities.

The DEIR has determined that the project is compatible under the Williamson Act and would have a less than significant impact on agricultural resources. The County's *Agricultural Preserve Standard Uniform Rules* states that groundwater recharge operations are compatible land uses on agricultural preserves if the preserve is used for commercial agriculture for at least eight months out of a twelve month period (Kern County Planning Department, 2007). Organic farming and livestock grazing are considered compatible agricultural uses. Therefore, the proposed project would be considered compatible with the existing Williamson Act contract for the Strand Ranch. As such, the Department has no comment on this project.

Thank you for giving us the opportunity to comment on this DEIR. If you have questions regarding our comments, or require technical assistance or information on agricultural land conservation please contact Elliott Lum, Environmental Planner, at 801 K Street, MS 18-01, Sacramento, California 95814; or, phone (916) 324-0869.

DOC-1

Sincerely,

Brian Leahy

Brian Leahy
Assistant Director

cc: State Clearinghouse

(661) 634-1400
Mailing Address
P.O. Box 58
Bakersfield, CA 93302-0058
Street Address
3200 Rio Mirada Dr.
Bakersfield, CA 93308

March 10, 2008

VIA HAND DELIVERY & U.S. MAIL

Hal Crossley, General Manager
Rosedale Rio-Bravo Water Storage District
849 Allen Road
P.O. Box 867
Bakersfield, CA 93302-0867

RE: Comments on the Draft Environmental Impact Report for the Strand Ranch Integrated Banking Project, dated January 2008 (SCH# 2007041080)

Dear Mr. Crossley:

The Kern County Water Agency (Agency) has reviewed the Draft Environmental Impact Report for the Strand Ranch Integrated Banking Project (DEIR) regarding water supply, groundwater levels and quality and proximity to Agency-owned and/or Agency-operated facilities. The Agency appreciates the opportunity to assist Rosedale-Rio Bravo Water Storage District (Rosedale) and Irvine Ranch Water District (Irvine Ranch) to move forward with the proposed Strand Ranch Integrated Banking Project (Project) and has the following comments.

As described in the DEIR, the Project proposes to annex the Strand Ranch into Rosedale's service area and integrate the operations of the Project into Rosedale's existing Groundwater Storage, Banking, Exchange, Extraction & Conjunctive Use Program (Program). However, the DEIR does not adequately describe the rights and obligations of either Irvine Ranch or Rosedale with respect to the Project. For example, it is unclear from the DEIR exactly how Rosedale will utilize its capacity in the Project to meet its existing obligations for the Program. It is also unclear where Rosedale will recover water previously recharged on the Project. Further, the DEIR does not state whether the Memorandum of Understanding (MOU) for the Program, provided as Appendix E to the DEIR, will be amended to reflect the integration of the Project into the Program. If, as stated in the DEIR, the Project will be incorporated into the Program, the MOU must be amended to reflect this integration to cover the operations of the Project and its potential impacts to adjoining entities. All of this information is necessary to adequately analyze the potential environmental impacts of the Project, and the DEIR does not meet the standards under the California Environmental Quality Act and should not be used as a basis to approve the Project. The DEIR must be amended and recirculated. KCWA-A

Below are additional specific comments regarding the DEIR:

1. Page 2-5: The DEIR states: KCWA-1

   The proposed project would be subject to and would be consistent with the conditions of the MOU.

The DEIR should be revised to clearly define how the Project will be incorporated into the Program. KCWA-1 (Cont.)

2. Page 2-6. The DEIR states:

> *Facilities would be constructed to recharge and recover up to 17,500 acre-feet per year (afy) for IRWD [Irvine Ranch].*

KCWA-2

This is not consistent with text on page 2-17, which clearly states that all recovery from these wells by Irvine Ranch and Rosedale is limited to 17,500 acre-feet. The DEIR should be revised to accurately and consistently describe the recovery capacity for the Project wells.

3. Page 2-9. The DEIR states that Irvine Ranch may purchase excess water through a State Water Project (SWP) contractor for delivery to Strand Ranch. However, the DEIR does not analyze the availability of such water supplies, does not identify potential restrictions that would be placed on such water supplies by the California Department of Water Resources (DWR), nor does it analyze potential impacts to local water districts resulting from less SWP water available for their use. The DEIR should be revised to describe how Irvine Ranch will avoid impacts to other SWP contractors or local districts. KCWA-3

4. Page 2-9. The DEIR states that Section 215 flood water could be delivered to Strand Ranch from the Friant-Kern Canal through the Cross Valley Canal (CVC). However, the DEIR does not analyze the availability of such water nor does it identify potential impacts to local districts that may have to compete with Rosedale for Section 215 flood water. To fully analyze the potential impacts from the Project, the DEIR must analyze potential impacts to local districts if Rosedale and Irvine Ranch utilize the Project to capture and store Section 215 flood water. KCWA-4

5. Page 2-18. The DEIR lists agencies that Rosedale and Irvine Ranch will need approvals from for the Project. In addition to approval for use, modifications required to the CVC, Rosedale and Irvine Ranch will need approval from the Agency for a point-of-delivery agreement among DWR, the Agency and other SWP contractors. Finally, an operations agreement will be needed for the CVC (see comment No. 13 below). KCWA-5

6. Page 3.6-4. The DEIR mentions the 2001 Building Code as it pertains to seismic hazards. This code is outdated. Therefore, the DEIR should state the Project shall adhere to the new 2007 Building Code which has been adopted by the County of Kern. The DEIR should also be revised to incorporate any changes from the 2007 Building Code. KCWA-6

7. Page 3.6-5. The DEIR discusses liquefaction and states that saturated soils lose cohesion and can be converted to a fluid state as a result of vibration and that structures such as levees, roads and pipelines may be damaged. Canals and pumping facilities may also be damaged. Proper monitoring and mitigation must be in place prior to Project operations as outlined in comment No. 13 below. KCWA-7

8. Page 3.6-6. The DEIR states that the Kern County Fire Department concludes that this area is not within a known shallow groundwater area and not susceptible to liquefaction. The DEIR also states that during years of recharge, banking operations may affect groundwater levels and that the groundwater table could be shallow enough for liquefaction to occur from seismic activity. However, the DEIR also states that groundwater levels were shallow in both 1999 and 2006. Incorporation of the mitigation measure described in comment No. 13 below could help in mitigating this potential impact. KCWA-8

9. Page 3.6-14. The DEIR states that subsidence impacts of the Project would be less than significant. However, on Page 3.6-7 the DEIR states the area of the Project site has experienced subsidence before. The DEIR states that no mitigation is needed for subsidence impacts because there is no confining layer below the Project site and that the Project would not extract any groundwater beyond that which has been recharged. The DEIR does not cite any evidence for this proposition and no on-site investigations have been provided to determine either the existence or lack of a confining layer under the Project site. If subsidence has occurred in the past as stated on Page 3.6-7 of the DEIR, then further exploration of the Property is warranted and proper monitoring must be put into place. KCWA-9

10. Pages 3.7-1 and 3.7-2. The DEIR discusses the storage and use of petroleum fuels, fertilizers and pesticides on the Project site. However, the DEIR does not include any investigation to determine concentrations and areas of contamination and depth of migration of these products. Nor does the DEIR contain any analysis of the potential for migration of these products due to recharge activities. The DEIR must contain such an investigation to determine if mitigation is necessary to avoid water quality impacts from the Project. KCWA-10

11. Page 3.8-5. The DEIR contains Table 3.8-1 which shows surface water quality for winter dry season averages for the three regional surface water sources. Table 3.8-1 lists values for the California Aqueduct based on Check 29 near Taft Highway and data from the Agency's Henry C. Garnett Water Purification Plant. Based on the data shown and the associated technical appendix, it appears the data are skewed by well water delivered to the California Aqueduct or the Agency's Henry C. Garnett Water Purification Plant. Data from upstream of the pump-in programs should be referenced to demonstrate the true water quality of the three regional sources. Such data will generally show higher Total Dissolved Solids and lower Arsenic which will be important when comparing the well water from the wells on the Project site to the regional surface water. Also, the Maximum Concentration Limit (MCL) for Arsenic as listed in Table 3.8-1 is incorrect. Table 3.8-1 shows 50 ug/L and the limit is 10 ug/L. KCWA-11

12. Pages 3.8-12 and 3.8-13. The DEIR contains Table 3.8-2 which shows water quality for wells located on the Project site sampled in 2003 and 2005. Several constituents measured are above MCL and some known constituents of concern in the area were not listed, such as Nitrate and Dibromo Chloropropane. In order to understand the water quality impacts from the Project, a full Title 22 of the California Code of Regulations analysis is required. Wells that do not meet the Title 22 requirements cannot be connected to either the CVC or the California Aqueduct unless they can be blended with other Project wells to meet the standards. The Agency recommends that KCWA-12

additional analyses be provided and monitoring wells be drilled to better characterize the groundwater quality of the Project and any potential mitigation measures that may be required. KCWA-12 C

13. Page 3.8-25. The DEIR states that underground structures such as support structures of the CVC could be damaged by upward pressure caused by rising groundwater. However, the DEIR concludes that impact from the Project would be less than significant by implementing Mitigation Measure 3.8-1. Mitigation Measure 3.8-1 states:

> *IRWD* [Irvine Ranch] *and Rosedale will install and monitor piezometers adjacent to the CVC within the Strand Ranch property. When groundwater approaches 12 feet bgs* [below ground surface] *beneath the CVC, IRWD and Rosedale will consult with geotechnical engineers to determine if conditions might pose a risk to subsurface structures if further recharge operations were to continue. Under such conditions, piezometer data collected on the Strand Ranch as well as information from the geotechnical engineers will be shared with KCWA* [Agency]. *If subsurface structures are determined to be at risk from high groundwater, IRWD and Rosedale will temporarily cease recharge activities until water surface elevations no longer pose a risk to subsurface structures.*

KCWA-1

Although the majority of the canal portion of the CVC that crosses Strand Ranch is above ground surface, other parts of the CVC at the western edge of the property are not. For example, the forebay for Pumping Plant 2 of the CVC is located on the western edge of the Strand Ranch property boundary, and its invert elevation is 19 feet below ground surface. Mitigation Measure 3.8-1 will not adequately protect the CVC from damage caused by the Project. Rosedale and Irvine Ranch must enter into an agreement with the Agency for a monitoring and operations plan to ensure that Project operations will not impact CVC facilities. Such a plan will include the installation of monitoring wells and recovery wells to evacuate water that is in close proximity to CVC facilities.

14. Pages 3.8-28 and 3.8-29; Impact 3.8-6. The DEIR states:

> *The quality of water extracted from the Strand Ranch could exceed thresholds imposed by the conveyance facilities. Less than Significant with Mitigation.*

The DEIR should clearly state that water pumped into the CVC or California Aqueduct must meet drinking water standards and must comply with the DWR Pump-in Guidelines. As noted above, several of the wells contain constituents that do not meet those standards. Therefore, as required by the DWR Pump-in Guidelines, it may be necessary to mitigate those wells by treating or blending water that is pumped. Additionally, it may be necessary to terminate operation of the wells when treatment or blending is not an option. The Project impacts cannot be deemed *Less than Significant* unless the Project complies with these requirements. KCWA-1

15. Appendix E of the DEIR is a copy of the MOU and is referenced on page 2-5. The MOU states on pages 3 and 4 that: KCWA-1

Any major modifications of the facilities and/or significant changes from that described in Exhibit B and in the environmental documentation for the Project will be subject to additional environmental review pursuant to CEQA and will be subject to review of the Monitoring Committee prior to implementation.

The DEIR states on page 2-6 that the DEIR satisfies the CEQA requirements as indicated in the MOU. However, the DEIR neither defines the process that will be used by the Monitoring Committee to review the Project prior to implementation nor evaluates any impacts from integration of the Project into the Program. **KCWA-15 (Cont.)**

16. Notice of Preparation. During the Notice of Preparation of an Environmental Impact Report scoping meeting held in April 2007, the Agency requested that Rosedale look at the rate at which Rosedale is urbanizing. The conversion of agricultural land to urban uses within Rosedale may affect Rosedale's ability to maintain a positive water balance. The DEIR does not address this issue and, therefore, does not analyze the full environmental impacts associated with the Project. For example, as shown in Table 5-6, conversion of idle agricultural land to urban uses will increase the overall consumptive use within Rosedale, reducing Rosedale's water balance. One component of the Project is to capture and store high flow Kern River water (see pages 2-9 and 2-10) with a portion of the water being provided to Irvine Ranch. If Rosedale is unable to maintain a positive water balance, its ability to provide this water to Irvine Ranch as part of the Project may be impacted. **KCWA-16**

17. Tumbleweed Control. The DEIR does not provide any information on how weeds will be controlled subsequent to recharge basin construction. Tumbleweeds proliferate after major ground disturbing activities and can inhibit recharge activities on banking projects and operations of the CVC. **KCWA-17**

The Agency appreciates the opportunity to assist Rosedale and Irvine Ranch to move forward with the proposed Strand Ranch Integrated Banking Project. If you have any questions, please call Curtis Creel of my staff at (661) 634-1414.

Sincerely,

James M. Beck
General Manager

cc: Jon Parker, Kern Water Bank Authority

KERN WATER BANK AUTHORITY

March 10, 2008

Via U.S. Mail and Hand Delivery

Rosedale – Rio Bravo Water Storage District
Attn: Hal Crossley, General Manager
849 Allen Road
P.O. Box 867
Bakersfield, CA 93302

Re: Strand Ranch Integrated Banking Project, Draft Environmental Impact Report, dated January 2008, State Clearinghouse No. 2007041080 ("DEIR")

Dear Mr. Crossley:

Kern Water Bank Authority appreciates the opportunity to comment on the above-referenced DEIR. These comments are provided on behalf of the Kern Water Bank Authority and its member entities, namely Dudley Ridge Water District, Kern County Water Agency - Improvement District No. 4, Semitropic Water Storage District, Tejon-Castac Water District, Westside Mutual Water Company and Wheeler Ridge-Maricopa Water Storage District (hereinafter referred to collectively as "KWBA").[1]

As you have been previously advised, KWBA is a California joint powers authority formed and existing pursuant to Government Code section 6500 et seq. KWBA is, and for several years has been, the owner of about 20,000 acres of land in Kern County, California, known as the "Kern Water Bank." KWBA owns and operates the Kern Water Bank for the purpose of, among other things, groundwater recharge, storage and extraction. The Kern Water Bank is immediately adjacent to the approximately 611 acres of land, which is known as Strand Ranch and is the centerpiece of the proposed Strand Ranch Integrated Banking Project evaluated in the DEIR (hereinafter, the "Project"), prepared by Rosedale-Rio Bravo Water Storage District as lead agency ("Rosedale" or "RRWSD") in consultation with Irvine Ranch Water District as responsible agency ("Irvine Ranch" or "IRWD").

As KWBA has stated in the past regarding similar proposed projects, KWBA is concerned with significant adverse environmental impacts of the proposed Project on the Kern Water Bank and its operations including, but not limited to, the degradation of groundwater levels and quality in the vicinity of the Kern Water Bank lands. Most of the following comments reflect KWBA-A

[1] We understand that the Kern County Water Agency ("KCWA") will be submitting comments and individual members of KWBA may also be submitting separate comments on the DEIR. KWBA joins in and incorporates herein by this reference the comments submitted by KCWA and individual members of KWBA.

this general concern, although some of the comments simply seek clarification of various components of the Project. However, for the reasons set forth below, of particular concern to the KWBA is the potentially significant water level impacts of the proposed Project on nearby KWBA wells and thereby Kern Water Bank operations. We are also very concerned with the DEIR's reliance on documentation which appears to have been subsequently repudiated or contradicted by key representatives of the Project proponent, Rosedale, in their recent communications that set forth contentions relating to Kern Water Bank operations. KWBA-A (Cont.)

KWBA believes that the DEIR is inadequate under CEQA[2] for various reasons, including, but not necessarily limited to, the reasons set forth herein.

I. The DEIR does not adequately describe Rosedale's 2001 Conjunctive Use Program, the so-called Final Master EIR for that Program, or the impacts of the Program as augmented by the subject Project

The DEIR indicates that Rosedale developed a Groundwater Storage, Banking, Exchange, Extraction and Conjunctive Use Program ("Program"), and, in July, 2001, certified a "Final Master EIR" ("Master EIR") covering the Program (e.g., DEIR, p. 1-5). The DEIR also indicates that the proposed Project will be "integrated" into Rosedale's Program (DEIR, p. 2-6).

First, the Program provided for in the Master EIR is limited to a maximum of 100,000 acre-feet ("AF")/year ("yr") of recharge and 45,000 AF/yr of recovery. According to Table 2-1 of the DEIR, Rosedale has already committed to 150,000 AF/yr of recharge and 47,500 AF/yr of recovery, and has exceeded the limits of the Program as previously evaluated in the Master EIR. With the proposed addition of the subject Strand Ranch Project to the Program, Rosedale will increase its commitments even more, to 167,500 AF/yr for recharge, and 65,000 AF/yr for recovery. Assuming, as the DEIR states, that the Project will be "integrated" into the Program, then the DEIR should, but fails to, evaluate the environmental impacts of all elements of the Program, operating as a collective whole, including the elements listed in Table 2-1 and the Strand Ranch Project. Evaluating the Project, as if it were isolated from the Program is unrealistic and serves to mask and understate the environmental effects of the Program and the Project including cumulative effects. KWBA-I a

Second, although the DEIR suggests reliance on the Master EIR, [3] the extent to which it does so, if at all, is unclear and should be clarified. Does the DEIR tier off of the Master EIR? KWBA-I b

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[2] The California Environmental Quality Act (Public Resources Code § 21000 et seq.), its regulations ("CEQA Guidelines") (title 14 of the California Code of Regulations, § 15000 et seq.), and applicable case law.

[3] For example, the DEIR includes statements like the following: *"IRWD would be provided a cumulative maximum banking allotment (maximum storage capacity) within Rosedale's Conjunctive Use Program of 50,000 acre-feet (af)."* (DEIR, p. S-4).

Does the DEIR rely on any analysis or conclusions in the Master EIR and, if so, which ones? Is the Project within or outside the scope of the Master EIR? To what extent, if at all, is the Project outside the scope of the Master EIR? Will the Project have environmental impacts not examined in the Master EIR for the Program and, if so, what are they? These questions, and others relevant to any reliance on the Master EIR, should be addressed and answered. Also, because the Project is going to be "integrated" into the overall larger Program, the DEIR should clearly explain in detail how that is going to occur operationally. KWBA-I b (Cont.)

Third, although the DEIR refers to the environmental document for the Program as a "Master EIR" at various places, the reference misrepresents what we understand the document actually is under CEQA. According to the Master EIR, it is really a "Program EIR as defined under Section 15168, Article 11, in the Guidelines for Implementation of the California Environmental Quality Act for the proposed program.... (Master EIR, p. 1). Assuming that is the case, then the DEIR's repeated references to the EIR for the Program as a "Master EIR" are false and misleading to the commenting public and, potentially, the decision makers relying on the DEIR. Under CEQA, "Program EIR" and "Master EIR" are entirely different documents with different requirements including for subsequent projects within the scope thereof (e.g., CEQA Guidelines §§ 15168, 15175 et seq.). KWBA-I c

II. The DEIR does not comply with CEQA's demand for an accurate, stable, finite and consistent project description that addresses the environmental impacts of the "whole of the action" under review

Leading CEQA decisions have long since recognized that "an accurate, stable and finite project definition is the *sine quo non* of an informative and legally sufficient EIR" (County of Inyo v. City of Los Angeles (1977) 71 Cal.App.3d 185, 199), and that the project must embrace the "whole of an action" (CEQA Guidelines § 15378(a)). As stated above (and below), the DEIR fails to adequately evaluate the environmental effects of the "whole of the action" or Project.

The project description is inadequate in several respects. First, the DEIR states "[i]n 2004, Rosedale entered into a Memorandum of Understanding (MOU) with Kern County Water Agency (KCWA) and other Adjoining Entities in the Kern Fan area, which include ...Kern Water Bank Authority...." (DEIR, pp. 2-4, 2-5.) The DEIR also states that the proposed Project "would be subject to and would be consistent with the conditions of the MOU." (DEIR, p. 2-5.) What does that mean? Is the MOU part of the project or not? If the MOU is part of the Project, then the DEIR should clearly state that and state that Rosedale is, at a minimum (see below), agreeable to revising the project description of the MOU, attached as Exhibit "B" to the MOU, to include the proposed Project as a part of the project description of the MOU, as a condition of Project approval. It is unclear from the DEIR just how the MOU will be made "subject to" and "consistent with conditions" of the MOU when it is not clearly part of the project, not a mitigation measure (discussed below), nor part of the MOU's project description. In addition, the MOU itself provides that "With respect to any future project within the Kern Fan Area, the KWBA-II a

Parties hereto shall use good faith efforts to negotiate an agreement substantially similar in substance to the MOU" (¶ 8). The DEIR should clarify how Rosedale will comply with this contractual obligation of the MOU, which Rosedale is a party to. KWBA-II a (Cont.)

Second, the DEIR states that the entire Strand Ranch is within a County-designated agricultural preserve and considered Prime or Unique ("Prime") Farmland (Appendix G, II (a)) under an existing Williamson Act contract, and that the Project will convert approximately 500 of the 611 Strand Ranch acres from agricultural fields to recharge facilities (DEIR, p. 3.2-7). As we understand the DEIR, it concludes that such conversion will not result in significant loss of Prime Farmland because the Kern County *Agricultural Preserve Uniform Rules* provide that land subject to a Williamson Act contract may be used for water recharge facilities provided the land "will continue to be used for commercial purposes for a minimum of eight (8) months out of each twelve (12) month period." (DEIR, p. 3.2-4.) Assuming but without conceding the correctness of such conclusion, then the project description should provide that recharge facilities will not be used for recharge more than four (4) months out of any twelve (12) month period.[4] Alternatively, that should be a mitigation measure and (as mentioned below) there does not appear to be any such mitigation. In this regard, we also note that the DEIR, at various places, discusses recharge activities that would exceed four months during each twelve month period (e.g., DEIR, p. 3.8-26). This apparent contradiction highlights and underscores the inadequacy of the DEIR's project description and need for clarification and revision. KWBA-II b

Third, the DEIR's project description at one point mentions eliminating groundwater extraction for agricultural purposes (DEIR, p. 2-3), but, elsewhere, the DEIR discusses organic farming and grazing for at least 8 months of the year (DEIR, p. 2-8). If farming and grazing is part of the Project, then the DEIR should identify the anticipated water sources for and impacts of this proposed Project activity. KWBA-II c

Fourth, the recovery scenarios presented on page 2-3 and 2-4 of the DEIR discuss delivery of recovered water to IRWD. However, the DEIR goes on to states that: *"This list is not intended to be exhaustive but rather intended to give a general understanding of the types of situations that might require dependence on banked water."* (DEIR, p. 2-3). The DEIR should specify if deliveries to others are in any way contemplated by IRWD, i.e. does IRWD intend to bank, sell, exchange, or in any way deliver water to others, whether from this Project specifically, or in general? If so, when will the CEQA review for such activities? The DEIR should explain whether the Project will be used for third-party sales, exchanges or deliveries and, if so, KWBA-II d

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[4] Instead, the DEIR's impacts discussion for Agricultural Resources states that the about 500 acres of land converted to recharge facilities "would be made available for organic farming or livestock grazing for a minimum if eight months per year." (DEIR, p. 3.2-7.) "Made available" is potentially meaningless and not necessarily the same as "used" for commercial purposes for at least 8 months of each 12-month period. In any case, there is nothing in the project description that requires said minimum use or any mitigation measure to that effect (DEIR, p. 3.2-8).

evaluate such activities, including their impacts, mitigation measures and alternatives, as required by CEQA. KWBA-II d (Cont.)

Fifth, the DEIR's description of the sources of recharge water is vague and too general for an adequate analysis of the environmental effects that may result from diverting, transporting and depositing the recharge water into the Project. For example, the DEIR lists MWD, SWP, Pre-1914 Water Rights, CVP and high-flow Kern River as potential sources of supply (DEIR, pp. 2-8, 2-9). The DEIR indicates or suggests that Irvine Ranch's SWP water may be stored in the Project (DEIR, p. 2-9). The DEIR also vaguely states: "Should water from other sources not suggested [above] be acquired for recharge, additional analysis may be subject to the discretion of Rosedale and IRWD." (DEIR, p. 2-8.) Will there be further CEQA analysis concerning the acquisition and recovery of such water supplies? If not, when will the CEQA review for such activities occur? The DEIR fails to adequately describe and evaluate the environmental effects of putting these water supplies into the Project, as well as recharging and recovering the same, including on the SWP and local users of SWP water. It appears that the DEIR may be improperly segmenting the project, unduly limiting the scope of impact analyses to the area in the vicinity of the Project, deferring analysis of Project impacts and/or understating Project impacts. As mentioned, CEQA requires environmental analysis of the whole of the project at the earliest possible time. There is no reason, to our knowledge or according to the DEIR, why the analysis cannot be done now or must be deferred. KWBA-II e

Sixth, the DEIR states that: *"When not in use by IRWD, the facilities could also be used by Rosedale to serve its existing commitments."* (DEIR, page 5-4 and 2-17). The DEIR also states the production from the Strand Ranch wells for any purpose for IRWD and Rosedale would not exceed 17,500 af/yr. However, of great concern is the statement that: "Extraction on the Strand Ranch by Rosedale would be limited to the amount previously recharged by Rosedale in its service area..." Such recharge could occur miles away from the Strand Ranch, providing none of the benefits of recharge but all of the impacts of extraction. If Rosedale does intend to use the facilities in such a manner, the DEIR must fully disclose such use and analyze the expected environmental impacts. We also note that no analysis of the additional use of the Strand Ranch facilities by Rosedale for recharge is provided in the DEIR. KWBA-II f

Seventh, the DEIR suggests the Project has a specific duration (p. 2-6, second paragraph). Is there a specific duration for the Project? If so, the DEIR should clearly state what the specific duration of the Project is. KWBA-II g

Eighth, The DEIR states that recharge ponds will be set back 110 feet from section lines (p. 2-6, last paragraph). However, the three ponds constructed for the pilot program are immediately adjacent to KWBA property with essentially no setback along the southern boundary and a much smaller setback along the western boundary. We assume the setback for the Project's recharge ponds will be greater, as set forth or suggested in the DEIR. Please KWBA-II h clarify what the minimum setback will be between KWBA's adjacent property and each and all of the Project's recharge ponds. KWBA-II h (Cont.)

Ninth, the description of the Project Recovery Facilities states that "...*between five and eight wells would be constructed on the Strand Ranch.*" (DEIR, p. 2-10).[3] However, later on the same page, a statement indicates that "... *additional wells may be needed.*" If so, will additional CEQA review occur? The project description should identify an upper limit for the number of wells necessary for the project and evaluate the impacts of the same. Also, please clarify what the minimum setback will be between existing KWBA wells and each and all of the Project's wells. KWBA-II i

III. The DEIR's description of the environmental setting appears outdated, inaccurate and lacking including with respect to the potential for pesticides to be transported to the Strand Ranch groundwater

The DEIR states that about 6,000 acres within Rosedale's 44,150 acres is developed to urban uses (DEIR, p. 1-5.) The so-called 2001 Master EIR uses the same number (Master EIR, p. 1). Frankly, with the significant urban expansion occurring in metropolitan Bakersfield since 2001 including in the area encompassed by Rosedale, we would be surprised if the area developed to urban uses is still the same seven years later.

The DEIR also states that pesticides were previously stored and used on the Strand Ranch, but concludes that the "potential for residual pesticides to be transported to the groundwater by the recharge water is minimal since the surface soils will be scrapped from the basin floors." (DEIR, p. 3.7-5.) However, this just scrapes the surface. The DEIR's analysis in this regard is deficient because there is no evidence that borings or other testing of soils occurred with respect to the soils below the surface and basin floors, to determine whether pesticides exist below the surface and basin floors and may be mobilized and transported to the groundwater by the Project's recharge operations. KWBA-III

The DEIR also indicates that SWP, CVP and waters from other systems may be recharged as a part of the Project. However, the DEIR does not include a sufficient discussion of the SWP, CVP or other water systems including current regulatory framework and environmental conditions.

IV. The DEIR's evaluation of groundwater quality and groundwater level impacts resulting from project operations is flawed, clearly erroneous or inaccurate, and/or not supported by substantial evidence KWBA-IV a1

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[3] Nine wells are shown on Figure 2-3 and nine wells are used in the technical analysis in Appendix F.

A. The modeling used to determine impacts from implementation of the proposed project has several inadequacies that make it unsuitable for determining potential impacts from the project and understates project impacts

1. The hydrogeologic conceptual model is an oversimplification of actual subsurface conditions which cannot be adequately simulated by the selected mathematical model

The hydrogeologic conceptual model used to represent very complex actual aquifer conditions consists of a simplified 3-layer aquifer. This hydrogeologic conceptual model is a vast oversimplification and not representative of how a complex heterogeneous leaky-aquifer system operates and is inconsistent with the DEIR's description of the project site and available field data from hundreds of wells in the Kern River Fan. Furthermore, the 2-dimensional mathematical model utilized to simulate impacts analysis is incapable of explicitly simulating the simplified 3-dimensional hydrogeologic conceptual model described above. The model can only simulate recovery from one layer, with a single constant (leakance) used to represent recharge from overlying aquifer layers. These inadequacies, and others discussed herein, are presented in greater detail in the attached letter from Geomatrix Consultants, Inc., enclosed herewith and incorporated herein by this reference. KWBA-I (Cont.)

2. The modeling used to determine well impacts does not and cannot simulate recovery from the wells proposed in the DEIR for the Project

The project description indicates wells will be completed from depths of 250 feet to 750 feet (DEIR, page 2-10). The model used to simulate Project impacts used wells completed in the "semi-confined" zone, below 350 feet (Appendix F, page 22). As such, the model does not simulate expected Project conditions. In fact, the model is a two-dimensional simulation, and is therefore incapable of simulating well recovery from multiple aquifer zones, which is proposed in the DEIR. As such the model can in no way provide a reasonably accurate estimate of Project impacts. KWBA-I

3. The modeling to determine recharge mounding impacts does not reflect proposed operations

Three recharge scenarios are modeled in Appendix F. They range in duration from 129 to 194 days. Elsewhere, the DEIR indicates that the property will be used for organic farming and/or grazing for at least 8 months of the year (page 2-8). If this is true, the duration of all of the recharge mounding scenarios exceed the time available for recharge to actually occur. More realistic recharge scenarios which consider the farming commitment must be conducted to accurately reflect potential impacts, especially considering mounding increases with comparable water volumes recharged in shorter duration cycles. Other problems with the recharge mounding analysis are discussed in Section IX(C). KWBA-I

4. **Analogies from other banking programs indicate the modeling underestimates drawdown impacts**

The model was not calibrated because *"the well field doesn't actually exist so we have no actual cause-and-effect scenario."* (Appendix G, Exhibit 1, p. 6). Even if that is the case, operations on the adjacent KWB lands can certainly be used as an analog to provide a general indication of the model's validity, even though KWB recovery rates are lower than those proposed for the Strand Ranch.

The model predicts that average drawdown, under a worst case scenario, will be about 43 feet on the Strand Ranch after 6½ months of pumping, and that impacts on adjoining sections will range from 12 to 20 feet (Appendix G, p. 29). No scenarios simulated adjacent well operations, but it can be assumed they would be in the same 12 to 20 foot range. This would indicate water levels on the Strand Ranch should drop about 60 feet if adjacent wells were also pumping.[6] KWBA-IV a4

Using KWB as an analog, 7 wells on the KWB in Section 11 and 14 contributed to a net recovery from within a square mile area of about 10,000 AF over a 9½ month period. Adjacent wells were also pumping. Actual water levels in the shallow interval of well 11P dropped about 90 feet during that time period, not the 60 feet the model predicts. This analogy strongly suggests that the model has under-predicted drawdown impacts, especially considering that the volume recovered in the analogy is much less and this smaller volume of water is recovered over a longer period of time.[7] Because the model does not provide a reasonably accurate indication of expected drawdown, the evaluation of potentially significant impacts from the proposed Project is deficient.

B. **The DEIR's analysis of Strand Ranch recovered water quality is flawed and inadequate**

1. **TDS of recovered water is understated**

The analysis of water quality impacts provided in Appendix G relies on a hypothetical base-case scenario with a long term average outflow of water with a concentration of total dissolved solids (TDS) of 229 mg/l (Appendix G, page 24). This value is not plausible. Actual aquifer data indicates this hypothetical value greatly underestimates the concentration of TDS of recovered water. The average TDS concentration in groundwater from a KWB well immediately adjacent to the Strand Ranch (well 30S/25E-11C1) over the period 1976 to 2001 is 562 mg/l. The well is completed from 226 feet to 626 feet, very similar to the 250 foot to 750 KWBA-IV b1

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[6] All other scenarios show less drawdown.
[7] The reduced volume and increased recovery time both reduce drawdown impacts.

foot interval proposed for Strand Ranch wells. The average TDS concentration in groundwater from wells located in close proximity to the Project and west of Strand Ranch[9] (30S/25E-3Q1, 30S/25E-3Q2, and 30S/25E-3R) is 330 mg/l. Finally, the TDS concentration in existing Strand Ranch well water ranges from 410 mg/l to 800 mg/l and averages 618 mg/l (DEIR, Table 3.8-2). All of the actual aquifer data indicates the TDS concentration in recovered water will be much higher, perhaps twice as much or more, than the hypothetical 229 mg/l. While the higher TDS concentration in the recovered water will provide for additional benefits to the groundwater basin with respect to the Project's salt balance, it is obvious that adverse impacts to downstream users will be much greater. The DEIR must provide an analysis of these potential impacts. Such analysis should also fully discuss any expected reliance on blending poor quality Strand Ranch water with water from other banking programs to ameliorate impacts from the Project. KWBA-IV b1 (Cont.)

2. The Strand Ranch brine plume contamination analysis is deficient

The DEIR identifies a contaminant brine plume under the Strand Ranch which *"...has been in existence for more than 30 years."* (Appendix G, page 17). The brine plume *"...may be summarized as having elevated levels of most or all constituents relative to the unimpacted shallow groundwater..."* (Appendix G, page 17). With respect to water quality issues related to the brine contaminant plume, Crewdson states: *"...the plume is a residual effect from oil-field brine discharge sources which are no longer active and both periodic recharge and periodic shallow groundwater extraction by the Kern Water Bank on adjacent lands is remediating the plume by diluting and permanently removing groundwater with elevated TDS content from within the plume perimeter. We note that the Kern Water Bank's operation of these wells is voluntary; the KWB was not responsible for the brine discharge nor are they being held responsible for its cleanup. Future Stand Ranch project operations will have the same beneficial impacts on the brine plume."* (Appendix F, page 8). Crewdson also states: *"The water quality benefits of a full recharge/recovery cycle include... ...ongoing dilution and extraction of the migrating brine plume as long as it continues to exist."* KWBA-IV b2

However, the DEIR is woefully lacking in that it does not consider the adverse impacts by the recovery and transport of contaminated water. In this regard, we note that Crewdson concluded that brine plume is "a cause of concern" and it "falls within the predicted capture zone of the well field under conditions of natural groundwater gradient and under conditions of pumping." (DEIR, Appendix F, pp. 6, 8.) However, Crewdson stated that the "quantitative analysis of the potential impacts of this brine plume on the Strand Ranch well field is outside the scope of this study." (DEIR, Appendix F, p. 6.)

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[9] Further removed from the brine plume.

3. The analysis of whether contaminates in Strand Ranch groundwater exceed MCL's is inadequate

The DEIR states that average contaminate levels in Strand Ranch groundwater do not exceed any Maximum Contaminate Level ("MCL"). (DEIR, pp. 3.8-24, 25.) First, the DEIR does not explain why it is appropriate to use an "average," which may serve to obscure and conceal the existence of one or more water samples that actually exceeded the applicable MCL. The actual contaminate level of each sample should be disclosed to the public and decisionmakers for comment and consideration. Second, even if an average analysis were appropriate, the DEIR's conclusion that Strand Ranch groundwater does not exceed any MCL is contradicted. As acknowledged elsewhere in the DEIR (p. 3.8-12), the actual MCL for arsenic is 10 ug/ℓ—not 50 as stated in Table 3.8-3. According to such table, the average arsenic in the deep groundwater zone is 45 ug/ℓ, well above the MCL. Using the base-case scenario discussed in Appendix G, (75% deep zone water and 25% shallow zone water), the arsenic concentration in recovered water is expected to be 34 ug/ℓ,[9] well above the MCL. The DEIR must provide further analysis of the potential significant impacts of contaminants on the environment (CEQA Guidelines, Appendix G ¶ VIII (a)). Such analysis should also fully discuss any expected reliance on blending poor quality Strand Ranch water with water from other banking programs to ameliorate arsenic impacts from the Project. KWBA-IV b3

4. Exchange deliveries will negate positive Project benefits

The DEIR states that *"Rosedale could agree to an exchange of its SWP entitlement, or other water supplies available to Rosedale, to MWD and transfer that same portion of IRWD's banked water to Rosedale's account and thereby eliminate the need for any direct extraction and conveyance."* (page 2-13). The water returned to IRWD under this scenario would not be recovered for export, but would rather be pumped at some time in the future by Rosedale's landowners and water users for use within the district.

This operation negates the positive net-salt benefits from project recharge and recovery. The water quality evaluation of the program in Appendix G relies heavily on the positive benefits of recharging and then recovering water: *"The recovery cycle will remove groundwater which has a higher TDS and COC content than was originally put into the aquifer during recharge;"* and *" The positive water quality benefits of a full recharge/recovery cycle include a net removal of salt from the basin under the unimpacted natural water quality conditions of the aquifer, as well as an additional net reduction in COCs, and an ongoing dilution and extraction of the migrating brine plume as long as it continues to exist."* Appendix G does not mention exchange deliveries, nor does it analyze the impact of such deliveries on water KWBA-IV b4

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[9] Crewdson used a blend of 75% deep zone water and 25% shallow zone water as his base-case scenario for expected water quality. 75% x 45ug/l = 37.5 ug/l.

quality due to reduced exports. The DEIR must provide a complete analysis of the effects of exchange deliveries considering the magnitude of such deliveries, the construction of the landowner wells used to effectuate such deliveries, and giving due consideration to the conflicting claims by Crossley and Crewdson regarding water quality impacts from interzonal flow and multi zone wells (see Section V, below). KWBA-IV b4 (Cont.)

V. The DEIR's cumulative impact analysis with respect to groundwater resources is deficient

As noted above, the DEIR indicates that the Strand Ranch Project will be "integrated" into Rosedale's Conjunctive Use Program. However, the DEIR should, but does not appear to, analyze the Project's incremental effects in combination, in connection or together with the effects of Program operations. It may be that the effects of operating the Project on the Kern Water Bank, as part of the Program, will be greater or significant even if that were not the case for the Program or the Project, when evaluated separately. In other words, the sum of the impacts of the integrated Program and Project may be greater than what each would produce as separate parts. The DEIR is deficient for failure to address cumulative impacts including on the Kern Water Bank and as provided in the Geomatrix letter enclosed. KWBA-V

VI. The DEIR's description and analysis of mitigation measures is inadequate

CEQA requires that an EIR describe feasible measures which could minimize significant adverse impacts, and provides further that mitigation measures must be fully enforceable through permit conditions, agreements, or other legally-binding instruments (CEQA Guidelines § 15126.4(a)(1)&(2)). The DEIR does not comply with these requirements and is deficient as provided above and below.

A. The MOU and mitigation measures for groundwater levels and quality

The DEIR states that no mitigation is required for lowered groundwater levels or for changes in water quality related to *"the addition of recharge water, neighboring contamination plumes, and intermixing of aquifer layers with varying water quality."* (DEIR, Table 5-1, p. 5-14).[10] The DEIR also states that: *"The proposed project would be subject to and would be consistent with the conditions of the MOU."* (DEIR, p. 2-5.) The DEIR suggests significant groundwater quality and other water-related impacts, including impacts on KWBA's neighboring wells, will be avoided because of the MOU. Consistently, statements made at a public meeting regarding the project on February 21 indicate the Project will rely on the MOU to mitigate water level and groundwater quality impacts. As mentioned above, however, the DEIR does not clearly include the MOU as part of the description of the Project, nor does it include the MOU as a mitigation measures. Further, the DEIR does not indicate that the MOU KWBA-VI a

[10] More comments regarding this conclusion are provided elsewhere in this document.

Mr. Hal Crossley
March 10, 2008
Page 12 of 19

will be amended to include the Stand Ranch Project as part of the MOU's project description. Does Rosedale intend to agree to amend the MOU to include the Strand Ranch as part of the MOU's project description? If not, then it is not clear how the MOU will ensure the Project will not have significant impacts or be legally enforceable. The DEIR should clearly explain how the MOU will be legally enforceable by adjoining entities, including KWBA. If the MOU is not part of the project description or a mitigation measure legally enforceable by KWBA and other enjoining entities, then the DEIR should describe and consider other appropriate mitigation measures. KWBA-VI a (Cont.)

B. Recovery wells proposed within 1/3 mile of offsite wells

Figure 2-3 shows wells on the Strand Ranch at 1/3-mile spacing. This spacing places the southwestern well less than ¼ mile away from an existing KWB well (30S/25E-3R). This proposed location will minimize impacts between Strand Ranch wells at the expense of creating significant impacts to this offsite well on the Kern Water Bank. The southwestern well location should be at least 1/3-mile from well 30S/25E-3R, as mitigation.[11] KWBA-VI b

C. 4-Month limit on recharge

As discussed above, the DEIR concludes there will be no significant effect on Prime Agricultural Lands if the recharge basins operations are limited to 4 months per year. Since this limit is not part of the Project's description, then it should be included as a mitigation measure and a condition of Project approval. KWBA-VI c

D. Project losses

The DEIR refers to losses as specified in the MOU (DEIR, page 2-17). The MOU in Appendix E provides for 3% recharge losses under certain conditions. This loss factor is not appropriate for the Strand Ranch. The Strand Ranch is immediately adjacent to the KWB, which uses a 6% loss factor for all recharged water. This 6% factor must also be used as mitigation for recharge losses on the Strand Ranch, regardless of the intended use of the recharged water, or the party recharging such water. KWBA-VI d

VII. The DEIR's alternative analysis is flawed including because the DEIR fails to consider alternatives that would avoid or substantially lessen significant impacts on the Kern Water Bank and its operations KWBA-VII a

[11] As discussed above, the model used to place wells (Appendix F) is fundamentally flawed and not capable of accurately predicting impacts from the Project on wells on the adjoining Kern Water Bank.

CEQA requires an EIR to describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the project objectives of the project but would avoid or substantially lessen any of the significant effects of the project (CEQA Guidelines § 15126.6(a)). As explained elsewhere in these comments, we believe that several analyses, including relating to Project impacts on Kern Water Bank operations including its wells, are flawed and conceal significant effects of the Project on the Kern Water Bank. The DEIR should, but fails, to consider alternatives that would avoid or lessen significant impacts.

A. Overall project components and recovery rates

As we understand it, the Project will consist of approximately 500 acres of recharge ponds on the 611 acres which comprise the Strand Ranch (DEIR, page 2-6). The projected number of recovery wells range from 5 to an unspecified upper limit (DEIR, page 2-10). Nine wells are shown on Figure 2-3 and nine wells are used in the technical analysis in Appendix F. Target recovery rates are 36 to 40 cfs (DEIR, page S-4). Total storage for IRWD is 50,000 AF, and the maximum annual recharge and recovery volume for IRWD is 17,500 AF (DEIR, page S-4). Additional use by Rosedale is contemplated but not specified or evaluated in the DEIR. KWBA-VII a (Cont.)

With 5 wells, the proposed well density for the program is one well per 122 acres. With 9 wells, well density is one well per 68 acres. The recovery rate proposed in the DEIR is 36 to 40 cfs/mi^2. The well density on adjacent KWBA lands is much lower at one well per 143 acres.[12] Under optimum conditions, the recovery rate on adjacent KWB lands is about 29 cfs/mi^2.[13] Both the well density and recovery rate on adjacent KWB lands are lower than those proposed for the Strand Ranch, and the KWBA believes these higher rates will have a significant adverse impact on KWB operations and water well levels. Certainly, Strand Ranch operations will lower water levels to a greater extent proportionally than adjacent KWB operations.[14] The DEIR has not considered alternatives that would ameliorate these concerns. It should do so.

B. Additional alternatives

The alternatives proposed for the project include no project, a recharge basin location alternative, and an injection well alternative (DEIR, page 2-18). Other alternatives which were rejected from consideration included the development of local storage facilities in Orange County, enhanced conservation policies to be implemented during periods of drought, and increased use of recycled water to reduce potable water demands. Given the concerns discussed above, we believe additional alternatives should be considered which reduce KWBA-VII b

[12] Well density for all KWB lands north of Panama Lane is about one well per 200 acres.
[13] Based on total recovery in 2007 from wells in the vicinity of Strand Ranch.
[14] As will be discussed later in more detail, we believe the modeling used to determine that impacts from the Strand Ranch are less than significant is faulty, and cannot be relied upon.

recovery on Strand Ranch to rates similar to adjoining projects, including the Kern Water Bank, by placing some of the wells elsewhere in Rosedale or by otherwise reducing the number of wells on the Strand Ranch. All or most of the Project's objectives can still be met, yet the impacts on the Kern Water Bank from the Project's higher recovery rates will be substantially lessened or avoided. KWBA-VII b (Cont.)

VIII. The DEIR's analysis of groundwater quality and groundwater level impacts on Kern Water Bank operations is clearly erroneous and deficient including because the analyses are contradicted by the subsequent opinions and statements of Rosedale's representatives

Appendix F and Appendix G purport to analyze well placement, expected drawdown from well operations, and water quality impacts from the proposed Program. These documents are the foundation for the conclusions (in Table 5-1 and elsewhere in the DEIR) that impacts from lowered water levels and changes in water quality are less than significant. Yet, several significant conclusions reached in these documents and in the DEIR are contradicted by subsequent documents provided by Rosedale and Sierra Scientific Services (Crewdson) to the Kern Fan Monitoring Committee (Letter to Kern Fan Monitoring Committee, dated January 15, 2008, and Memorandum from Sierra Scientific Services to Rosedale and Buena Vista dated February 15, 2008, enclosed and incorporated herein by this reference). These contradictions are so blatant and far-reaching that they totally invalidate the findings in Appendix F and G of the DEIR.[15] These issues are discussed in more detail below.

KWBA-VIII a

A. The DEIR's analysis of whether recovery rates and well density of project operations will lead to significant impacts on groundwater quality or groundwater levels is contradicted by Rosedale's representatives' subsequent opinions and statements

The mathematical model used to evaluate project impacts consists of 9 wells recovering 45 cfs for a total annual recovery volume of 17,500 AF. This equates to a well density of one well per 68 acres, an instantaneous recovery rate of 45 cfs/mi^2 and a total annual recovery of 17,500 AF/mi^2. KWB lands north of Panama Lane have a well density of one well per 200 acres, an instantaneous recovery rate of about 19 cfs/mi^2, for a total annual recovery of about 13,800 AF/mi^2. Obviously, the proposed Project has a significantly higher well density, higher recovery rate, and higher annual recovery volume than KWB lands. With respect to impacts from these much higher Strand Ranch rates, Appendix F of the DEIR states that: *"As long as the project puts as much water in the ground as it takes out, the net basin impact from water level drawdown*

[15] KWBA does not in any way endorse or support the statements, opinions or conclusions reached in the January 15 letter or February 15 memorandum. If fact, they may be totally inaccurate. However, the contradictions between the same and Appendix F and G, and related groundwater analyses in the DEIR, are significant and, at a minimum, severely undermine the credibility of Appendices F and G to such an extent that the DEIR's groundwater impact analysis is not supported by substantial evidence and deficient.

will be pre-compensated for by the water-level rise due to recharge mounding, so there will be no net long term effect on the basin no matter how far apart recharge and recovery are separated in time." and *"...the individual and combined net impacts of the total operation avoids and prevents unacceptable extreme impacts to the aquifer and the basin."* (Appendix F, Page 6 and page 45).[16]

In complete contradiction to the above conclusions, Crossley[17], in reference to KWB's lower recovery rates, states: *"Such operations offer potentially adverse impacts on flow dynamics, contaminant-plume mobilization, downward interzonal flow, and water quality."* Crewdson[18], again in reference to KWB's lower recovery rates states: *"...high-volume recovery operations are creating a persistent head difference between the shallow and deep aquifers causing sustained in-situ interzonal WQ (sic) degradation of the deep aquifer..."* and *"potential consequences include:*

- *a lowering of COCs toward the deep aquifer and embedding them in the intermediate zone;*
- *b lowering the air-entry depth in the shallow aquifer; reducing the T&SC (sic) values of the zone and initiating aerobic processes that did not previously exist in this zone;*
- *c unknown other impacts"*

KWBA-VIII a (Cont.)

All of the adverse impacts discussed by Crossley and Crewdson, if real, would apply to an even greater extent to the proposed Project, which will be recovering water at much higher rates than those on adjacent KWB lands. Certainly, there can be no doubt that downward interzonal flow will occur as a result of the proposed Project, which, according to Crewdson, will cause *"sustained in-situ interzonal WQ (sic) degradation of the deep aquifer..."* Given that the Strand Ranch has much poorer quality water in the shallow part of the aquifer than most of the KWB, these purported impacts, if real, would be much worse on the Strand Ranch. Crewdson suggests that limiting pumping on the KWB to 70,000 AF/year would mitigate the impacts from what he terms "excessive" recovery practices. Scaling Crewdson's mitigation factor to the Strand Ranch would require that recovery on the proposed project be limited to 2,100 AF/year, not 17,500 AF/year as proposed in the DEIR. If Crewdson's and Crossley's opinions and statements are accurate, then the DEIR's analysis of groundwater impacts, including water quality impacts, is not credible and clearly erroneous.

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[16] Through December 2007, the KWB has recharged approximately 3.7 times as much water as it has recovered.
[17] Letter to Kern Fan Monitoring Committee dated January 15, 2008.
[18] Memorandum to Marty Milobar and Dan Bartel, BVWSD, and Hal Crossley, RRBWSD.

B. The DEIR's analysis of whether the project's multi-zone, high-density recovery wells will lead to significant impacts on groundwater quality or groundwater levels is contradicted by Rosedale's representatives' subsequent opinions and statements

The DEIR states that wells will have *"completion intervals between depths of 250 to 750 feet below ground surface (bgs)."* (DEIR, page 2-10) According to the analysis provided in Appendix G, these wells will cross multiple zones in the aquifer which exhibit poorer quality in shallow zones and better quality in deeper zones (Appendix G, page 16-19). However, despite this being the case, and despite the density of these wells being much higher than KWB wells and the overall water quality in the shallower interval being much worse than that overall in the shallower interval on KWB lands, the DEIR finds that impacts to groundwater quality due to *"the addition of recharge water, neighboring contamination plumes, and intermixing of aquifer layers with varying water quality."* (DEIR, Table 5-1, page 5-14) will be less than significant. Similarly, further findings related to water quality are reached in Appendix G, including the following: *"Since the three surface waters have lower TDS concentrations and lower constituent-of-concern concentrations than the groundwaters in the aquifer zones under the Project site, the historical data record shows that all recharge-then-recovery operations in all such projects have a beneficial salt balance impact and a beneficial COC balance impact on the basin."* and *"...based on the observed positive impacts from existing projects, we conclude that the water quality impacts from this project will be significantly positive for the basin as well."* (Appendix G, page 3). KWBA-VIII b

However, in complete contradiction to these findings in the DEIR, Crossley states that, with respect to multi-zone wells: *"Poor quality water is allowed and/or induced to migrate from the shallow aquifer (approx. 0-300 ft deep) into the deep aquifer (approx. 400-700 ft deep) within the KFRA [Kern Fan Recharge Area] because of multi-zone completion intervals..."* *"Since the shallow zone contains higher-TDS, higher-COC groundwater including elevated nitrates, elevated radioactivity, and local contaminant plumes, while the deep zone contains lower-TDS, low-COC, higher quality water, this interzonal flow represents an ongoing, permanent degradation of the deep aquifer..."* In like fashion, Crewdson states that the interzonal flow from "multi-zone" wells creates an *"adverse rather than beneficial"* impact. He further states that any *"net salt benefit to the basin from project recharge/recovery does not alter, compensate for, or mitigate the physical migration of salts and COCs or the consequential WQ (sic) degradation of the deep aquifer."* As indicated above, it is important to keep in mind that the shallow water quality on the Strand Ranch is much worse than that on most of the KWB, so any such adverse impacts, if real, would be much greater on the Strand Ranch.

So in summation, Crewdson, while under contract to IRWD and in reliance on the *"historical data record"* from adjoining projects and the *"observed positive impacts from existing projects"* concludes that the Strand Ranch Project will have a *"significantly positive"* water quality impact on the basin. However, less than two months later, in complete contradiction, he changes his position and concludes that multi-zone wells on the Kern Fan, which are proposed for the Strand Ranch Project, at a high density, create an *"adverse rather than beneficial impact"* that is so severe that the *"net salt benefit to the basin from project recharge/recovery does not alter, compensate for, or mitigate the physical migration of salts and COCs or the consequential WQ (sic) degradation of the deep aquifer."* KWBA-

Again, if Crewdson's and Crossley's opinions and statements are accurate, then the DEIR's analysis of groundwater impacts, including water quality impacts, from multi-zone wells is not credible and clearly erroneous.

C. The DEIR's analysis of the Project's recharge activities is contradicted by Rosedale's representatives' subsequent opinions and statements

Crewdson used a specific yield of 21% for the model presented in Appendix G (DEIR, p. 23). In a presentation to the Kern Fan Monitoring Committee on January 15, 2008, Crewdson used a specific yield of 10% to characterize the aquifer underlying adjacent KWB lands. KWBA- Obviously, the same aquifer underlies the KWB and the Strand Ranch. Although Crewdson goes to great lengths in Appendix G to discuss the selection of aquifer parameters, the subsequent dismissal of the 21% values for a much lower 10% value must be explained given that the higher value dramatically reduces simulated project impacts in comparison to the lower value. If Crewdson's subsequent opinions and statements are accurate, then the DEIR's analysis of groundwater recharge activities is not credible and clearly erroneous.

D. The DEIR's analysis of the potential for contaminant plumes to impact groundwater quality is contradicted by Rosedale's representatives' subsequent opinions and statements

As stated earlier, the DEIR identifies a contaminant brine plume under the Strand Ranch which *"...has been in existence for more than 30 years."* (Appendix G, page 17). The brine plume *"...may be summarized as having elevated levels of most or all constituents relative to the unimpacted shallow groundwater..."* (Appendix G, page 17). With respect to water quality issues related to the brine contaminant plume, Crewdson states: *"...the plume is a residual* KWBA- *effect from oil-field brine discharge sources which are no longer active and both periodic recharge and periodic shallow groundwater extraction by the Kern Water Bank on adjacent lands is remediating the plume by diluting and permanently removing groundwater with elevated TDS content from within the plume perimeter. We note that the Kern Water Bank's operation of these wells is voluntary; the KWB was not responsible for the brine discharge nor are they being held responsible for its cleanup. Future Stand Ranch project operations will have the same beneficial impacts on the brine plume."* (Appendix F, page 8). Crewdson also states: *"The water quality benefits of a full recharge/recovery cycle include... ...ongoing dilution and extraction of the migrating brine plume as long as it continues to exist."*

However, in written comments to the Kern Fan Monitoring Committee, Crossley completely rejects the above conclusions. With reference to multi-zone wells in the Kern Fan area (which obviously includes the Strand Ranch), Crossley states: *"Since the shallow zone contains ... local contaminant plumes, while the deep zone contains... ...higher quality water, this interzonal flow represents an ongoing, permanent degradation of the deep aquifer..."* If Crossley's opinions and statements are accurate, then the DEIR's analysis of groundwater quality impacts from contaminant plume migration is not credible and clearly erroneous. KWBA-VIII d (Cont.)

E. Appendix F and Appendix G may have not have been prepared by a California-licensed Professional Geologist

Appendix F and Appendix G were prepared for IRWD by Robert A. Crewdson, who identifies himself as *"a Bakersfield, California consultant doing business as Sierra Scientific Services (SSS). SSS specializes in quantitative ground water hydrology, applied potential theory and time series analysis, quantitative groundwater flow analysis, water quality geochemistry, well testing and monitoring, contaminant transport modeling, and aquifer properties testing."* (Appendix F, page 14 and Appendix G, page 10). We believe the work product in Appendix F and G meets the definition of geology in the California Business and Professions Code (Chapter 12.5, Article 1, Section 7802). We were unable to locate Robert A. Crewdson within the State of California's database of professional geologists (http://www.geology.ca.gov/). If Crewdson indeed is not a state-licensed Professional Geologist, the credibility of Appendix F and G is suspect[19] KWBA-VIII e

F. The contradictions by Rosedale's Representatives' subsequent opinions and statements invalidate the findings in Appendix F and G

As detailed above, the contradictions to the conclusions in the DEIR that are conspicuous in the January 15 letter and February 15 memorandum are stunning and incontrovertible. So which of the scenarios presented by Rosedale and Crewdson is correct? Do multi-zone wells and high recovery rates cause insignificant impacts, and in fact lead to positive water quality benefits, or do multi-zone wells and high recovery rates cause adverse impacts on flow dynamics, contaminant-plume mobilization, downward interzonal flow, and water quality? How can IRWD, as a responsible agency, possibly rely on the reports prepared by Crewdson, when some of the most significant, project-favorable conclusions are completely contradicted in documents subsequently prepared by Rosedale and Crewdson? Does the KWBA-VIII f

[19] The California Business and Professions Code require that all geologic plans, specifications, and reports be prepared by a professional geologist or by a subordinate employee under his or her direction (Chapter 12.5, Article 3, Section 7835). Further, anyone who conducts, as proprietor, any place of business from which geological work is solicited, performed, or practiced for others is guilty of a misdemeanor unless such geological work is supervised or performed by a professional geologist (Chapter 12.5, Article 6, Section 7872).

Rosedale Board of Directors, as lead agency, accept Crewdson's work in support of their project and disregard the work solicited by them that completely contradicts many of the supportive conclusions reached in the DEIR? We do not see how the public can adequately comment on the proposed project without the benefit of seeing both Appendix F and G and the subsequent contradicting documents.

KWBA-VIII f (Cont.)

The only resolution to the contradictions raised in these documents is to reject Appendix F and G outright, have a reputable California Licensed Professional Geologist, preferably with a Certification in Hydrogeology, independently evaluate the proposed Project to honestly determine potential project impacts, and revise and circulate a new draft EIR for the proposed Project consistent with the above comments.

IX. Conclusion

Once again, KWBA appreciates the opportunity to review the DEIR for the proposed Project. Unfortunately, based on our review of the DEIR for the Project, KWBA believes that it was not prepared in compliance with CEQA and objects to approval of the Project based on the DEIR. For the reasons provided above, KWBA respectfully requests that Rosedale prepare a new draft EIR for the Project in compliance with CEQA and circulate it for public review and comment. Please contact the undersigned if you should have any questions regarding these comments.

KWBA-IX

Sincerely,
Kern Water Bank Authority

Jonathan D. Parker,
General Manager
Professional Geologist No. 4728
Certified Hydrogeologist No. 110[20]

Enclosures

cc: KWBA Board of Directors
Ernest Conant
Gene McMurtrey

[19] Having been employed by KWBA continuously since 1999 first as its Project Manager and then as its General Manager, I am familiar with Kern Water Bank operations including underlying aquifer response to and water quality associated with such operations.

Geomatrix

March 10, 2008
Project 8101.006

Mr. Jon Parker
Kern Water Bank Authority
Post Office Box 80607
Bakersfield, California 93380-0607

Subject: Review of Strand Ranch Integrated Banking Project
Draft Environmental Impact Report dated January 2008
Prepared for Rosedale-Rio Bravo Water Storage District

Dear Mr. Parker:

As you requested, Geomatrix Consultants, Inc. (Geomatrix), has reviewed the subject Draft Environmental Impact Report (DEIR) for the Strand Ranch Integrated Banking Project (project) submitted by Rosedale-Rio Bravo Water Storage District (RRBWSD) in January 2008. We have focused our review on the potential impacts of the proposed project on groundwater resources, specifically Section 3.8 (Hydrology, Groundwater Resources and Water Quality) and associated Appendices and Exhibits. However, this does not mean we agree with portions of the DEIR that are not addressed below.

The primary issues we have regarding the DEIR's analysis of the proposed project's potential impacts to groundwater include the following:

1. The hydrogeologic conceptual model utilized to develop a mathematical model to evaluate potential impacts on groundwater is not representative of the hydrogeologic environment and inconsistent with field observations at the proposed project site and vicinity.

2. The 2-dimensional mathematical model utilized for the groundwater impacts analysis is incapable of explicitly simulating the simplified 3-dimensional hydrogeologic conceptual model described above, and as a result, the DEIR underestimates water well drawdown and the project's impacts on nearby production wells.

3. The pumping and recharge scenarios simulated with WinFlow© for groundwater impacts analysis are based on assumptions inconsistent with site conditions and realistic and/or proposed operational procedures, and as a result, the DEIR underestimates water well drawdown and the project's impacts on nearby production wells.

These issues and others are discussed in more detail in the following paragraphs.

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1. **The hydrogeologic conceptual model utilized to develop a mathematical model to evaluate potential impacts on groundwater is not representative of the hydrogeologic environment and inconsistent with field observations at the proposed project site and vicinity.**

The DEIR indicates the project site is located along the Kern River Fan and underlain by a leaky-aquifer system consisting of a thick (~1,000 feet) "sequence of nearly-horizontal, laterally discontinuous, interbedded, unconsolidated, sandy and silty sediments but there is no widespread, laterally continuous impermeable confining layer anywhere under the area of interest" (DEIR, Appendix F, Page 21). We concur that the Kern River Fan is underlain by a heterogeneous leaky-aquifer system. GEO-1

However, the mathematical model used in Appendix F of the DEIR to evaluate potential impacts to groundwater was based on a hydrologic conceptual model of a homogeneous, 3-layer aquifer system consisting of a shallow, 250-foot thick unconfined aquifer, an intermediate 100-foot thick "leaky" aquitard, and a deep 300-foot thick semi-confined aquifer. This hydrogeologic conceptual model is a vast oversimplification and not representative of the complex hydraulic relationships in this heterogeneous leaky-aquifer system and is inconsistent with the DEIR's description of the project site and available field data from hundreds of wells in the Kern River Fan, which do not show the presence of a 100-foot thick leaky aquitard.

2. **The 2-dimensional mathematical model utilized for the groundwater impacts analysis is incapable of explicitly simulating the simplified 3-dimensional hydrogeologic conceptual model described above, and, as a result, the DEIR underestimates water well drawdown and the project's impacts on nearby production wells.**

The mathematical model utilized to evaluate potential impacts to groundwater was developed using the 2-dimensional analytical model WinFlow© developed by Environmental Simulations, Inc. (ESI). A 2-dimensional analytical model can only explicitly represent a single-aquifer layer with uniform aquifer properties. To represent a multi-layer aquifer system, a constant "leakage term" is utilized to implicitly represent interzonal groundwater flow between layers. However, WinFlow© cannot simultaneously simulate potential groundwater impacts in even the simplified 3-layer aquifer system presented in the DEIR. GEO-2

The WinFlow© calculates drawdown in the deep semi-confined aquifer based on the Hantush and Jacob leaky-aquifer solution (Hantush and Jacob, 1955). This solution has a number of simplifying assumptions including that the aquifer and the aquitard have an infinite areal extent.

are homogeneous, isotropic, and of uniform thickness over the area influenced by the test and that the drawdown in the unpumped aquifer (or aquitard) is negligible. One key assumption inherent in the Hantush and Jacob solution is that the leakage rate is constant. These assumptions overly simplify the complex leaky-aquifer hydraulics and, importantly, will significantly underestimate drawdown resulting from the proposed project.

The Hantush and Jacob leaky-aquifer solution assumption that drawdown in the unpumped aquifer (or aquitard) is negligible, coupled with a constant leakage term, results in an infinite source of potential groundwater recharge to the deep semi-confined aquifer. Under such conditions, it would be expected that simulated drawdown would stabilize when the rate of leakage from the unpumped aquifer (or aquitard) equals (or equilibrates with) the total pumping discharge from the aquifer. Likewise, simulated drawdown would be expected to recover quickly after pumping stops in the presence of an infinite source of groundwater recharge from the unpumped aquifer (or aquitard). The DEIR simulation results indicate that under these solution assumptions "the area will achieve steady-state within about 100 days after pumping begins and the water levels will begin to recover after 194 days when pumping ceases. As long as the leaky-aquifer assumptions continue to be met, the water levels in the study area will recover to pre-pumping levels in another 100 days or less, in the absence of other influences" (DEIR, Appendix F, page 29). However, hydrographs of wells in the Kern River Fan show that drawdown occurs in all monitored intervals (e.g. shallow unconfined aquifer, intermediate aquitard, and deep semi-confined aquifer) during pumping events, indicating that the assumption of a constant leakage is invalid. **GEO-2 (Cont.)**

In the real world, leaky-aquifer systems typically do not have an infinite source of recharge with which to equilibrate. Under these more realistic conditions, the drawdown in a pumped well would continue to increase, albeit slowly, until pumping ceased. During the pumping period, continued leakage from the unpumped aquifer (or aquitard) would also result in drawdown in the unpumped interval (e.g. the aquitard and overlying unconfined aquifer). During a subsequent recovery period, drawdown would decrease as before, although more slowly since there is now less available water from the unpumped aquifer (or aquitard) with which to re-equilibrate. As a result, groundwater levels may not recover to pre-pumping levels, but instead recover to some lower level.

The DEIR acknowledges that if the constant leaky-aquifer assumption is not maintained drawdowns will be greater than simulated. In their own words "If recharge does not match [pumping] recovery, then the predicted drawdowns within the aquifer after 300 days of pumping may be as much as twice as much as predicted or more, depending on the rate of depletion of the shallow, unconfined aquifer" (DEIR, Appendix F, page 27).

3. The pumping and recharge scenarios simulated with WinFlow© for groundwater impacts analysis are based on assumptions inconsistent with site conditions and realistic and/or proposed operational procedures, and, as a result, the DEIR underestimates water well drawdown and the project's impacts on nearby production wells.

For the potential impacts analysis, the WinFlow© model was utilized to evaluate the potential drawdown associated with various well configurations and pumping rates. The base case WinFlow© model of the deep, 300-foot thick semi-confined aquifer was assigned a homogeneous horizontal hydraulic conductivity (K_h) of 57 feet per day (ft/d) and a specific storage (S_s) of $6.67e^{-5}$ per foot (1/ft), apparently based on analyses of soil samples to a depth of 100 feet and several geophysical logs from the project site. Interzonal groundwater flow was represented by an assumed constant leakage factor (1/B) of $1.67e^{-4}$ 1/ft. This assumption was reportedly based on the weighted-average vertical hydraulic conductivity (K_v) of 0.0475 ft/d for the 100-foot thick aquitard, although the source of the K_v data was not provided. The assumption of a homogeneous, isotropic aquifer is not consistent with project site conditions and statements made in the DEIR, which indicate the project site is underlain by a "sequence of nearly-horizontal, laterally discontinuous, interbedded, unconsolidated, sandy and silty sediments but there is no widespread, laterally continuous impermeable confining layer anywhere under the area of interest" (DEIR, Appendix F, Page 21). GEO-3

For the first pumping scenario, nine recovery wells, screened across the entire 300-foot thick semi-confined aquifer, were pumped at a combined rate of about 90 acre-feet per day (af/d) for 194 days to recover a total of 17,500 acre-feet (af). Simulated drawdown beneath the project site stabilized after about 100 days of pumping at an average of 43 feet. Following the 194 day pumping period, simulated groundwater levels recovered within 100 days. Additional recovery scenarios were simulated using seven recovery wells and five recovery wells pumping at combined rates of 70 af/d for 250 days and 50 af/d for 350 days, respectively. For these scenarios, simulated drawdown beneath the project site stabilized after about 100 days of pumping at an average of 34 and 24 feet, respectively.

The DEIR states that the proposed recovery wells will have "*completion intervals between depths of 250 to 750 feet below ground surface (bgs)*" (DEIR Section 2.5.4, Page 2-10). However, the recovery wells in the model were simulated as being single interval wells "completed across the full 300-foot thickness of the bottom, semi-confined zone" (DEIR Appendix F, page 23). The 2-dimensional WinFlow© model utilized for the analysis is incapable of simulating production and interzonal flow in wells completed across multiple zones.

The resulting drawdown analysis is inherently flawed in this respect and inconsistent with the proposed project recovery well construction.

In addition, all of the recovery scenarios described previously underestimate drawdown resulting from recovery operations because the leakage term is held constant, providing an infinite source of groundwater recharge to the deep semi-confined aquifer. Essentially, the model is simulating continued recharge at the same time recovery is occurring. It is unlikely that the project would be operated in this manner since recharge water is typically available during wet years, and demand for recovery water is typically during subsequent dry periods that may be years later. Hence the resulting drawdown analysis is flawed in that it does not simulate realistic recharge and recovery cycle operational procedures. GEO-3 (Cont.)

4. The DEIR does not analyze cumulative drawdown impacts

A cumulative impacts analysis was not conducted. The DEIR and Appendix F indicate that recharge would always precede recovery, cumulative storage would not exceed 50,000 af, and recovery would not exceed 17,500 af per year. Under dry-year conditions, 3 years of pumping would be required to recover approximately 50,000 af. However, the cumulative drawdown impacts associated with recovery of approximately 50,000 af over a 3-year period were not presented. Furthermore, evaluations of cumulative drawdown impacts were not presented for dry-year periods when other nearby water bank recovery operations would also be underway. The simplified 2-dimensional WinFlow© model used for the proposed project's single-year drawdown impacts analysis is incapable of simulating the cumulative impacts in a multi-layer aquifer system resulting from multi-year recovery operations using recovery wells completed within multiple aquifer zones. GEO-4

5. Summary and Conclusion

In summary, the DEIR and associated Appendices and Exhibits utilize a hydrogeologic conceptual model that overly simplifies the Kern River Fan area into a simple 3-layer leaky-aquifer system consisting of an unconfined aquifer, a leaky aquitard, and a confined aquifer. All layers are assumed to have uniform aquifer properties. However, the analysis of potential project impacts was conducted using a 2-dimensional analytical model that cannot even explicitly represent the simplified 3-layer aquifer system previously described. The model simulates only 1-layer, with groundwater flow between layers represented by a constant "leakage" factor. The impacts analysis assumes well completion intervals inconsistent with the well completion intervals stated in the DEIR (Section 2.5.4, Page 2-10) and assumes unrealistic recharge/recovery operations. The cumulative impacts of multi-year pumping while other water banking operations are also recovering water were not presented. GEO-5

In short, the mathematical model utilized is an inappropriate tool for analysis of the potential project's groundwater impacts and the conclusions in the DEIR regarding the project's groundwater impacts are significantly understated and unreliable.

GEO-5 (Cont.)

Sincerely yours,
GEOMATRIX CONSULTANTS, INC.

David M. Bean, PG, CHg.
Principal Hydrogeologist

Attachment - Resume for David M. Bean

Geomatrix

David M. Bean
Principal Hydrogeologist

Education
Georgia Institute of Technology: M.S., Geophysical Sciences, 1981

Georgia Institute of Technology: B.S., Applied Biology, 1978

Registrations
Registered Geologist, California, #5618
Certified Hydrogeologist, California, #606
Nuclear Safety and Nuclear Gauge Operator Certification #11193

Affiliations
International Association of Hydrogeologists
Association of Groundwater Scientists and Engineers
Fresno Geological Society
Groundwater Resources Association of California

SKILLS AND EXPERIENCE

Mr. Bean has 20 years of experience using analytical and numerical 2- and 3-dimensional groundwater flow and contaminant transport models (Dream, 2-Dan, Flowpath, MODFLOW, MOC, MT3D) to evaluate the fate and transport of chemicals in groundwater. He has also used particle tracking models (MODPATH, Path3D) to optimize the zone-of-capture of remediation wells and evaluate the influence of municipal well fields and agricultural supply wells on the migration of contaminants in groundwater. Mr. Bean has experience in aquifer testing and data analysis, database design and management, statistical data analysis, report preparation, and regulatory agency interaction. His groundwater modeling experience includes:

Containment and Remediation Plan, Los Angeles County Sanitation District Plant No. 20, Palmdale Water Reclamation Plant, Palmdale, CA. The Los Angeles County Sanitation District (LASCD) retained Geomatrix to prepare a water budget and calibrate a numerical groundwater flow model of their Water Reclamation Plant (WRP) Plant No 20 in Palmdale, Los Angeles County, California. The WRP is located in Antelope Valley in an area experiencing significant groundwater overdraft in recent years. Disposal of WRP effluent at Palmdale has resulted in significant groundwater mounding beneath the disposal areas and the formation of a plume of nitrate in groundwater exceeding drinking water standards. The purpose of the modeling effort was to calibrate both vadose zone and saturated zone fate and transport models to historical plant operations from 1953 to present, and then use the calibrated models to evaluate potential effluent management schemes and remedial options for the groundwater nitrate plume.

The vadose zone model was calibrated to observed vertical and lateral distribution of soil moisture and nitrate in the 9 shallow borings and 8 deep monitoring wells in the vadose zone. The saturated zone model was calibrated to almost 3,200 water level observations in 41 monitoring and water supply wells within the model domain.

Following calibration, the model was used to predict nitrate and total dissolved solids loading under a proposed effluent management plan and evaluate five alternatives to concurrently remediate the existing nitrate plume in groundwater. Based on the modeling predictions, an alternative was selected and recommended to the local regulatory agency for approval.

Evaluation of Nitrate in Groundwater, City of Fresno, Fresno, CA. Geomatrix developed a geographic information system (GIS) to evaluate the distribution of nitrate in groundwater beneath the City of Fresno and surrounding communities. The GIS contained over 40 years of historical groundwater elevation and groundwater quality data from over 300 wells. The GIS was used to evaluate historical sources of nitrate to groundwater (septic systems, dairies, waste water discharge areas, etc) and changes in nitrate in groundwater over time from 1960 to present. The evaluation results were utilized to develop a nitrate management plan to further reduce nitrate concentrations in groundwater.

Kern Water Bank Authority, Bakersfield, CA. Developed a regional

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scale groundwater flow model to evaluate recharge and pumping operations at the Kern Water Bank. The model used MODFLOW and MODPATH to evaluate the impacts of the infiltration of over 900,000 acre-ft of applied water on groundwater levels beneath 75 recharge basins spread over a 13 square mile area. The model incorporated monthly recharge and pumping within the Kern Water Bank area from 1990 through 2002. The model has been used to optimize future recharge and recovery operations maximize storage and recovery within the bank and minimize outside losses.

Verdugo Basin Model, Cresenta Valley Water District, Cresenta Valley, CA. Geomatrix was retained to prepare a water budget and calibrate a groundwater flow model of the Verdugo Basin in Los Angeles County for the Cresenta Valley Water District. The Verdugo Basin is a fault controlled, steeply-dipping basin with over 900 feet of relief filled with alluvium and debris flows derived from the surrounding Verdugo and San Gabrial Mountains. The model was calibrated to over 3,000 water level observations from June 1981 through December 2002 and incorporates mountain front recharge and intermittent streams. The model was used to evaluate potential artificial recharge areas within the Verdugo Basin.

Conceptual Model, Westlands Water District, Fresno, CA. Developed a conceptual numerical model of a proposed water bank at Arroyo Pasajero, Fresno County. The 3-D MODFLOW and MT3DMS model simulated 50-years of seasonal recharge and extraction operations of up to 50,000 acre-ft per year. The model was used to optimize the number and locations of proposed additional extraction wells to recover the recharged water without creating excessive drawdown beneath adjacent properties and to account for mixing of the recharge water with native water.

Feasibility Study, Merced Irrigation District, Merced, CA. Directed a 2-year well field feasibility study in the southeast quadrant of the water district to evaluate groundwater resources and potential recharge areas. Installed 14 exploration boring and two test wells to identify up to 50 cfs of additional irrigation well capacity. Developed a GIS of existing wells within the study area and a regional scale MODFLOW model calibrated to 30 years of observed groundwater levels in over 160 observation wells. The GIS and model were used to evaluate the feasibility of installing a well field capable of delivering 50 cfs of irrigation water when surface supplies are curtailed.

Regional Scale Model, Joint Defense Group, Sacramento, CA. Developed a regional scale model of the Sacramento area using MODFLOW, MODPATH , and MT3DMS to evaluate the effects of Sacramento River recharge and Ranney Collector pumping on the migration of a plume of PAHs and BTEX in groundwater. The model was extensively calibrated to seasonal changes in river stages and groundwater extraction from the Ranney collector.

ARVIN-EDISON WATER STORAGE DISTRICT

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March 10, 2008

Hal Crossley, General Manager
Rosedale-Rio Bravo Water Storage District
849 Allen Road
P.O. Box 867
Bakersfield, CA 93302

RE: *Strand Ranch Integrated Banking Project Comments*

Dear Mr. Crossley,

Thank you for providing Arvin-Edison Water Storage District (AEWSD) the opportunity to comment on the Rosedale-Rio Bravo Water Storage District (RRBWSD) and Irvine Ranch Water District's (IRWD) draft environmental impact report (DEIR) regarding the Strand Ranch Integrated Banking Project (Project).

AEWSD is generally supportive of groundwater banking programs and projects. As you are aware, AEWSD is currently working with RRBWSD to finalize a long-term banking program. Historical programs between AEWSD and RRBWSD are cited in the DEIR.

AEWSD would like to take this opportunity to address some of its concerns regarding certain items mentioned or described in the DEIR. We request either a formal response to our comments or that they are adequately addressed in the final environmental impact report. Our more specific comments are as follows:

Section 2.5.3 (page 2-8) – Water Supplies

One of the Project water supplies indicated is Central Valley Project (CVP). It is important to note that conveyance of such supplies cannot restrict AEWSD's capacity use in the Friant-Kern Canal (FKC) in any way. AEWSD is the lone long-term CVP contractor in the last reach of the FKC. AEWSD-1

Section 3.8 – Hydrology, Groundwater Resources and Water Quality

Table 3.8-1 (page 3.8-5) and Table 3.8-3 (page 3.8-25) AEWSD-2

The above-mentioned tables list an arsenic maximum containment level (MCL) of 50 ug/L but Table 3.8-2 (page 3.8-12) lists an arsenic MCL of 10 ug/L. The reported MCL data should be consistent with current regulatory standards.

Groundwater Impacts – Mitigation Measure 3.8-1 (page 3.8-27)
AEWSD is concerned with negative impacts as a result of high groundwater levels in the vicinity of the Cross Valley Canal (CVC). The CVC and AEWSD have experienced problems with concrete panels "popping off" due to the high water levels from groundwater banking operations which have led to costly repairs. The referenced 12 feet bgs (below ground surface) measurement should be at or below the CVC invert (bottom) elevation. Please convert the 12 feet bgs standard to indicate the corresponding differential to CVC invert elevation to confirm an adequate differential is maintained at an acceptable water level near the CVC. AEWSD-3

Thank you and again we appreciate the opportunity to provide input into your Project. If you have questions or comments, please don't hesitate to call or email.

Sincerely,

Steve Collup
Engineer-Manager

cc: Steve Lewis, Staff Engineer
Jeevan Muhar, District Engineer

CHAPTER 11
Responses to Comments

California Department of Conservation, March 6, 2008

Comment DOC-1

The comment expresses agreement that the project as described in the EIR is compatible with the Williamson Act. No response is required.

Kern County Water Agency, March 10, 2008

Comment KCWA-A

The comment states that the EIR does not adequately describe the rights and obligations of either Rosedale or IRWD, particularly with respect to how Rosedale will utilize the facilities to meet its Conjunctive Use Program obligations and how the Memorandum of Understanding (MOU) will be incorporated into the project. The comment requests that the EIR be recirculated for these reasons.

Section 2.8 of the Project Description in the EIR provides a clear explanation of Rosedale's ability to utilize the proposed facilities to meet its existing obligations. The EIR explains that recharge facilities on Strand Ranch could be used for up to 17,500 afy for IRWD with the full remaining unused capacity available to Rosedale. The extraction facilities on Strand Ranch could be used to extract up to 17,500 afy to meet the needs of IRWD or to meet existing Rosedale obligations other than IRWD, but total extraction from these wells for any purpose will not exceed 17,500 afy. The extraction facilities located off of the Strand Ranch could be used, up to the full capacity thereof, to help meet the 17,500 afy obligation to IRWD or to meet existing Rosedale obligations other than IRWD. Recovery operations from wells located both on and off Strand Ranch would be limited to a combined rate of 36 cfs (or up to 40 cfs as required to meet requirements imposed by the proposed MOU) for either IRWD or Rosedale's use. The annual volume of IRWD's extractions from the three wells located off Strand Ranch would be limited to 17,500 afy in combination with extractions from wells on the Strand Ranch. The annual volume of Rosedale's extractions from the three wells located off Strand Ranch would be limited to the amount of water previously recharged within the Rosedale service area and would not exceed, in combination with Rosedale's extractions from other wells in its program, Rosedale's 45,750 afy maximum recovery obligations as presented in Table 2.1 of the EIR. See also responses to comments KCWA-1, KCWA-2 and KWBA-IIf below.

In addition, Section 2.8 explains that when high-flow Kern River water is available, or during periods when IRWD is not utilizing the Strand Ranch recharge basins, or when IRWD has reached its maximum annual recharge of 17,500 af, Rosedale would be able to use the basins to recharge water for its own needs or for its other program partners.

The comment and response do not meet any of the criteria for recirculation of an EIR. The *CEQA Guidelines* Section 15088.5 states that an EIR must be recirculated if "significant new information" comes to light during the public review process. The Guidelines note that "new information added to the EIR is not "significant" unless the EIR is changed in a way that deprives the public of a meaningful opportunity to comment upon a substantial environmental effect of the project…" Furthermore the *CEQA Guidelines* suggest that recirculation could be required under the following circumstances:

1) A new significant impact is identified that was not analyzed in the EIR;

2) New information suggests that a substantial increase in the severity of an impact is identified;

3) Mitigation that would reduce impacts is not being considered; or

4) The EIR is "so fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded."

The comment and response do not present any "significant new information" that would suggest recirculation of the EIR. The comment and response do not present evidence that the impacts identified in the EIR would be substantially greater than described in the EIR. No significant impact has been identified for which additional mitigation has been suggested that Rosedale is not willing to adopt. And finally, the EIR is clearly not conclusory in nature, but rather provides substantial evidence through data analysis and groundwater modeling supporting the conclusions of the analysis.

Comment KCWA-1

The comment requests that the EIR clearly define how the project will be covered in the MOU. Rosedale has negotiated two virtually identical MOUs in connection with its existing projects. The EIR on page 2-5 states that the project would be subject to and consistent with the conditions of one such MOU. That MOU is included in Appendix E of the EIR. Prior to implementing the proposed project, Rosedale will use good faith efforts to negotiate an agreement substantially similar in substance to this MOU. Said negotiations will determine whether the MOU obligation is satisfied by amendment of an existing MOU to incorporate the current project or by negotiation of a new MOU for the current project.

Comment KCWA-2

The comment suggests that the EIR is not internally consistent since the maximum extraction for IRWD of 17,500 afy does not include potential additional extraction by Rosedale. As noted on page 2-6 and 2-17 of the EIR, groundwater extraction from the project facilities on Strand Ranch by either IRWD or Rosedale would be capped at 17,500 afy. IRWD does not anticipate the need to extract water except in dry year periods. During years when IRWD is not extracting water or not fully using the 17,500 afy extraction capacity, Rosedale would be allowed to utilize Strand Ranch facilities to extract up to the maximum 17,500 afy capacity to meet obligations of other banking projects. In addition, when not being utilized to provide water to IRWD, Rosedale would be allowed to utilize project facilities not located on Strand Ranch to extract water to meet the requirements of its existing projects shown on Table 2-1. See response to comment KCWA-A.

Comment KCWA-3

The comment states that the EIR does not address adequately the availability of SWP water or assess the impacts of using the water on other water districts. The EIR describes potential water sources in Section 2.5.3. The EIR acknowledges that firm water sources have not yet been identified. IRWD would be opportunistic in its pursuit of water that was made available at any time. The EIR lists and describes what these sources could be, but does not consider that any of the sources would constitute a dependable yearly water supply. The water would only be made available by DWR, BOR, or the USACE, under conditions of approval established by them, including service priorities, such that no SWP contractors or other water districts should be adversely affected. Rosedale and IRWD would be subject to the conditions established by the water supplier. IRWD and Rosedale would adhere to CEQA requirements as imposed by regulators of project water sources. To further clarify the EIR in response to this comment, the following modification has been made to the discussion of Impact 3.12-2:

> The proposed project does not require a new water supply. IRWD would secure entitlements for excess water not otherwise being used, subject to the conditions established by the water supplier and availability ~~during wet hydrologic periods~~.

This textual change has also been made in three other locations in the Final EIR: the third objective on page S-3, the third objective on page 2-1, fourth paragraph on page 2-8, and the third objective on page 6-2.

Comment KCWA-4

The comment states that the EIR does not adequately address the potential impacts to local districts from the use of Section 215 flood waters. Under existing conditions, Rosedale diverts Section 215 flood waters during certain wet periods for recharge into its service area. Integrating the Strand Ranch into the Rosedale service area would not change Rosedale's right to receive Section 215 flood waters but may allow Rosedale to recharge greater quantities and, thereby, avoid greater loss of such supply. However, this water would only be made available by BOR under conditions of approval established by BOR, including service priorities, such that no other local district should be adversely affected.

Comment KCWA-5

The comment notes that a point-of-delivery agreement would be required between KCWA, DWR and SWP contractors. Also the comment notes that an operations agreement would be required with the KCWA. The list of approvals provided on page 2-18 of the EIR includes an approval from DWR for use of the California Aqueduct as well as an agreement with KCWA for the use of the CVC. In response to this comment, the following modification has been made to page 2-18:

- Kern County Water Agency: approval for use and modifications required to the Cross Valley Canal and a point-of-delivery agreement among DWR, KCWA, and other SWP contractors.

Comment KCWA-6

The comment notes that the EIR references the 2001 Building Code and requests that the newer code approved in 2007 be incorporated. The project would be subject to the most recently updated Building Code. The 2007 Building Code identifies the project within the same Seismic Risk Zone 4 as the previous code. In response to this comment the following text change has been made to the second sentence of the first paragraph on page 3.6-4 of the Final EIR:

> The 2007~~1~~ California Building Code locates the entire region within Seismic Risk Zone 4.

Comment KCWA-7

The comment notes that canals can be damaged by liquefaction. The EIR acknowledges that elevated groundwater levels could result in liquefaction hazards at the Strand Ranch. Shallow groundwater has occurred in the area historically. Therefore, structures such as the CVC are subject to liquefaction hazards without the project. The project may increase the frequency for shallow groundwater under the site, but would not present a new liquefaction hazard in an area not already subject to the hazard and, with incorporated monitoring and mitigation, would not increase the hazard. As to monitoring and mitigation, see response to KCWA-13. Furthermore, the project area is located toward the middle of the San Joaquin Valley, approximately 15 miles from the Kern Front fault as shown on Figure 3.6-1. Groundshaking intensities at the Strand Ranch resulting from activity on distant faults would be considerably less than in areas closer to active fault zones.

Comment KCWA-8

The comment notes the discussion in the EIR of liquefaction potential at the Strand Ranch. The EIR acknowledges in Impact 3.6-1 that the Strand Ranch would be subject to liquefaction hazards that would be more acute during periods of shallow groundwater. See responses to comments KCWA-7 and KCWA-13.

Comment KCWA-9

The comment requests evidence that subsidence would not be a significant impact of the project. Impact 3.6-3 identifies that subsidence could result from the project. The impact discussion notes that subsidence generally occurs due to compaction of overlying confining layers resulting from long-term drawdown. The existing conditions at Strand Ranch do not reflect this hydrogeologic regime since groundwater levels have fluctuated substantially over the years including recent high water elevations. The historic subsidence identified in the EIR occurred in areas where long-term drawdown was not relieved by periodic recharge. As stated in the EIR on page 3.6-7, the "usual remedial action for land subsidence is that of raising the water table by injecting water or by reducing groundwater pumpage." The project would not extract groundwater without first providing recharge of surface water into the underlying aquifer. In addition, there are limitations to the amount of groundwater that can be extracted which help safeguard the aquifer from being overdrawn. More water will always be recharged than recovered. Therefore, in consideration of the absence of an overlying confining layer relative to the proposed producing zones at the project site combined with a positively balanced groundwater recharge and recovery program, the project site would have a less than significant potential for subsidence.

Comment KCWA-10

The comment suggests that additional investigations are required to determine if historical uses affecting soil quality at the Strand Ranch could affect groundwater quality. The EIR evaluates the potential for contaminated soils to exist on site in Section 3.7. Impact 3.7-1 identifies that contaminated soils could occur on site. The EIR summarizes the results of the Phase I Site Assessment and concludes that as part of the project, soils near the fuel and pesticide storage sites would be removed prior to the construction of recharge basins. The EIR notes that surface soils would be graded and used to form the recharge basin berms, removing any residual pesticides that may exist. Furthermore, legacy pesticides that could have moved deeper into the ground would have been dissipated during recent periods of high groundwater. Water quality analyses from groundwater beneath the project site have not reported elevated levels of pesticides. In response to this comment, to ensure that water quality is protected, the following mitigation measure has been added to the discussion under Impact 3.7-1:

> **Mitigation Measure 3.7-1a.** IRWD shall collect representative samples of soils remaining in place near the former fuel and pesticide storage areas identified in the Phase I Site Assessment. The samples shall be analyzed for total petroleum hydrocarbons and pesticides. IRWD shall remove from the site in accordance with applicable waste disposal regulations, soils identified as containing hazardous quantities of contaminates.

Comment KCWA-11

The comment suggests that TDS and arsenic levels noted in Table 3.8-1 may not represent actual water quality of SWP delivered to the site. The comment also notes that the arsenic MCL is incorrectly noted in Table 3.8-1. The quality of water in the California Aqueduct varies. The California Department of Water Resources manages the quality of water discharged into the aqueduct. Well water supplied from Strand Ranch to the CVC would comply with DWR and KCWA requirements. The EIR acknowledges the water quality variability of the source supplies and finds that the pump-in water quality requirements provide adequate protection to maintain adequate quality. Mitigation Measure 3.8-3 on page 3.8-29 of the EIR identifies that IRWD and Rosedale shall ensure that water quality testing is conducted prior to introduction of extracted groundwater into the CVC or California Aqueduct subject to review and approval by the KCWA and DWR. The EIR correctly identifies the arsenic MCL of 10 ug/l in Table 3.8-2 and incorrectly identifies 50 ug/l as the MCL in Tables 3.8-1 and 3.8-3. In response to this comment, Tables 3.8-1 and 3.8-3 have been revised to reflect the correct arsenic MCL of 10 ug/l.

Comment KCWA-12

The comment notes that some constituents of concern may not be listed in Table 3.8-2 and that additional water quality analysis may be necessary prior to implementing the project. Table 3.8-2 lists only constituents of concern that were above the "Non Detect" level. A full listing of water quality analysis results is included in Appendix H that includes the full Title 22 analysis results. Nitrate and Dibromo Chloropropane were below the detection limit for samples collected on the Strand Ranch. Mitigation measure 3.8-3 commits IRWD and Rosedale to conducting water quality sampling of extracted water to ensure that water quality requirements of the conveyance facilities are met. The Final EIR has been modified to include the additional Appendix H.

Comment KCWA-13

The comment identifies an area at the western edge of the property where CVC facilities are not above-ground and states that mitigation measure 3.8-1 is insufficient to protect CVC facilities from impacts of shallow groundwater in this area. The comment requests that Rosedale and IRWD enter into an agreement with the KCWA for a monitoring and operations plan. Mitigation measure 3.8-1 commits IRWD and Rosedale to installing piezometers and conducting regular monitoring to ensure that groundwater is not raised above 12-feet below ground surface. In response the mitigation measure has been modified as shown below:

> **Mitigation Measure 3.8-1:** IRWD and Rosedale will agree with the KCWA on a monitoring and operations plan to avoid impacts to CVC facilities as a result of project operations. As part of said monitoring and operations plan IRWD and Rosedale will install and monitor piezometers adjacent to the CVC within the Strand Ranch property. When groundwater approaches 12 feet ~~bgs~~ beneath the CVC facilities, IRWD and Rosedale will consult with geotechnical engineers to determine if conditions might pose a risk to subsurface structures if further recharge operations were to continue. Under such conditions, piezometer data collected on the Strand Ranch as well as information from the geotechnical engineers will be shared with KCWA. If subsurface structures are determined to be at risk from high groundwater, IRWD and Rosedale will temporarily cease recharge activities until water surface elevations no longer pose a risk to subsurface structures.

Comment KCWA-14

The comment notes that the EIR must state that the quality of water pumped into the CVC or California Aqueduct meet DWR pump-in guidelines. The EIR identifies that water pumped into the CVC must meet DWR pump-in water quality requirements. Mitigation Measure 3.8-3 on page 3.8-29 of the EIR identifies that IRWD and Rosedale shall ensure that water quality testing is conducted prior to introduction of extracted groundwater into the CVC or California Aqueduct subject to review and approval by the KCWA and DWR. IRWD and Rosedale would not be able to utilize the CVC or California Aqueduct without meeting pump-in water quality requirements. See response to comment KCWA-12.

Comment KCWA-15

The comment states that the EIR does not define the manner in which the project would be integrated into the MOU nor evaluate impacts of integration. See response to comment KCWA-1. The EIR does evaluate the impacts of integrating the project into the existing Conjunctive Use Program. Section 2.4 of the EIR summarizes the existing Program and lists each distinct banking agreement within the Program. Sections 2.5.2 and 2.5.4 describe how Rosedale would be able to utilize the proposed facilities to meet existing obligations. Impact 3.8-1 addresses the potential impacts of drawdown that could occur in conjunction as a result of the proposed project. These effects could be experienced during extraction conducted by either IRWD or Rosedale. Extraction from Strand Ranch would be limited to 17,500 afy. For IRWD, extraction could only occur after the water had been recharged on the Strand Ranch. For Rosedale, extraction could only occur after the water had been recharged within the Rosedale service area. See responses to comments KCWA-A and KCWA-1 for further discussion of extraction limitations and incorporation of the project within MOU requirements.

Comment KCWA-16

The comment states that the EIR is inadequate since it does not evaluate land conversion and water balance within Rosedale's service area as requested by KCWA in the NOP scoping period. The EIR acknowledges on page 5-4 that land uses within Rosedale's service area are encroaching onto former agricultural lands. Table 5-6 shows that urban water use has doubled in the service area since 1976 and that overall water use has remained relatively constant at approximately 91,000 afy. The EIR notes that this trend is expected to continue. Water balance within the Rosedale service area would not be adversely affected by the proposed project. Given the requirement in the MOU that a portion of recharged water is to remain in the ground as losses, the project presents a benefit to the overall water balance in the region. Further, the conversion of irrigated agricultural lands to recharge basins rather than homes reduces urbanization while increasing Rosedale's ability to capture and recharge available water. The EIR adequately identifies the project's relationship to land use trends in the region and concludes that the project would not adversely impact water balance. Even so the project would capture high flow Kern River water that might otherwise be lost.

Comment KCWA-17

The comment notes that the EIR does not include a tumbleweed control program. Section 2.8.1 notes that the project area would be leased for grazing much of the time. Grazing would assist in minimizing proliferation of weeds on the project site. Section 2.8.2 describes the project's incorporated commitment of Rosedale and IRWD to conducting weed control measures utilizing products approved for aquatic use. This maintenance responsibility would include tumbleweed abatement.

Kern Water Bank Authority, March 10, 2008

Comment KWBA-A

The comment summarizes the primary concern that the proposed project would adversely affect water levels and water quality in the region. The EIR adequately evaluates the project's potential effects on water levels at neighboring wells. The EIR adequately identifies potential water quality concerns and identifies measures to maintain water quality. See responses to more detailed comments pertaining to the same issues below.

Comment KWBA-Ia

The comment states that the EIR should evaluate the entire Conjunctive Use Program since the project will be integrated into the Program. The comment asks whether the EIR tiers from the Master EIR. The EIR does not tier from the existing Master EIR prepared for Rosedale's

Program, nor does it undertake to evaluate the entire Conjunctive Use Program. Rather the EIR is a stand-alone EIR evaluating the Strand Ranch Project's potential effects in conjunction with the existing Program. Previous environmental documents including the Master EIR find no significant impacts to groundwater resources resulting from the proposed Conjunctive Use Program, since ultimately more water would be recharged than extracted. The Strand Ranch EIR provides a similar assessment concluding that, although water levels would fluctuate as they do under current conditions, more water would be recharged into Rosedale's service area than would be extracted for the project. The EIR concludes that integration of two projects that result in beneficial water balance to the region would not present significant adverse impacts to the groundwater basin. The EIR also provides a cumulative assessment of the project's relationship to other water banking operations in the region including the KWBA and concludes that the effects of the project in combination with other groundwater banking in the Kern Fan are not cumulatively significant.

The comment correctly notes that Rosedale's Master EIR identifies that the Program would accommodate a maximum of 100,000 afy of recharge and a maximum of 45,000 afy of extraction. Over time, following additional environmental review, the Program has been modified to increase maximum recharge to not less than 150,000 afy as shown in Table 2-1 of the EIR. The EIR provides the inventory of projects that make up the current Conjunctive Use Program. Each project listed in Table 2-1 has had environmental review in compliance with CEQA. Maximum extraction for the Program exceeds the maximum extraction provided for in the Master EIR by 750 afy. The potential impact of extracting the additional 750 afy is covered in this EIR since the Strand Ranch facilities in combination with the three wells in Rosedale may be used to extract this additional water. Although the additional 750 afy could be extracted by the project facilities, extraction from Strand Ranch would be capped at 17,500 afy as clearly described in the EIR.

Comment KWBA-Ib

The comment requests clarification of the relationship of the project with the existing Conjunctive Use Program and Master EIR. As noted in response to comment KWBA-1a, The EIR does not tier from the Master EIR prepared for the Conjunctive Use Program. The EIR is a stand-alone EIR evaluating the Strand Ranch Project's potential effects in conjunction with the existing Program. Section 2.8 of the EIR clearly explains that Rosedale may use the proposed project facilities to meet its existing obligations within the Conjunctive Use Program under the limitations presented by the terms of the project. See response to comment KWBA-Ia.

Comment KWBA-Ic

The comment states that the EIR incorrectly identifies the Master EIR, which should be called a Program EIR. The Strand Ranch EIR does not tier from the Master EIR, but references it in relation to the existing Conjunctive Use Program. The Master EIR was certified with the title "Master EIR" by Rosedale in 2001, and therefore, the Strand Ranch EIR references it appropriately by its title.

Comment KWBA-IIa

The comment states that the project description does not describe the whole action and is therefore inadequate, particularly with respect to how the MOU would be integrated. See responses to comments KCWA-A and KCWA-1.

Comment KWBA-IIb

The comment asks how the property can be used as agricultural land for eight months per year while at the same time accommodating more than four months per year of recharge. This is not a contradiction, and agricultural uses will be made in at least the indicated proportional duration, for the following reasons: recharge operations would not occur every year. During dry years, the property would be available for agricultural use all year. Furthermore, during periods of recharge, some areas will remain open for grazing. The EIR notes on page 2-16 that recharge operations would vary widely from year to year but that in years when water was available recharge activities are estimated to occur for three to four months. In any event, Rosedale and IRWD will comply with all requirements of law and contract. The foregoing is part of the incorporated commitments of the project as described in the EIR and accordingly, a mitigation measure is not necessary.

Comment KWBA-IIc

The comment notes that the EIR mentions that the project would eliminate agricultural extractions but also could include organic farming. In response to this comment, the first paragraph on page 2-3 has been revised as follows:

> Utilizing existing underground storage capacity of the Kern County aquifer avoids the need to construct extensive surface water storage facilities elsewhere to perform the same function. In addition, the project helps protect the basin from overdraft by annexing Strand Ranch into Rosedale and ~~eliminating~~ <u>reducing</u> the extraction of groundwater for agricultural production. Strand Ranch currently is not part of a water storage district, and thus water extracted for agricultural irrigation is not replenished. <u>Once the project is annexed into Rosedale extraction for agriculture would only occur after recharge.</u>

Comment KWBA-IId

The comment requests clarification for whether the water would be used for third party exchanges or sales. The EIR project description presents scenarios for when IRWD would consider accessing water from the banking program. The scenarios highlight situations where IRWD may need supplemental water supplies. The EIR does not evaluate a scenario in which water is extracted for the purpose of third party exchanges or sales. Under such scenarios, additional CEQA review would be undertaken as determined to be required.

Comment KWBA-IIe

The comment suggests that the EIR does not adequately identify water sources or assess potential impacts of using the water sources identified. The EIR does not defer analysis as suggested in the comment. The EIR provides detailed description of water sources in Section 2.5.3. The EIR notes that water would be accessed opportunistically when not being used and subject to availability. The EIR clearly states on page 2-8 that it is the intent of the EIR to evaluate potential impacts such that no additional CEQA analysis would be required to recharge water from the sources described in the document. The EIR then states that if other water sources become available, subsequent CEQA may be required. IRWD and Rosedale would adhere to CEQA requirements as imposed by regulators of project water sources. See also response to comments KCWA-3 and KCWA-4.

Comment KWBA-IIf

The comment asks for clarification on whether Rosedale could extract water from Strand Ranch that was recharged elsewhere within Rosedale's service area. As noted in the comment, the EIR states on page 2-17 that Rosedale could extract up to 17,500 afy from Strand Ranch that was recharged elsewhere in Rosedale's service area. The service area overlies a continuous aquifer that is in direct connection with the Strand Ranch as well as other water users in the region including the KWBA. The impact analysis in Section 3.8.4 assesses extraction of up to 17,500 afy from Strand Ranch irrespective of water recharged at Strand Ranch. The EIR fully analyzes the use of Strand Ranch facilities by Rosedale. The EIR concludes that although localized areas of drawdown would occur during temporary extraction periods, the overall effect on the continuous Kern Fan aquifer would be beneficial.

Comment KWBA-IIg

The comment asks if there is a specific duration for the project. The duration of the project has not been limited.

Comment KWBA-IIh

The comment requests clarification for the minimum setback designed for the recharge ponds. The EIR states on page 2-6 that recharge basins would be set-back a minimum of 110 feet from the section lines to meet County set-back requirements. However, the EIR mistakenly identified the Kern County setback requirement as 110 feet. The Kern County zoning ordinance reads "A minimum setback of forty-five (45) feet and fifty-five (55) feet shall be required for all permanent buildings and structures from midsection and section lines respectively." The earthen embankments for the project will be constructed consistent with the County's setback requirements, including any necessary adjustments to the interim basins. In response to this comment the seventh sentence in the last paragraph on page 2-6 of the Final EIR has been modified as follows:

> The basins would be set back a minimum of 55~~110~~ feet from ~~the perimeter roadways (or~~ section lines~~)~~ around Strand Ranch as required by Kern County.

Comment KWBA-IIi

The comment states that the EIR should limit the number of wells proposed by the project. The EIR on page 2-16 limits the extraction rate from Strand Ranch to 36 cfs with the capability to go to 40 cfs during temporary periods if required to do so by the proposed MOU. It is also stated on page 2-16 that the combined recovery operations from wells located both on and off Strand Ranch would be limited to a combined rate of 36 cfs (or 40 cfs if required by the proposed MOU) for either IRWD or Rosedale's use. To achieve this extraction rate, the EIR assumes that between 5 and 8 wells would be necessary on Strand Ranch with the option to construct up to 3 additional wells in the existing Rosedale service area. Given that extraction capabilities of individual wells will vary, the EIR's analysis is based on an overall extraction rate rather than a number of wells. If the wells constructed could not extract the target rate, the EIR leaves open the possibility that additional wells could be drilled to achieve the target rate. The drawdown impacts would not change if more wells were needed to achieve the same 36 cfs capacity. The EIR on page 2-10 clearly states that wells on the Strand Ranch would be located a minimum of an 880-foot setback from the adjacent southern property line.

Comment KWBA-III
The comment suggests that urban uses may exceed 6,000 acres within Rosedale's service area. The comment also suggests that the assessment of residual pesticides and water sources is inadequate. The comment also suggests that the DEIR does not include sufficient discussion of the SWP, CVP or other water systems. The EIR notes on page 5-4 that urbanization within the Rosedale service area is a trend that is likely to continue. The comment is correct that current urban uses are likely greater than 6,000 acres within the service area. The EIR notes that as part of the project, stained soils near the former fuel storage areas would be removed. Surface soils containing residual pesticides would be graded from the recharge ponds to create the berms. Furthermore, high groundwater in recent years has likely leached any residual pesticides from the soils. Water quality analyses from groundwater beneath the project site have not reported elevated levels of pesticides. See response to comment KCWA-10. See responses to comments KCWA-3 and KCWA-4 regarding water supplies.

Comment KWBA-IVa1
The comment states that the hydrogeologic conceptual model is an oversimplification of the actual subsurface conditions, which cannot be simulated with the selected mathematical model. There appears to be some misunderstanding by the commenter on the strategy used to estimate groundwater level impacts from the proposed project. This response to comment will serve to eliminate such misunderstanding.

IRWD retained the services of a third-party reviewer, Wildermuth Environmental, to evaluate the groundwater modeling methods with respect to the conceptual hydrogeologic model documented in the EIR. The review assessed the applicability of the groundwater modeling conducted by Sierra Scientific Services (SSS) supporting the EIR analysis. Wildermuth Environmental credentials are presented in Appendix I of the Final EIR. The third-party review concluded given the described conceptual model, and parameterization of the model, that the modeling efforts were reasonable and sufficient to support the conclusions of the EIR. The following discussions responding to KWBA comments on the groundwater modeling efforts were prepared with the assistance of both Sierra Scientific Services and Wildermuth Environmental. Appendix I has been added to the Final EIR.

Three-Layer Conceptual Model. The groundwater modeling conducted by SSS to assess impacts to groundwater levels assumes that the underlying geologic conditions beneath Strand Ranch can be described as a three-layer model consisting of an upper aquifer, a middle relatively impervious layer, and a lower aquifer. The actual hydrogeology of the Kern River fan area is complex. The three-layer hydrologic conceptual model is based on decades of groundwater basin operations that include pumping and artificial recharge and the observation of the groundwater system response through long time histories of piezometric measurements and chemical analyses. Similar three-layer conceptual models for the Kern River fan area have been used and accepted in previous groundwater investigations that include: DWR/KCWA (DWR, 1977, Kern County Groundwater Model); Water Agencies of Kern County (Optimization Report, 1983); DWR/KCWA (KCWA, 1994, Kern Water Bank Monitoring Report); Kern Fan Monitoring Committee (KCWA, Kern Fan Monitoring Report); California Department of Water Resources (Swartz, July, 1995); Kern Water Bank Authority (Schmidt, 1997, KWBA Maximum Recovery Plan); and Kern County Water Agency (KCWA, Initial Water Management Plan).

The adaptation of the three-layer hydrologic conceptual model for the Strand Ranch and surrounding area is based in part on the work done by the entities listed above and specifically on the geology in the area of the Strand Ranch and the time history data for piezometric and groundwater chemistry in this area.

Two-Dimensional Model. The groundwater modeling conducted by SSS presents a two-dimensional mathematical model of the groundwater system. The upper aquifer is analyzed independently from the lower aquifer. This strategy assumes that the recharge and recovery operations proposed by the project function independently of each other. The impacts from recharge were assumed to occur only in the upper layer thereby creating the maximum groundwater level increases from recharge. A two-dimensional simulation of only the shallow zone is appropriate for estimating the maximum potential impact from recharge. The impacts for recovery were assumed to occur from wells completed in the deep layer only thereby maximizing drawdown estimates from the project. A two-dimensional simulation of the deep zone is appropriate for estimating the maximum potential impact from recovery. These are conservative assumptions and were used to develop conservative (maximum) impacts.

The mathematical model applied provides reasonable and conservative estimates of drawdown. The Hantush-Jacob equation was used for evaluating drawdown in the lower deep zone. This model can only be applied to a single aquifer layer and assumes a leakance from overlying aquifer layers. Assuming that all project production wells are single-zone, fully penetrating deep-zone wells, this is a reasonable and conservative application.

The EIR did not propose using multi-zone (multi-aquifer) wells, and therefore, multi-zone wells were not modeled. The Hantush-Jacob equation is a reasonable method for evaluating single-zone wells. All project wells that were modeled were single-zone, fully penetrating deep-zone wells. In response to this comment, the following sentences have been added to the last paragraph on page 2-10:

> All production wells will be completed within a single zone, shallow or deep. The project does not propose any multi-zone production wells.

The following additional references were used in preparing this response. These references have been added to Chapter 7 References of the Final EIR.

California Department of Water Resources. (1977). *Kern County Groundwater Model.*

California Department of Water Resources and Kern County Water Agency. (1994). *Kern Water Bank Monitoring Report, 1991 - 1993, Kern County, California.*

Kern Fan Monitoring Committee. (1996). *KCWA, Kern Fan Monitoring Report, 1994-96, Kern County California.*

Hantush, M.S., & Jacob, C.E. (1955). Non-steady radial flow in an infinite leaky aquifer. *Trans. Am. Geophys. Union., 36,* 95-100.

Kern County Water Agency. (2001). *Initial Water Management Plan, Bakersfield, California.*

Schmidt, K.D. (1997). *Kern Water Bank Authority Maximum Recovery Plan, Bakersfield, California.*

Swartz, R.J. (1995). *Development and calibration of the Kern Fan ground water model.Office Report, California Department of Water Resources, San Joaquin District, California.*

Water Agencies of Kern County. (1983). *Optimization Report, Kern County, California.*

Comment KWBA- IVa2

The comment states that the model used does not and cannot simulate recovery from the project wells proposed in the EIR and that it is incapable of simulating well recovery from multiple aquifer zones. The mathematical model applied provides reasonable estimates of drawdown. The Hantush-Jacob equation was used for evaluating drawdown in the lower deep zone. This model can only be applied to a single aquifer layer and assumes a leakance from overlying aquifer layers. Assuming that all project production wells are single-zone, fully penetrating deep-zone wells, this is a reasonable and conservative application.

The EIR does not propose using multi-zone (multi-aquifer) wells, and therefore, multi-zone wells were not modeled. The Hantush-Jacob equation is a reasonable method for evaluating single-zone wells. All project wells that were modeled were single-zone, fully penetrating deep-zone wells. Under these assumptions, the application of the Hantush-Jacob equation is reasonable.

For clarification, the following sentences have been added to the last paragraph of the Final EIR on page 2-10:

> All production wells will be completed within a single zone, shallow or deep. The project does not propose any multi-zone production wells.

Comment KWBA- IVa3

This comment states that the groundwater modeling used to determine recharge mounding impacts does not reflect proposed operations. The assumptions used to estimate shallow zone piezometric impacts from recharge are consistent with constraints imposed upon it by the Williamson Act. The proposed recharge operations for the Strand Ranch property assume that the property will be used for agriculture eight months per year on average. Recharge operations will occur based on the availability of water for recharge and the need to store water up to the project limit of 50,000 af. See response to comment KWBA-IIb.

Comment KWBA- IVa4

This comment states that analogies to other banking projects underestimate the calculated drawdown impacts. The comment also indicates that KWB recovery rates are lower than those proposed for the Strand Ranch.

The comment presents a qualitative observation of drawdown at unspecified locations which are said to be due to pumping at seven unspecified wells with unspecified pumping rates, unspecified durations, and at unspecified distances from the observation points, in addition to other unspecified "adjacent" wells which were also pumping. The commenter's analogy does not refute the analysis presented in the EIR.

In recognition of the natural variability of the key aquifer parameters, a sensitivity analysis was conducted using the range of likely aquifer parameters so as to represent the widest possible range of drawdown scenarios. The EIR presents the results of this sensitivity analysis in Appendix F, pp. 31 - 32.

The published recovery rate data for eleven (11) KWB wells in the area of the Strand Ranch is presented in the EIR (Appendix F, Table 1). Of the eleven (11) KWB wells in the area of interest surrounding the Strand Ranch, seven (7) had long-term (4-month) average recovery rates in excess of 5 cfs. These seven KWB wells ranged from 5.3 to 7.2 cfs and averaged 6.4 cfs which is significantly higher (128%) than the proposed Strand Ranch recovery rates. The other 4 wells averaged 4.2 cfs. The eleven-well average recovery rate is 5.6 cfs, which is 112% greater than the average proposed recovery rates per well for the Strand Ranch.

Comment KWBA- IVb1

This comment states that the water quality analysis (total dissolved solids) of recovered water is flawed and inadequate, specifically that the TDS of recovered water is understated. The comment points out possible TDS impacts on downstream users.

The TDS concentration of recovered water is not understated. The EIR analysis is supported by data collected from deep and shallow zone monitoring wells. The EIR assumes that with a 1:3 blending ratio of shallow-zone and deep-zone water with established average TDS values of 559 mg/l and 119 mg/l, respectively, the resulting blended water will have an average TDS concentration of 229 mg/l (mixing calculation: 0.25(559) + 0.75(119) = 229 mg/l). The TDS concentrations are blended averages from Appendix G page 23.

The shallow zone TDS concentration of 559 mg/l in the project description agrees with the TDS concentration of 562 mg/l suggested in the comment. The deep-zone TDS concentration of 119 mg/l in the project description differs from the TDS concentration in the comment because the deep-zone TDS concentration in the project description is based on the TDS concentration data from monitoring wells completed only in the deep zone whereas the TDS concentration estimates in the comment come from multi-zone wells which are influenced by higher-TDS water from shallower zones.

All groundwater recovered from the proposed project that is intended to be discharged into the Cross Valley Canal must meet the pump-in criteria of the Cross Valley Canal and the California Aqueduct. The EIR requires water sampling to confirm that water quality pump-in requirements are met. No adverse impacts to downstream users from the recovery of water at the proposed project would occur. See response to comment KCWA-14.

Comment KWBA- IVb2

This comment states that the brine plume analysis is deficient, specifically the EIR does not consider impacts due to the recovery and transport of contaminated water. The EIR incorporates the available brine plume data, identifies the plume perimeter, describes the nature and extent of impact, and provides a general fate and transport analysis of the plume into the water quality analysis of the project (see EIR, Appendix G, pages 16 - 25). According to a December 2007, verbal communication with Jon Parker (see EIR, Appendix G, page 16, footnote 4), the Regional Water Quality Control Board is aware of the brine plume but has not issued any orders regarding the plume.

All groundwater recovered from the proposed project that is intended to be discharged into the Cross Valley Canal must meet the pump-in criteria of the Cross Valley Canal and the California Aqueduct. The EIR requires water sampling to confirm that water quality pump-in requirements are met. No adverse impacts to downstream users from the recovery of water at the proposed project would occur. See response to comment KCWA-14.

Comment KWBA- IVb3

This comment states that the EIR analysis of contaminants in the Strand Ranch groundwater quality relative to maximum contaminant levels (MCL) is inadequate. The EIR uses average constituent concentrations as statistical metrics. This use is reasonable and acceptable. The MCL for arsenic is 10 ug/l, not 50 ug/l as stated in Table 3.8-3. The comment correctly points out the typographical error in the arsenic MCL value in Table 3.8-3, which will be changed to 10 ug/l in the EIR. See response to comment KCWA-11.

The commenter has made a valid point regarding the potential for arsenic concentrations in recovered water exceeding the arsenic MCL. If elevated arsenic levels are encountered from the wells screened in the deep aquifer, the extracted water would be blended with water from the wells screened in the upper aquifer which are not likely to exhibit the same high levels of arsenic. The groundwater recovered from the proposed project that is intended to be discharged into the Cross Valley Canal must meet the pump-in criteria of the Cross Valley Canal and the California Aqueduct. The EIR requires water sampling to confirm that water quality pump-in requirements are met. No adverse impacts to downstream users from the recovery of water at the proposed project would occur. See response to comment KCWA-14.

Comment KWBA- IVb4

The comment states that if exchange deliveries are completed, these deliveries will negate the positive net salt benefits. The salt balance in the project area will be positively impacted if the recovery of project water occurs by exchange. The EIR states on page 22 that recharging low-TDS water results in positive salt benefit to the basin. The EIR also illustrates that exporting higher TDS water results in positive salt benefit to the basin. Regarding exchange deliveries, the recharge of low-TDS water into the basin would still occur, but the export of higher TDS groundwater would not occur. If exchange deliveries were to occur, an overall net salt benefit would be positive. There are no impacts or negation of benefits from exchange deliveries.

The Strand Ranch project is not proposing to use multi-zone well completions. See response to comment KWBA-IVa1.

Comment KWBA- V

This comment states that the EIR fails to address the cumulative impacts of Rosedale's conjunctive use program. The comment further states that the impact analysis, with respect to groundwater resources, is deficient. The EIR concludes that the Strand Ranch water banking project would benefit the overall water balance. Similarly, Rosedale's Conjunctive Use Program provides an overall benefit to water balance within the service area. The EIR discusses cumulative impacts of the project to groundwater within the region on page 4-9. The analysis considers that several water banking projects exist on the Kern Fan. The EIR does not provide a quantitative accounting of all water extractions in the Kern Fan since such an effort is not necessary. Rather, the EIR provides a qualitative assessment of the overall benefit to the Kern Fan posed by water banking, and relies on the direct impact assessment conducted for the potential drawdown effects of the project on neighboring wells as an indication that the project would not add considerably to a regional, cumulatively significant groundwater drawdown. The analysis predicts based on historical patterns that groundwater levels under Strand Ranch and within the Kern Fan would recover quickly from periodic pumping caused by water banking projects managed under the existing cooperative groundwater management process. See response to comment Geomatrix-4.

Comment KWBA-VIa

This comment states that the description and analysis of mitigation measures is inadequate, specifically in relation to the MOU and mitigation measures for groundwater levels and quality. The EIR clearly commits Rosedale and IRWD to work within the context of an MOU as discussed in response to comment KCWA-1. The limited scope of the project as shown in the detailed project description, coupled with the mitigation measures included in the proposed MOU adequately minimize impacts on neighboring lands including the KWB.

Comment KWBA- VIb

This comment states that the analysis of mitigation measures is inadequate, specifically in relation to wells within 1/3 of a mile of existing wells. The guiding principle for the placement of the proposed Strand Ranch project well field is to use a minimum setback distance of no less than 880 feet (1/6-mi) from the property boundary. The individual well-to-well distances across the property boundary between project and non-project wells will depend on the setback distances used by the operators of non-project wells.

As a practical matter, the EIR points out that the well field is proposed to be laid out within the available area defined by the setback distances and with spacings and orientations in such a way to meet project objectives and to minimize the drawdown impacts on adjacent wells. The proposed project anticipates from 5 to 8 wells on the Strand Ranch. For well-field scenarios containing less than nine wells, the likely well placements would be such that one or more of the proposed locations (shown in Figure 2-3) which would not be used are those closest to the southern project boundary separating the Strand Ranch property and the KWB property, all else being equal.

The proposed project well location closest to KWB well 3R, i.e., the southwestern-most well location is labeled SR 09. Based on the modeling analysis presented in the EIR, the difference in the calculated drawdown at KWB well 3R between operating a well at SR 09 and not operating a well at SR 09 is only 1 foot of drawdown.

The existing KWB well 3R is set back from the property line by about 100 feet. Hypothetically, if the KWBA were to move well 3R to a setback distance 880 feet away from the property line, thereby honoring the local setback rule of thumb, then the decrease in calculated drawdown due to the increased setback distance is only 1 foot.

The EIR modeling work indicates that most of the drawdown occurs close to the wells on the Strand Ranch property and that the drawdowns decrease rapidly with increasing distance from the wells. Outside the property, the drawdowns are both smaller and change more slowly with increasing distance. Based on the EIR modeling data, the KWB well 3R is already sufficiently far away from the proposed Strand Ranch well location SR 09 that moving either well a few hundred feet only changes the drawdown by about 1 foot.

The setback distances are guiding principles, based on local experience, which provide standardized drawdown mitigation by the use of well separation which is sufficient in itself to substantially reduce impacts. The drawdown modeling in the EIR demonstrates that the voluntary compliance by the Strand Ranch project to honor the 880-foot setback reduces impacts on the KWBA wells.

Comment KWBA-VIc

This comment states that the analysis of mitigation measures is inadequate, specifically in relation to the 4-month limit on recharge. Since this limit is not part of the project description, the comment states that the 4-month limit on recharge should be listed as a mitigation measure. See response to comment KWBA-IIb.

Comment KWBA-VId

This comment states that the analysis of mitigation measures is inadequate, specifically in relation to project water losses. The comment states that a 3 percent loss in Appendix E is not appropriate and a 6 percent loss factor should be used as a mitigation measure. Appendix E of the EIR contains the proposed MOU. As noted on page 2-5 of the EIR, the proposed project would be subject to and consistent with the conditions of the proposed MOU. Therefore, the project is designed to recover only the amounts that have been stored through recharge activities minus the accounting of factored losses. A breakdown of these losses is outlined on page 4-10 of the EIR and summarized below.

The project is subject to the following losses: a 3 percent surface recharge loss, an additional 3 percent loss for water recharged and subsequently extracted for out-of-district use, an additional 5 percent loss for water banked by out-of-County entities, and a potential 4 percent loss for water banked if purchased by adjoining entities within 3 years.

Comment KWBA-VIIa

The comment states that the alternatives analysis is flawed because the EIR does not consider alternatives that would avoid impacts to the KWBA. The comment continues to state that the well density and recovery rates on adjacent KWBA lands are lower than those proposed for the Strand Ranch. CEQA requires that an EIR provide a reasonable range of alternatives that would avoid significant unavoidable impacts of the proposed project. The EIR concludes that the proposed project would not result in any significant and unavoidable impacts. Nonetheless, the EIR considered a no project alternative, a recharge location alternative, and an injection well alternative. (See EIR, Chapter 6). The analysis concluded that the proposed project presented fewer potentially significant impacts than the other alternatives. Furthermore, the analysis concludes that the proposed project is the environmentally superior alternative.

The comment relative to well density is not supported by fact. A review of the well location map (EIR, Appendix F, Figure 1) shows that the KWBA well density adjacent to and just southwest of the Strand Ranch project site (in and near the SE quarter of Sec 03) is irregularly spaced and much higher density than the proposed well field on the Strand Ranch project contradicting the claim in the comment. A review of the reported recovery rates (EIR, Appendix F, Table 1) for the eleven KWBA wells in the area of interest surrounding the Strand Ranch and the proposed Strand Ranch wells shows that seven of the eleven KWBA wells have long-term recovery rates (5.3 to 7.2 cfs) exceeding the proposed 5 cfs per project well, contradicting the claim in the comment. Second, the claim that the Strand Ranch drawdown impacts will "certainly" be greater than the KWBA drawdown impacts is not supported by fact. Drawdown is proportional to recovery rate. The maximum proposed recovery rate on the Strand Ranch is 36 cfs to 40 cfs whereas the maximum observed recovery rate from the eleven adjacent KWB wells in the area of interest is 61.5 cfs, i.e., approximately 170 percent greater than the proposed Strand Ranch recovery rate (EIR, Appendix F, Table 1). In addition, the total 36 to 40 cfs for the project may be divided with some extraction occurring on the Strand Ranch and some from wells located in the Rosedale service area. The project description identifies that up to 3 wells could be constructed off of Strand Ranch in Rosedale's service area. Section 2.8 identifies that recovery operations from wells located both on and off Strand Ranch would be limited to a combined rate of 36 cfs with operational flexibility to 40 cfs for either IRWD or Rosedale's use.

Comment KWBA-VIIb

This comment states that the alternatives analysis is flawed because the EIR does not consider storage facilities in Orange County, conservation measures, or the increased use of recycled water. The comment also suggests that impacts to wells in the KWB could lessened by placing some of the project wells elsewhere in Rosedale. The EIR does describe the alternatives of conservation, recycled water and additional storage in Orange County in Section 6.5. The EIR concludes that since the Strand Ranch Water Banking Project is a dry-year water reliability project, it is best developed in conjunction with these other water demand management strategies to provide an overall balanced water supply portfolio. Aggressive pursuit of augmented IRWD water demand management alternatives would not sufficiently increase conservation achieved by IRWD's existing demand management programs to eliminate imported water from the supply portfolio or preclude the utility of the proposed project as a water reliability project. The total 36 to 40 cfs for the project may be divided with some extraction occurring on the Strand Ranch and some from wells located in the Rosedale service area. The project description identifies that up to 3 wells could be constructed off of Strand Ranch in Rosedale's service area. Section 2.8 identifies that recovery operations from wells located both on and off Strand Ranch would be limited to a combined rate of 36 cfs with operational flexibility to 40 cfs for either IRWD or Rosedale's use.

Comment KWBA-VIIIa

The comment states that the conclusions reached relative to groundwater quality, groundwater level impacts, and recovery rates in the EIR are erroneous and are contradicted by subsequent opinions and statements made by Rosedale representatives.

Rosedale denies the alleged contradictions but does not address the same since statements made subsequent to the EIR do not pertain to the adequacy of the analysis contained in the EIR. The following response addresses that portion of the comment which pertains to the adequacy of the EIR. The Strand Ranch project is proposing to recover no more than 17,500 af per year from the Strand Ranch causing temporary, seasonal, localized impacts, which are predicted to fully recover before the next pumping season. An evaluation of water level impacts with respect to well density was completed and summarized in Table 2 of Appendix F of the EIR. The project proposes 5 to 8 production wells on the Strand Ranch property. Impact analysis scenarios were evaluated assuming both seven wells and nine wells on the Strand Ranch. On page 3.8-23 of the EIR the well density is also addressed. The project description identifies that up to 3 wells could be constructed off of Strand Ranch in Rosedale's service area. Both the seven-well (on Strand Ranch) and three-well (in Rosedale's service area) drawdown analyses were performed assuming that adjacent KWBA wells were not pumping simultaneously with the proposed project wells. The effect at the KWBA wells due to pumping from the seven Strand Ranch wells and three Rosedale wells would still be within the one to 29 feet range. This small range of impact on water surface elevations on adjacent wells would not result in a loss of the KWB to perform recharge and recovery operations.

As the EIR points out, the appropriate measure of significant impact for the Strand Ranch project is the predicted drawdown itself, and not the number of wells, or the spacing of wells, or the particular cfs, or the placement of a single well, or some setback distance, or some other design specification.

The Strand Ranch project is not proposing to use multi-zone well completions and is therefore not proposing to create a potential pathway of concern. For clarification, the following sentences have been added to the last paragraph on page 2-10 of the EIR:

> All production wells will be completed within a single zone, shallow or deep. The project does not propose any multi-zone production wells.

Multi-zone wells can be a pathway for aquifer water quality degradation in wells that do not pump for long periods. Multi-zone wells are not planned for this project. By eliminating consideration of the use of multi-zone wells, concerns regarding adverse impacts of plume mobilization, downward inter-zonal flow, and inter-zonal water quality issues due to multi-zone cross connection are eliminated.

Comment KWBA-VIIIb

The comment states that the multi-zone high density recovery wells will lead to significant impacts on groundwater quality and levels and is contradictory to subsequent opinions and statements made by Rosedale representatives. Rosedale denies the alleged contradictions but does not address the same since statements made subsequent to the EIR do not pertain to the adequacy of the analysis contained in the EIR. The following response addresses that portion of the comment which pertains to the adequacy of the EIR.

As stated in response to comment KWBA-VIIIa, the Strand Ranch project is not proposing to use multi-zone well completions. By eliminating consideration of the use of multi-zone wells, concerns regarding adverse impacts of plume mobilization, downward inter-zonal flow, and inter-zonal water quality issues due to multi-zone cross connection are avoided.

Regarding well density, please see response to comments KWBA-VIIa and KWBA-VIIIa.

Comment KWBA-VIIIc

This comment states that the planned recharge activities are in contradiction with subsequent opinions and statements made by Rosedale representatives, specifically in reference to specific yield. Rosedale denies the alleged contradictions but does not address the same since statements made subsequent to the EIR do not pertain to the adequacy of the analysis contained in the EIR. The following response addresses that portion of the comment which pertains to the adequacy of the EIR.

In the analysis of the proposed Strand Ranch project, SSS applied data from nearby actual measurements to support a specific yield of approximately 20% on or immediately north of the Strand Ranch (DEIR, Appendix F).

Comment KWBA-VIIId

This comment states that the EIR's analysis and conclusion regarding the potential for contaminant plumes to impact groundwater quality is in contradiction with subsequent opinions and statements made by Rosedale representatives. Rosedale denies the alleged contradictions but does not address the same since statements made subsequent to the EIR do not pertain to the adequacy of the analysis contained in the EIR. The following response addresses that portion of the comment which pertains to the adequacy of the EIR.

Multi-zone wells can be a pathway for aquifer water quality degradation in wells that do not pump for long periods. Multi-zone wells are not planned for this project. Therefore concerns regarding adverse impacts of plume mobilization, downward inter-zonal flow, and inter-zonal water quality issues due to multi-zone cross connection are avoided. See response to comment KWBA-VIIIa.

Comment KWBA- VIIIe
This comment states that Appendix F and Appendix G were not prepared by a State Licensed Professional Geologist. The groundwater modeling analysis was prepared by Dr. Robert Crewdson, sole proprietor of Sierra Scientific Services (SSS). Although not a Licensed Professional Geologist, Dr. Crewdson has substantial credentials qualifying him to conduct the analysis he prepared for the project. Dr. Crewdson is a research associate and adjunct professor at California State University, Bakersfield, where he has taught upper division and graduate level courses in hydrology, contaminant transport, geochemistry, and geophysics. IRWD retained the services of a third-party reviewer, Wildermuth Environmental, to evaluate the groundwater modeling methods with respect to the conceptual hydrogeologic model documented in the EIR. The review assessed the applicability of the groundwater modeling conducted by SSS supporting the EIR analysis. Wildermuth Environmental credentials are presented in Appendix I of the Final EIR. The third-party review concluded given the described conceptual model, and parameterization of the model, that the modeling efforts were reasonable and sufficient to support the conclusions of the EIR. The discussions responding to KWBA comments on the groundwater modeling efforts were prepared with the assistance of both SSS and Wildermuth Environmental. Appendix I has been added to the Final EIR.

The *CEQA Guidelines* Section 15149 describes the technical qualifications required to conduct an adequate CEQA analysis. The section clearly states that "an EIR is not a technical document that can be prepared only by a registered professional." The *CEQA Guidelines* note that State statutes may provide that only registered professionals prepare certain studies used to control detailed design, construction, and operation. Final design that will control construction and operation of the proposed project facilities will be prepared by licensed professionals in compliance with California law.

Comment KWBA-VIIIf
This comment states that the Rosedale representatives' subsequent opinions and statements invalidate the findings in Appendices F and G of the EIR. Rosedale denies the alleged contradictions but does not address the same since statements made subsequent to the EIR do not pertain to the adequacy of the analysis contained in the EIR. The comment also questions the validity of Appendix F and G as it was not completed by a California licensed geologist. As to this comment, see response to comment KWBA-VIIIe.

Geomatrix, March 10, 2008 (attachment to KWBA letter)

Comment GEO-1

The comment states that the hydrogeologic model utilized to develop the mathematical model is not representative of the hydrogeologic environment and that it is inconsistent with field observations at the project site and vicinity. See response to comment KWBA-IVa1.

Comment GEO -2

This comment states that the selected mathematical model cannot simulate a three-dimensional hydrogeologic conceptual model as described within the EIR. And, as such, the EIR underestimates water well drawdown and the project's impacts on nearby wells. See response to comments KWBA-IVa1 and KWBA-IVa2.

The model includes parameters for influence from "leakance" into the zone being modeled from other aquifer zones. The assumption of a constant leakance rate is a simplification of the physical system required for the modeling. The modeling prepared by SSS assigns a leakance parameter based upon vertical hydraulic conductivities for sand silts and silty sands of the Kern Fan area. The sensitivity analysis completed and summarized in Table 4 of Appendix F in the EIR shows how drawdown varies based on increasing and decreasing the leakance parameter. The analysis shows that under a scenario where very low leakance occurred, drawdown on the closest neighboring well could be as much as an additional 15 feet. This sensitivity analysis shows that under this low leakance scenario, maximum drawdown at the closest KWBA well would be approximately 44 feet as opposed to the 29 feet described in the body of the EIR under the base case. This range of drawdown impact on water surface elevations in adjacent wells would not result in a loss of the KWBA to perform recharge and recovery operations. The sensitivity analysis provides a worse case leakance minimum that is more conservative than the base case with a decreasing leakance over time.

Comment GEO -3

This comment states that pumping and recharge scenarios simulated for groundwater impacts are based on assumptions inconsistent with site conditions and proposed operational procedures; as a result the DEIR under estimates water well drawdown and project impacts. Regarding assumptions made for the model, see response to comment KWBA-IVa1. Sources for model parameter data, including K_v, are listed in Appendix F, Exhibit 2, page 9.

Three hypothetical well field operating scenarios of 5, 7, and 9 wells were evaluated and documented in Appendix F of the EIR. Each scenario was designed to recover 17,500 af per year with all wells pumping at a nominal 5 cfs. The range of analysis was completed to evaluate well interference, evaluate the distribution of drawdown, and minimize the drawdown impacts to non-project wells in the surrounding area. All recovery facilities will be consistent with the project description on page 2-16 and 2-17 of the EIR with extraction rate limited to 36 cfs. Rosedale would have the ability to increase the combined rate of recovery to 40 cfs as required to meet mitigation requirements imposed by the proposed MOU.

Regarding pumping operations relative to screen intervals and aquifers, please see response to comment KWBA-IVa2.

Regarding the application of a constant leakance, please refer to response to comment Geomatrix-2.

Comment GEO -4

The comment states that a cumulative impacts analysis was not conducted for recovery of 50,000 af over three years and furthermore that cumulative drawdown impacts were not presented for dry-year periods when other nearby water banking entities were also recovering water. The comment states that the Winflow model used for the drawdown analysis is incapable of simulating the cumulative impacts in a multi-layer system aquifer resulting from multi-year recovery operations using wells completed within multiple aquifer zones.

The EIR considers direct impacts of the project in Section 3.8. This section of the EIR analyzes the direct impact of the extraction from Strand Ranch in combination with the three wells on Rosedale property to be used in conjunction with the Strand Ranch wells. The cumulative section of the EIR provided in Chapter 4 describes the regional setting, acknowledging historical groundwater extraction and water banking programs in the Kern Fan area.

The EIR concludes that the Strand Ranch water banking project would benefit the overall water balance. Similarly, Rosedale's Conjunctive Use Program provides an overall benefit to water balance within the service area. The EIR discusses cumulative impacts of the project to groundwater within the region on page 4-9. The analysis notes that several water banking projects exist on the Kern Fan. The EIR does not provide a quantitative accounting of all water extractions in the Kern Fan since such an effort would be a substantial undertaking requiring data collection not warranted within the context of a CEQA cumulative analysis. Rather, the EIR provides a qualitative assessment of the overall benefit to the Kern Fan posed by water banking, and relies on the direct impact assessment conducted for the potential drawdown effects of the project on neighboring wells, the historical recovery rates for wells in the area, and the net benefit from the project's losses to the groundwater basin as the basis for concluding that the project would not have an incremental effect on groundwater drawdown that is cumulatively considerable in combination with other projects extracting groundwater in the Kern Fan region.

Local groundwater banking projects are designed to maintain a positive project balance such that no net water would be removed from the basin. These projects operate by recharging water when it's available and recovering when it's needed. Water banks that are operated in this way only recover water up to the amount previously banked minus an amount to account for losses and basin contributions. The net depletion to the basin resulting from the recovery operations is compensated if not exceeded by recharge.

The proposed project is designed to always maintain a positive balance relative to the basin. Recharge will always occur prior to recovery. The analysis concludes that recharge and recovery will have an approximately equal and opposite impact on the same area. Three years of recovery by the project at 17,500 afy for a total of 50,000 af would always follow three years of recharge of a total of 50,000 af. Accounting for losses required in the proposed MOU, the project would provide a net benefit to the groundwater basin. This direct beneficial effect of the project would similarly be a cumulative beneficial result of the project.

As stated on page 4-10, ASR projects on the Kern Fan operate under MOUs which have been developed in order to protect the underlying groundwater resources and avoid adverse affects to neighboring entities. Under the MOUs, groundwater banking operations are to be "consistent with avoiding, mitigation or eliminating to the greatest extent practicable, significant adverse impacts" (KCWA, 2004). These ASR projects are designed to recover only the amounts that have been stored through recharge activities minus the accounting of factored losses (from 6 to 15 percent per the MOU).

The wells in the drawdown analysis were not modeled as multi-zone wells. See response to comment KWBA-IIIa.

Comment GEO -5
The comment is a summary of comments presented in Geomatrix-1, 2, 3, and 4. See response to comments Geomatrix-1, Geomatrix-2, Geomatrix-3, and Geomatrix-4.

Arvin-Edison Water Storage District, March 10, 2008

Comment AEWSD-1
The comment states that any water supplied to the project cannot restrict AEWSD's capacity use of the Friant-Kern Canal. As noted on page 2-9 of the EIR, water from the CVP would only be available when capacity in the Friant-Kern Canal and CVC was made available after other capacity rights were honored. The project would in no way impinge on AEWSD's capacity in the Friant-Kern Canal.

Comment AEWSD-2
The comment notes that the arsenic MCL is inaccurately listed in Tables 3.8-1 and 3.8-3. See response to comment KCWA-11.

Comment AEWSD-3
The comment expresses concern over the potential for high groundwater levels to affect the CVC. See response to comment KCWA-13.

CHAPTER 12
Revisions Made to the Final EIR

This chapter provides a compilation of revisions made to the Draft EIR following the public review period.

Executive Summary

The following project objective provided on page S-3 of the Final EIR has been modified as shown:

- Allow storage of water ~~during wet hydrologic periods~~ subject to the conditions established by the water supplier and availability for recovery and use during dry periods to provide IRWD customers with increased water supply reliability through redundancy and diversification.

Chapter 2

The following project objective provided on page 2-1 of the Final EIR has been modified as shown:

- Allow storage of water ~~during wet hydrologic periods~~ subject to the conditions established by the water supplier and availability for recovery and use during dry periods to provide IRWD customers with increased water supply reliability through redundancy and diversification.

The first paragraph on page 2-3 of the Final EIR has been modified as shown:

> Utilizing existing underground storage capacity of the Kern County aquifer avoids the need to construct extensive surface water storage facilities elsewhere to perform the same function. In addition, the project helps protect the basin from overdraft by annexing Strand Ranch into Rosedale and ~~eliminating~~ reducing the extraction of groundwater for agricultural production. Strand Ranch currently is not part of a water storage district, and thus water extracted for agricultural irrigation is not replenished.

Figure 2-3 has been modified to say "Potential ~~Proposed~~ Well Locations"

The last paragraph on page 2-6 of the Final EIR has been modified as shown:

> The basins would be set back 55~~110~~ feet from ~~the perimeter roadways (or~~ section lines~~)~~ around Strand Ranch as required by Kern County.

The first paragraph under Section 2.5.3 on page 2-8 of the Final EIR has been modified as shown:

> ...Source water for the proposed project does not represent a new water supply; rather, IRWD would secure entitlements to excess water otherwise not being used ~~during wet hydrologic periods~~ subject to the conditions established by the water supplier and availability.

The last paragraph on page 2-10 of the Final EIR has been modified as shown:

> All production wells will be completed within a single zone, shallow or deep. The project does not propose any multi-zone production wells.

The following bullet point on page 2-19 of the Final EIR has been modified as shown:

- Kern County Water Agency: approval for use and modifications required to the Cross Valley Canal and a point-of-delivery agreement among DWR, KCWA, and other SWP contractors

Chapter 3

The second sentence of the first paragraph on page 3.6-4 of the Final EIR has been modified as shown:

> The 2007~~1~~ California Building Code locates the entire region within Seismic Risk Zone 4.

The following mitigation measure has been added to page 3.7-5 of the Final EIR and to Table S-1 in the Summary chapter of the Final EIR as Mitigation Measure 3.7-1.

> **Mitigation Measure 3.7-1.** IRWD shall collect representative samples of soils remaining in place near the former fuel and pesticide storage areas identified in the Phase I Site Assessment. The samples shall be analyzed for total petroleum hydrocarbons and pesticides. IRWD shall remove from the site in accordance with applicable waste disposal regulations, soils identified as containing hazardous quantities of contaminates.

As a result of the above mentioned change, the mitigation measure on page 3.7-6 has been changed to Mitigation Measure 3.7-2.

Tables 3.8-1 and 3.8-3 have been revised to reflect the correct arsenic MCL of 10 ug/l.

The following mitigation measure on page 3.8-27 of the Final EIR as well as Table S-1 on page S-14 has been modified as shown:

> **Mitigation Measure 3.8-1:** IRWD and Rosedale will agree with the KCWA on a monitoring and operations plan to avoid impacts to CVC facilities as a result of project operations. As part of said monitoring and operations plan IRWD and Rosedale will install and monitor piezometers adjacent to the CVC within the Strand Ranch property. When groundwater approaches 12 feet beneath the CVC facilities, IRWD and Rosedale will consult with geotechnical engineers to determine if conditions might pose a

risk to subsurface structures if further recharge operations were to continue. Under such conditions, piezometer data collected on the Strand Ranch as well as information from the geotechnical engineers will be shared with KCWA. If subsurface structures are determined to be at risk from high groundwater, IRWD and Rosedale will temporarily cease recharge activities until water surface elevations no longer pose a risk to subsurface structures.

The following sentence has been added to the first paragraph on page 3.8-14:

> Table 3.8-2 lists sampling results above Non-Detect. **Appendix H** contains the laboratory data sheets identifying all constituents analyzed including those not detected.

The title of Table 3.8-3 on page 3.8-25 has been modified as follows:

> ~~Surface~~ Water Quality for Select Parameters

The following modification has been made to the discussion of Impact 3.12-2 on page 3.12-5:

> The proposed project does not require a new water supply. IRWD would secure entitlements for excess water not otherwise being used, subject to the conditions established by the water supplier and availability ~~during wet hydrologic periods~~.

Chapter 6

The following project objective provided on page 6-2 of the Final EIR has been modified as shown:

- Allow storage of water ~~during wet hydrologic periods~~ subject to the conditions established by the water supplier and availability for recovery and use during dry periods to provide IRWD customers with increased water supply reliability through redundancy and diversification.

Chapter 7

The following references have been added to Chapter 7 References of the Final EIR:

California Department of Water Resources. (1977). *Kern County Groundwater Model.*

California Department of Water Resources and Kern County Water Agency. (1994). *Kern Water Bank Monitoring Report, 1991 - 1993, Kern County, California.*

Kern Fan Monitoring Committee. (1996). *KCWA, Kern Fan Monitoring Report, 1994-96, Kern County California.*

Hantush, M.S., & Jacob, C.E. (1955). Non-steady radial flow in an infinite leaky aquifer. *Trans. Am. Geophys. Union., 36*, 95-100.

Kern County Water Agency. (2001). *Initial Water Management Plan, Bakersfield, California.*

Schmidt, K.D. (1997). *Kern Water Bank Authority Maximum Recovery Plan, Bakersfield, California.*

Swartz, R.J. (1995). *Development and calibration of the Kern Fan ground water model.Office Report, California Department of Water Resources, San Joaquin District, California.*

Water Agencies of Kern County. (1983). *Optimization Report, Kern County, California.*

Chapter 8

The following contributors have been added to page 8-2 of the Final EIR:

Wildermuth Environmental

23692Birtcher Drive
Lake Forest, CA 92630

Mark Wildermuth
Tom McCarthy

Appendices

Appendix H: Title 22 Sample Analysis Results has been added to the Final EIR.

Appendix I: Wildermuth Environmental Credentials has been added to the Final EIR.

Appendices

Appendix A
Notice of Preparation

ROSEDALE - RIO BRAVO
WATER STORAGE DISTRICT
849 Allen Road • P. O. Box 867 • Bakersfield, California 93302-0867 • (661) 589-6045 • FAX (661) 589-1867

Notice of Preparation

Date: April 18, 2007

To: Responsible and Trustee Agencies and Interested Parties

Subject: Notice of Preparation of an Environmental Impact Report for the Strand Ranch Integrated Banking Project

This Notice of Preparation (NOP) has been prepared to notify agencies and interested parties that the Rosedale-Rio Bravo Water Storage District (Rosedale) as the Lead Agency is beginning preparation of an Environmental Impact Report (EIR) pursuant to the California Environmental Quality Act (CEQA) for the proposed Strand Ranch Integrated Banking Project. The Strand Ranch is located adjacent to the Rosedale district boundary in Kern County and is owned by the Irvine Ranch Water District (IRWD). IRWD has entered into an agreement with Rosedale to participate in their Conjunctive Use Program. The proposed project would integrate the Strand Ranch into Rosedale's existing Conjunctive Use Program, augmenting Rosedale's existing groundwater storage, recharge, and extraction capabilities. IRWD would be a Responsible Agency for the project. The proposed project would increase water supply reliability for both Rosedale and IRWD customers and would increase groundwater recharge capabilities for Rosedale.

Rosedale is soliciting the views of interested persons and agencies as to the scope and content of the environmental information to be studied in the EIR. In accordance with CEQA, agencies are requested to review the project description provided in this NOP and provide comments on environmental issues related to the statutory responsibilities of the agency. The EIR will be used by Rosedale and IRWD when considering approval of the Strand Ranch Integrated Banking Project.

In accordance with the time limits mandated by CEQA, comments to the NOP must be received by Rosedale no later than 30 days after publication of this notice. We request that comments to this NOP be received no later than May 18, 2007. Please send your comments to the address shown below. Please include a return address and contact name with your comments.

Two public meetings will be held to receive public comments and suggestions on the project, one in Orange County and one in Kern County. The scoping meetings will be open to the public on:

	ORANGE COUNTY	KERN COUNTY
DATE:	Tuesday, April 24, 2007	Tuesday, May 8, 2007
TIME:	5:30 PM	11:00 AM
LOCATION:	Irvine Ranch Water District 15600 Sand Canyon Avenue Irvine, California	Rosedale-Rio Bravo Water Storage District 849 Allen Road Bakersfield, California

Project Title: Strand Ranch Integrated Banking Project EIR

Signature: Hal Crossley

Title: General Manager

Address:
Rosedale-Rio Bravo Water Storage District
Attn: Hal Crossley, General Manager
849 Allen Road
P.O. Box 867
Bakersfield, CA 93302

Telephone: (661) 589-6045

INTRODUCTION

Rosedale-Rio Bravo Water Storage District (Rosedale) manages the portion of the regional Kern County groundwater basin that is within its boundaries. Rosedale operates groundwater recharge and banking programs, and is developing recovery programs for its landowners and for other districts within and outside of Kern County, California. Rosedale and Irvine Ranch Water District (IRWD) are proposing the Strand Ranch Integrated Banking Project (proposed project) to augment Rosedale's groundwater banking program by integrating Strand Ranch into Rosedale's existing Conjunctive Use Program. Strand Ranch consists of approximately 600 acres of agricultural land owned by IRWD adjacent to the Rosedale district boundary in Kern County. As part of the proposed project, Strand Ranch would be annexed into Rosedale's boundaries. Rosedale and IRWD propose to develop facilities on this property capable of recharging an average of approximately 17,500 acre-feet per year (AFY) to and from the underlying aquifer. Rosedale and IRWD also propose to develop facilities on or near Strand Ranch to recover approximately 17,500 AFY of water from the aquifer. Rosedale would operate these facilities to optimize the use of the groundwater storage and recovery capacity of the aquifer and to provide a reliable source of water for Rosedale and IRWD customers.

PROJECT BACKGROUND

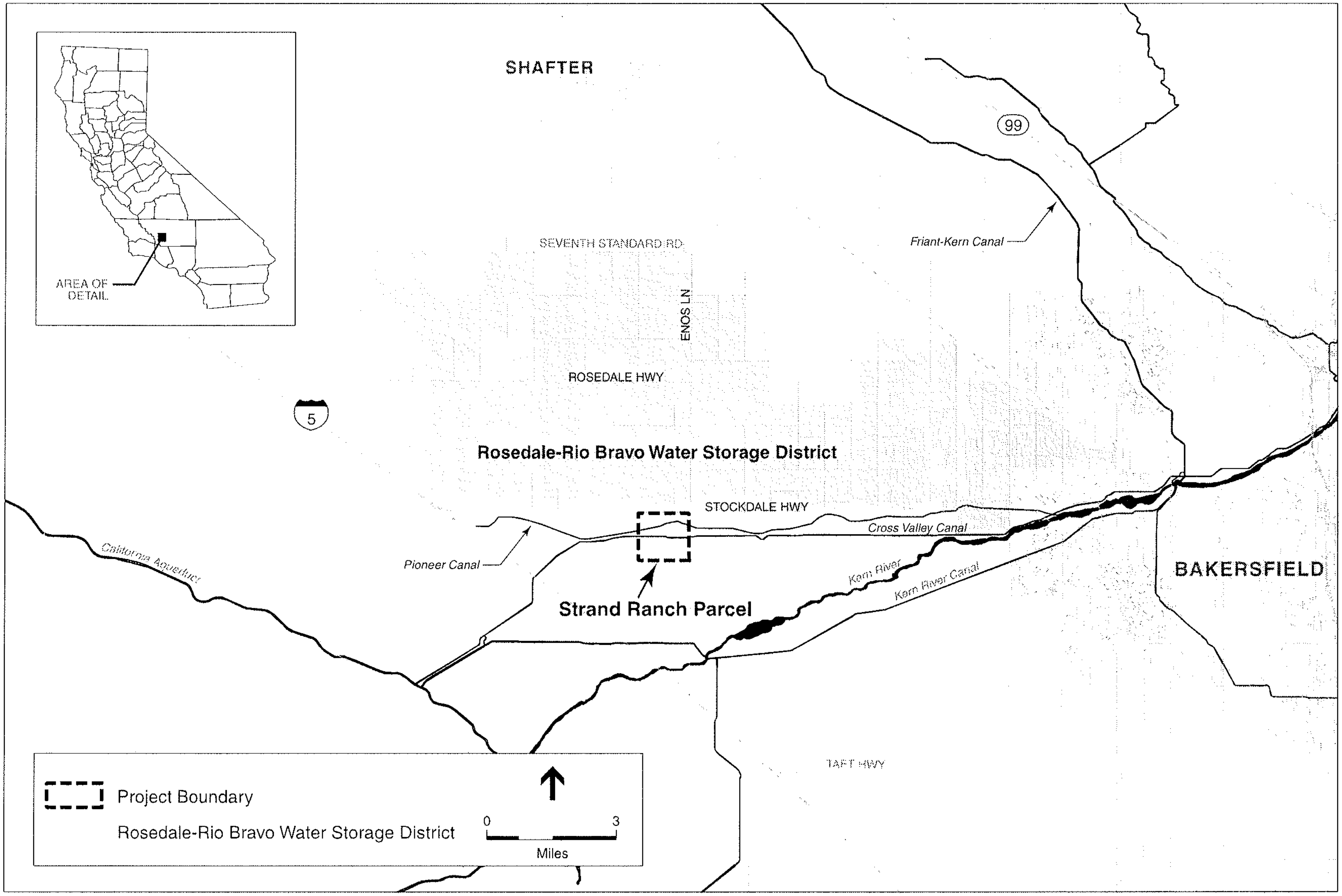
Rosedale-Rio Bravo Water Storage District

Rosedale was established in 1959 to develop a groundwater recharge program to offset overdraft conditions in the regional Kern County aquifer. Rosedale, located west of Bakersfield, encompasses approximately 43,000 acres in Kern County (**Figure 1**), with 28,500 acres developed as irrigated agriculture and about 6,000 acres developed for urban uses.

Rosedale's Groundwater Storage, Banking, Exchange, Extraction & Conjunctive Use Program (Conjunctive Use Program) currently manages approximately 300,000 acre feet (AF) of stored groundwater in the underlying aquifer, which has an estimated total storage capacity in excess of 930,000 AF. Rosedale acquires water for its Conjunctive Use Program from the Kern River, the Friant-Kern Canal of the Central Valley Project (CVP), and the State Water Project (SWP) through water supply contracts with the Kern County Water Agency (KCWA). Rosedale certified a Final Master EIR covering the Conjunctive Use Program in July 2001.

Irvine Ranch Water District

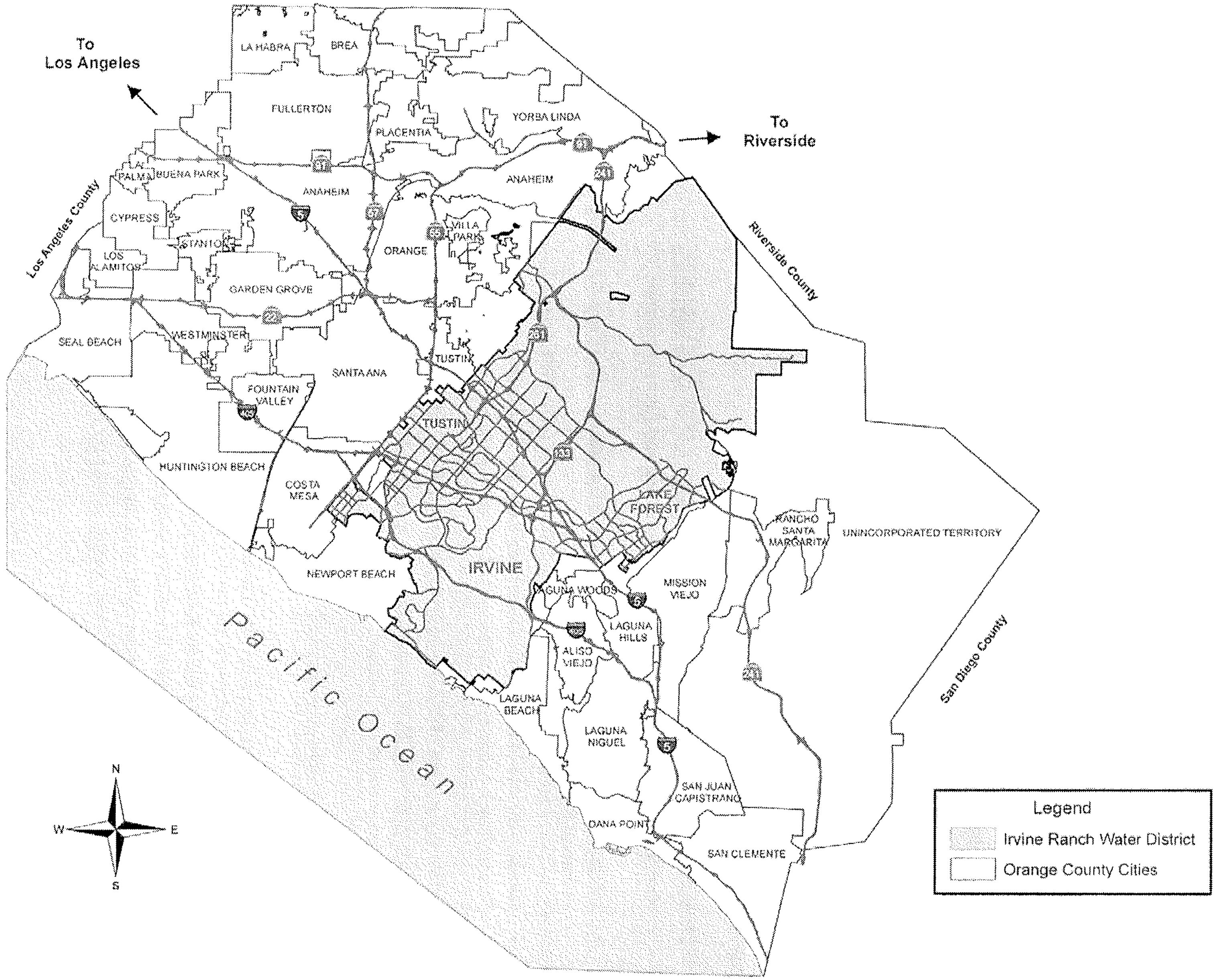
IRWD was established in 1961 as a California Water District pursuant to the California Water District Law (California Water Code, Division 13). IRWD provides potable and recycled water, sewage collection and treatment, and urban runoff treatment to municipal and industrial (M&I), and agricultural customers within an 114,560-acre service area in Orange County, California (**Figure 2**). Currently, 60 percent of the water IRWD provides for its customers comes from local sources, including groundwater (produced from the groundwater basin managed by Orange County Water District), surface water, and reclaimed water.



SOURCE: Kern County, 2007; ESA, 2007.

IRWD . 205426

Figure 1
Project Location
Strand Ranch



SOURCE: Thomas Brothers, 2007; IRWD, 2007.

IRWD . 205426

Figure 2
IRWD Service Area

The remaining 40 percent of IRWD's water supply is imported by the Metropolitan Water District of Southern California (Metropolitan) and purchased from the Municipal Water District of Orange County (MWDOC). IRWD purchased the 611-acre Strand Ranch in Kern County for the purpose of developing a program to bank water to increase the reliability of water supplies to its customers.

Strand Ranch

The 611-acre Strand Ranch property is located in unincorporated Kern County in the northern Kern River Fan area south of Stockdale Highway (Figure 1). Strand Ranch is adjacent to Rosedale's existing boundary and to portions of the Kern Water Bank. Strand Ranch currently is used for agriculture and interim recharge ponds. Two existing water conveyance facilities bisect the property: the Pioneer Canal and the Cross Valley Canal.

PROJECT OBJECTIVES

The objectives of the proposed project are as follows:

- Provide additional groundwater recharge, storage, and recovery capacity in the regional Kern County area to augment Rosedale's existing and future programs;
- Integrate IRWD's participation in Rosedale's Conjunctive Use Program through the use of Strand Ranch;
- Increase the use of the aquifer underlying Rosedale by annexing and developing the Strand Ranch property for recharge and recovery purposes;
- Allow the storage of water during wet hydrologic periods for recovery and use during dry periods to provide IRWD customers with increased water supply reliability through redundancy and diversification.

PROJECT DESCRIPTION

As described below, the proposed project includes the development of facilities for groundwater recharge, recovery, and conveyance at Strand Ranch and the operation of such facilities to provide groundwater storage for use by Rosedale and IRWD. As a part of the proposed project, Strand Ranch would be annexed into Rosedale's boundaries and assimilated into its Conjunctive Use Program, and IRWD would acquire rights to recharge, store, and recover water from the underlying aquifer, thereby improving water supply reliability for its customers.

Recharge Facilities

Rosedale and IRWD would construct facilities on Strand Ranch capable of directly recharging approximately 17,500 AFY. The recharge facilities may occupy the entire Strand Ranch property, less portions used for recovery. Recharge facilities would consist of recharge basins formed from earthen berms made from on-site soils. Any acreage not used for recharge or recovery could be used for continued agricultural operations or fallowed. The recharge facilities would be operated by Rosedale as a component of its Conjunctive Use Program.

Recharge Water

Recharge water for the proposed project would be secured and acquired by IRWD from various sources, potentially including federal, state, and local supplies. Possible sources have not been identified but could include State Water Project water and Kern River water depending on annual availability. IRWD would have rights to a maximum cumulative storage of 50,000 AF.

Conveyance Facilities

New and existing facilities would be used to convey surface water to and from Strand Ranch. Existing conveyances include the Cross Valley Canal (CVC) (operated by KCWA), Pioneer Canal, farm piping and ditches. New conveyance facilities would include turnouts, onsite channels, pipelines, and pumping facilities. Water recovered from the Strand Ranch for IRWD would be conveyed via the CVC to the California Aqueduct where it would flow south to Metropolitan's facilities for distribution to IRWD customers.

Recovery Facilities

Production wells would be constructed on or near Strand Ranch, designed to pump groundwater at a rate to recover approximately 36 cubic feet per second, considering peak delivery needs, facility redundancy, and other operational criteria. Recovery facilities would include recovery wells and piping. Rosedale would use Strand Ranch facilities and its other Conjunctive Use Program facilities to provide IRWD up to 17,500 AFY of recovered water.

DISCUSSION OF IMPACTS

The EIR will assess the physical changes to the environment that would likely result from construction and operation of the Strand Ranch Integrated Banking Project, including direct, indirect and cumulative impacts. Potential impacts of the proposed project are summarized below. The EIR will identify mitigation measures if necessary to minimize potentially significant impacts of the proposed project.

Aesthetics

The existing aesthetic quality of the project area is dominated by rural agriculture. The proposed project would alter the character and visual conditions of the project site by constructing recharge basins and wellheads. The EIR will evaluate the proposed project for impacts related to aesthetic resources, including consistency of the proposed project with the Kern County General Plan and local ordinances.

Agricultural Resources

The proposed project would convert up to 611 acres of agricultural land to groundwater recharge facilities. Strand Ranch is covered under a Williamson Act contract. Some agriculture may remain active on the property. The EIR will identify land uses allowed by Kern County and the Department of Conservation on Williamson Act lands.

Air Quality

Construction of the proposed project would generate emissions from construction equipment exhaust, earth movement, construction workers' commute, and material hauling. The EIR will evaluate the effects of construction activities on air quality and will develop mitigation measures if necessary to reduce the level of impact.

Biological Resources

The proposed project is located on and surrounded by productive agricultural lands. Natural habitat on the Strand Ranch is limited. The EIR will evaluate the potential for the proposed project to impact biological resources, such as sensitive species and critical habitats, including the consistency of the proposed project with the Kern County General Plan, Metropolitan Bakersfield Habitat Conservation Plan (HCP), Kern Water Bank HCP, local ordinances, and state and federal regulations.

Cultural Resources

Although the parcels are productive agricultural lands, excavation below the top soil could uncover previously unknown archaeological or paleontological resources. Historic resources may exist in the area. The EIR will assess the potential effects of the proposed project on cultural resources at Strand Ranch. Mitigation measures will be developed if necessary to reduce the level of impact where possible.

Geology and Soils

The proposed project is located in a seismically active region. The construction of recharge basins could be subject to potential seismic hazards including ground shaking and surface rupture. In addition, construction activities could expose soils to storm water erosion. The EIR will summarize previous geologic studies conducted for Strand Ranch to evaluate percolation capacities of the underlying soils. The EIR will evaluate geologic hazards in the region and will develop mitigation measures if necessary to reduce potential effects from the proposed project.

Hazards and Hazardous Materials

Excavation activities could uncover contaminated soils or hazardous substances that pose a substantial hazard to human health or the environment. The EIR will assess the potential for encountering such hazards at Strand Ranch and will develop mitigation measures if necessary to ensure that any hazards encountered during construction would be handled in accordance with applicable regulations.

Hydrology and Water Quality

The EIR will summarize the water quality at Strand Ranch using existing available data. Monitoring requirements will be identified to determine water quality impacts due to groundwater recharge and pump back operations. The EIR will evaluate the potential for surface contamination to be transported by percolating water into the groundwater table, and the potential effects of the proposed project on neighboring water banking operations. Rosedale has entered into a Memorandum of Understanding (MOU) with neighboring districts that outlines mitigation measures and commitments necessary to ensure that water banking activities do not impact neighboring water quality, agricultural operations, or pumping levels. The EIR will consider these mitigation measures to reduce potential water quality impacts.

Land Use

Strand Ranch is located in a rural area of Kern County. The proposed project would convert up to 611 acres of productive agricultural land into recharge basins. The EIR will evaluate the compatibility of the proposed project with existing and planned land uses.

Noise

Construction of the proposed project would generate noise that could affect residences, businesses, and other sensitive receptors near the project site. The EIR will evaluate the proximity of sensitive receptors to the project site and recommend mitigation measures if necessary to ensure that the proposed project complies with local policies and ordinances to minimize noise impacts.

Population and Housing

Implementation of the proposed project would enhance reliability of the water supply for agricultural and urban use within Rosedale's service area and for IRWD customers during drought conditions. The EIR will describe growth trends in the Rosedale and IRWD service areas.

Traffic and Transportation

Construction of the proposed project would temporarily add additional trips to the local transportation corridors. The EIR will evaluate the impact of the proposed project on traffic and circulation at the project site. The EIR will develop mitigation measures if necessary to minimize any potential effects.

Appendix B
Scoping Comment Letters

Rosedale-Rio Bravo Water Storage District
Strand Ranch Integrated Banking Project
Irvine Ranch Water District
Scoping Meeting Notes
April 24, 2007
5:30 pm

Present:
Tom Barnes – ESA

Oral Comments:

1) What will be the water source be?

2) What is the expiration of the Williamson Act Contract?

Rosedale-Rio Bravo Water Storage District
Strand Ranch Integrated Banking Project
Rosedale-Rio Bravo Water Storage District
Scoping Meeting Notes
May 8, 2007
11:00 am

Present:
Tom Barnes – ESA

Oral Comments:

Kern Water Agency

1) Generally support banking.
2) When will Strand Ranch be annexed?
3) Will turnouts be covered and documented in this EIR or KWA EIR?
4) Recovery facilities? Where will wells be located in order to assess water quality issues.
5) How many wells, seven or eight? (36 cfs)
6) 36 cfs is high per sq/m?? than KWB
7) The EIR needs to evaluate whether the 17,500 would be produced in consecutive years
8) Is 50,000 af of storage cumulative?
9) Is there a maximum for the life of the project?
10) Biological resources (not in Metro HCP)
11) Kern County floor HCP in progress needs to be addressed.
12) Make sure that hydrology section does what NOP says it will. Add tech data depth
13) Population: housing – how is Rosedale urbanizing and how it fits with water use. Show that water is available.

14) Identify water sources
15) Recovery plan will be scrutinized
16) May be overly optimistic
17) Cumulative ?? analysis
18) Will GW balance method be used?
19) How will MOU fit in? Existing or new MOU? Will there be any mods? Stand alone?
20) Loss factors in MOU will be of concern to KWB

21) Is this EIR mean to be a Master EIR?
22) Cumulative – look at potential future ????
23) KWA – will this evaluate whole Rosedale?
24) Document that evaluates all of Rosedale operations if they are part of project
25) How does IRWD fit in?
26) UWMP could be appended to EIT to see how this fits into their portfolio

27) Tax situation? County tax on land – how is that handled?

Dan Burtwell BV Water

1) Cumulative impacts of partnership will they doc talk about contractual commitments to BV Water
2) How does pump cease from MOU ??? ? Who gets shut down first?

KERN WATER BANK AUTHORITY

May 16, 2007

Mr. Hal Crossley
Rosedale – Rio Bravo Water Storage District
849 Allen Road
Bakersfield, CA 93302

Subject: Notice of Preparation of an Environmental Impact Report for the Strand Ranch Integrated Banking Project

Dear Mr. Crossley:

The Kern Water Bank Authority (KWBA) appreciates the opportunity to provide comments on the Notice of Preparation (NOP) of an Environmental Impact Report (EIR) for the Strand Ranch Integrated Banking Project (Project). The documentation attached to the NOP indicates Rosedale – Rio Bravo Water Storage District (Rosedale) and Irvine Ranch Water District (IRWD) plan to develop a project capable of recharging and recovering 17,500 acre-feet/year of water. Recovery would utilize wells expected to extract 36 cfs of water, both on the Strand Ranch and elsewhere on District lands. The maximum storage allocated to IRWD at any time would not exceed 50,000 acre-feet.

Some of the information that will be necessary for us to evaluate the project will include:

- A cumulative analysis of all of Rosedale's banking and sales programs. We are very pleased to hear that you intend to provide this type of comprehensive analysis. In previous CEQA analyses, Rosedale provided historical balance data illustrating how each of the District's programs fits into its operations (e.g. see Table 5 and supporting tables in the MEIR). Such analysis is particularly important given Rosedale's sales programs. We recommend that the DEIR utilize the methodology developed through the groundwater mediation process to document the District's balance for this analysis. This analysis should also evaluate a worst-case scenario wherein Rosedale has to meet all of its current and expected obligations during a prolonged drought.
- Detailed analysis of the project's expected impacts to water levels and quality. This analysis should consider the worst-case scenario wherein Rosedale needs to return all of IRWD's 50,000 acre-feet of storage in consecutive years.
- Discussions at the public hearing seemed to indicate Rosedale has an obligation to provide the 17,500 acre-feet of capacity to IRWD on a first priority. If Rosedale intends

to utilize the Project for itself or others above this capacity, the DEIR should analyze potential impacts from these additional uses.
- Information on proposed well locations, screened intervals, expected recovery rates and recovery rate declines. The recovery rate declines will be important in evaluating the programs worst-case recovery scenarios mentioned above.
- Detailed information on water sources for the program, particularly with respect to water that will be sold or otherwise provided to IRWD by Rosedale.

Thank you for the opportunity to provide input for your proposed EIR. Please call if you have any questions.

Sincerely,
Kern Water Bank Authority,

Jonathan D. Parker,
General Manager

cc: KWBA Board of Directors
Dick Diamond, Irvine Ranch Water District

SINCE 1933 ORANGE COUNTY WATER DISTRICT A TRADITION OF INNOVATION

ORANGE COUNTY WATER DISTRICT

Orange County's Groundwater Authority

May 3, 2007

Hal Crossley
General Manager
Rosedale-Rio Bravo Water Storage District
849 Allen Road
Bakersfield, CA 93302

Subject: **Notice of Preparation of Environmental Impact Report Strand Ranch Integrated Banking Project**

Dear Mr. Crossley:

The Orange County Water District (OCWD) appreciates the opportunity to review the Notice of Preparation (NOP) for the Strand Ranch Integrated Banking Project. At this time we have no specific comments on the NOP. However, we would like to receive a copy of the Draft Environmental Impact Report when it becomes available. Please feel free to call me at (714) 378-3256, if you have any questions concerning our request. Once again, thank you for the opportunity for allowing OCWD to be part of the environmental review process for the project.

Sincerely,

Dan Bott

Dan Bott
Senior Planner
Planning & Watershed Management

Received Time May. 23. 3:07AM

Mailing Address P.O. Box 8300 Fountain Valley, CA 92728-8300 • 10500 Ellis Avenue, Fountain Valley, CA 92708
Telephone (714) 378-3200 Fax (714) 378-3373 Web Page www.ocwd.com

PLANNING DEPARTMENT

TED JAMES, AICP, Director
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RESOURCE MANAGEMENT AGENCY

DAVID PRICE III, RMA DIRECTOR
Community & Economic Development Department
Engineering & Survey Services Department
Environmental Health Services Department
Planning Department
Roads Department

November 12, 2007

File: Rosedale Rio Bravo
Strand Ranch – NOP

Rosedale-Rio Bravo Water Storage District
Attn: Hal Crossley, General Manager
P.O Box 867
Bakersfield, California 93302

RE: **Late Comments – Notice of Preparation**
Strand Ranch Integrated Banking Project

Dear Mr.Crossley,

Kern County Planning has reviewed the Notice of Preparation for the proposed Strand Ranch Integrated Banking Project EIR. This proposed project on 600 acres of land owned by the Irvine Ranch Water District will construct facilities capable of recharging an average of 17,500 AFY of water. The project site, south of Stockdale Highway at Enos Lane is designated R-IA (Resource- Intensive Agriculture) by the Metropolitan Bakersfield's General Plan and 8.1 (Intensive Agriculture) by the Kern County General Plan. It is zoned A (Agriculture) and is subject to a Williamson Act Land Use Contract. Staff has met with the project applicants and consultants and appreciates your consideration of these late comments.

This department has determined that a Williamson Act Contract is compatible with water banking if the qualifying agricultural use would occur approximately 8 to 10 months of the year, compared with year-round—or nearly year-round—cultivation of the site. The DEIR should detail what the qualifying agricultural uses and how they are compatible with the water recharge activities.

The property is currently under the land use jurisdiction of Kern County and encumbered by a Williamson Act Land Use Contract. If the cancellation of the Williamson Act Contract is proposed then the following comments are provided as a Responsible Agency under Section 15381 of the revised CEQA guidelines, as any proposed cancellation of the Williamson Act Contract will require Kern County Board of Supervisors approval and use the FEIR for compliance with CEQA as a Responsible Agency.

The preferred method for removing property from the Williamson Act Contract is nonrenewal. After a notice of nonrenewal is filed on the property with Kern County, a cancellation could be considered. The Agricultural Resources section of the DEIR requires the following discussion to meet the requirements of Kern County Planning for use in any request for cancellation, which is a discretionary action that can be denied, conditionally approved or approved. Provide a clear and complete description of the process for submittal and processing of a cancellation request including details on the required findings under 51282 of the Government Code. A copy of the required findings have been attached for your use.

As noted clearly on Zone Map 121, a Specific Plan line has been adopted for the Kern River Freeway ending at the center of Section 2. Potential compatibility issues and impacts need to be included in the DEIR.

Please provide this office with notifications and documents related to this matter including, but not limited to the Draft EIR, Response to Comments, all hearing notices, staff reports and Notice of Determination.

If you have any questions regarding this matter, please contact me at (661) 862-8866 or Loreleio@co.kern.ca.us. Thank you.

Sincerely,

Lorelei H. Oviatt A.I.C.P
Division Chief

Appendix C

RRBWSD Summary of CEQA Documentation

ESA

Summary of RRBWSD Banking Program CEQA Documents

Master EIR for Groundwater Storage, Banking, Exchange, Extraction and Conjunctive Use Program

- Up to 100,000 AF/year recharge.
- Over 300,000 AF of groundwater storage volume used for programs.
- Construction of 15 to 20 wells, extraction capacity of 35,000 to 45,000 AF/year
- Recharge in advance of extraction.
- Water supplies from SWP, Kern River, Friant-Kern Canal, or other sources.
- Overall program goal that for each acre foot of water extracted, one acre foot would remain in District (2:1 program).
- Expects that a MOU will be entered into and a monitoring committee will be established.
- States that as details of each project are defined, site specific environmental reviews per CEQA will be conducted.

Addendum No. 1 to Master EIR

- States that groundwater storage capacity under District is 930,000 AF (per "Determination of Aquifer Storage Capacity" by Sierra Scientific Services, January 20, 2003).

EIR for BVWSD/RRBWSD Water Banking and Recovery Program

- 25% of groundwater banking from existing accounts in BVWSD, 75% from accounts developed primarily from recharge of BVWSD Kern River high flow water in RRBWSD.
- 100% of recovery for first two years will be from previously banked waters in BVWSD.
- Thereafter, recovery will be made jointly by RRBWSD and BVWSD from the previously banked accounts and the accounts to be developed through recharge within RRBWSD.
- More than 80,000 AF/year could be recharged in RRBWSD.
- Recovery/delivery may be more than 20,000 AF/year.
- Primary method of recovery/delivery will be via SWP exchange.
- RRBWSD to construct three additional extraction wells, and possibly replace two existing wells (Westside Well Field).
- Offers to enter into MOU's setting provisions for monitoring program.
- Maximum program storage of 200,000 AF in RRBWSD.
- New recharge basins to be constructed for 200-300 cfs additional capacity (includes Paul Enns and Fanucchi basins).

Negative Declaration for GLC Banking and Recovery Program

- Development of recharge areas for a total District capacity of 600 cfs (includes Sec. 25).
- Sale of a total of 220,000 AF to GLC according to buildup schedule, max. delivery of 9,500 AF/yr.
- 60,000 AF of storage for MWD exchange portion of project.
- Max. delivery of 20,000 AF/yr with MWD exchange.
- 10 additional extraction wells to be constructed (8 new and 2 replacement, Westside Well Field).

Addendum No. 1 to Negative Declaration for GLC Program

- Increases the total sale quantity to 262,500 AF if sufficient water supplies are available.

Negative Declarations for Kern Tulare and Groundwater Banking – Allen Road Wellfield (AEWSD)

- Construction of a total of 7 extraction wells, extraction capacity of 20,500 AF/year.
- 2:1 Groundwater Banking Programs.
- Provides for the construction of a monitoring well.

Appendix D

RRBWSD Conjunctive Use Program Banking Program Operations

Rosedale Rio-Bravo Water Storage District Water Balance, 2006

Source: Balance_c RRBWSD rev 2006.xls, RRBWSD Programs worksheet.

AEWSD 2:1 Program (from 2004 on)

	For AEWSD				For RRBWSD		
Year	Total Delivered	Gross	Total Returned	Bank Balance	Gross	Losses	Net after Losses
				38453			
2004	0	0	17938	20515	0	0	21018
2005	86046	43023	3948	59590	43023	1506	41517
2006	0	0	417	59173	0	0	0
2007	0	0	0	59173	0	0	0
2008	0	0	0	59173	0	0	0
2009	0	0	0	59173	0	0	0
2010	0	0	0	59173	0	0	0
2011	0	0	0	59173	0	0	0
2012	0	0	0	59173	0	0	0
2013	0	0	0	59173	0	0	0
2014	0	0	0	59173	0	0	0
2015	0	0	0	59173	0	0	0
2016	0	0	0	59173	0	0	0

KT&RG 2:1 Program (from 2004 on)

		For KT & RG					For RRBWSD		
				Total to					
Year	Total Delivered	Gross	Banking Losses	Bank (net)	Total Returned	Bank Balance	Gross	Losses	Net after Losses
						1318			
2004	0	0	0	0	0	1318	0	0	0
2005	49747	24874	1492.41	23381	0	24699	24874	249	24625
2006	10000	5000	300	4700	0	29399	5000	50	4950
2007	0	0	0	0	0	29399	0	0	0
2008	0	0	0	0	0	29399	0	0	0
2009	0	0	0	0	0	29399	0	0	0
2010	0	0	0	0	0	29399	0	0	0
2011	0	0	0	0	0	29399	0	0	0
2012	0	0	0	0	0	29399	0	0	0
2013	0	0	0	0	0	29399	0	0	0
2014	0	0	0	0	0	29399	0	0	0
2015	0	0	0	0	0	29399	0	0	0
2016	0	0	0	0	0	29399	0	0	0

BVWSD Banking Program No net water to RRBWSD						
		For BVWSD				
Year	Total Delivered	Gross	Banking Losses	Total to Bank (net)	Total Returned	Bank Balance
2004	313	313	34	279	0	279
2005	58210	58210	6403	51807	0	52085
2006	38352	38352	4219	34133	0	86219
2007	0	0	0	0	0	86219
2008	0	0	0	0	0	86219
2009	0	0	0	0	0	86219
2010	0	0	0	0	0	86219
2011	0	0	0	0	0	86219
2012	0	0	0	0	0	86219
2013	0	0	0	0	0	86219
2014	0	0	0	0	0	86219
2015	0	0	0	0	0	86219
2016	0	0	0	0	0	86219

CLWA Banking Program No net water to RRBWSD						
		For CLWA				
Year	Total Delivered	Gross	Banking Losses	Total to Bank (net)	Total Returned	Bank Balance
2004	0	0	0	0	0	0
2005	20000	20000	2200	17800	0	17800
2006	20000	20000	2200	17800	0	35600
2007	0	0	0	0	0	35600
2008	0	0	0	0	0	35600
2009	0	0	0	0	0	35600
2010	0	0	0	0	0	35600
2011	0	0	0	0	0	35600
2012	0	0	0	0	0	35600
2013	0	0	0	0	0	35600
2014	0	0	0	0	0	35600
2015	0	0	0	0	0	35600
2016	0	0	0	0	0	35600

Total All Programs (from 2004 on)							
		For Partners			For RRBWSD		
Year	Total Delivered	Total to Bank	Total Returned	Bank Balance	Gross	Losses	After Losses
				39771			
2004	313	279	17938	22112	0	0	21018
2005	214003	136011	3929	154175	67897	1755	66142
2006	68352	56633	417	210391	5000	50	4950
2007	0	0	0	210391	0	0	0
2008	0	0	0	210391	0	0	0
2009	0	0	0	210391	0	0	0
2010	0	0	0	210391	0	0	0
2011	0	0	0	210391	0	0	0
2012	0	0	0	210391	0	0	0
2013	0	0	0	210391	0	0	0
2014	0	0	0	210391	0	0	0
2015	0	0	0	210391	0	0	0
2016	0	0	0	210391	0	0	0

Notes: Losses for banked water assessed as 5%. The additional 1% loss is taken off the return water (SWP exchange booked to RRB when water is returned to banking partners).

Appendix E

Memorandum of Understanding Groundwater Banking and Sale Program

661/634-1400

ìailing Address
P.O. Box 58
B ìeld, CA 93302-0058

Street Address
3200 Rio Mirada Dr.
Bakersfield, CA 93308

April 30, 2004

Mr. Hal Crossley, General Manager
Rosedale-Rio Bravo Water Storage District
P.O. Box 867
Bakersfield, CA 93302

Re: Memorandum of Understanding, Rosedale-Rio Bravo Water Storage District Groundwater Banking and Sale Program

Dear Mr. Crossley:

Enclosed please find executed copies of the above-referenced Memorandum of Understanding. It is our understanding that this MOU does not in any way modify or amend our letter agreement regarding the banking and sales programs dated December 1, 2003. Please acknowledge that this is also your understanding by signing the acknowledgement below and returning a copy of this letter.

Sincerely,

Thomas N. Clark
General Manager

Being authorized by the district, we agree to the foregoing.

Hal Crossley
Rosedale-Rio Bravo Water Storage District
By Hal Crossley, General Manager
Dated: May 10, 2004

MEMORANDUM OF UNDERSTANDING

REGARDING OPERATION AND MONITORING
OF THE
ROSEDALE-RIO BRAVO WATER STORAGE DISTRICT
GROUNDWATER BANKING AND SALE PROGRAM

This Memorandum of Understanding is entered into the Effective Date hereof by and among **ROSEDALE-RIO BRAVO WATER STORAGE DISTRICT**, hereinafter referred to as "Rosedale", and **ROSEDALE RANCH I.D. OF NORTH KERN WATER STORAGE DISTRICT, SEMITROPIC WATER STORAGE DISTRICT, BUENA VISTA WATER STORAGE DISTRICT, HENRY MILLER WATER DISTRICT, BERRENDA MESA WATER DISTRICT, KERN COUNTY WATER AGENCY, KERN WATER BANK AUTHORITY, IMPROVEMENT DISTRICT NO. 4 KERN COUNTY WATER AGENCY, and WEST KERN WATER DISTRICT**, collectively referred to as "Adjoining Entities."

RECITALS

WHEREAS, Rosedale expects that certain real property more particularly shown on the map attached hereto as Exhibit A and incorporated herein by this reference ("Project Site"), or portions thereof, will be used in connection with the Project; and

WHEREAS, Rosedale intends to develop and improve the Project Site as necessary to permit the importation, percolation and storage of water in underground aquifers for later recovery, transportation and use for the benefit of Rosedale, all as more fully described in Exhibit B attached hereto and incorporated herein by this reference ("Project"); and

WHEREAS, Adjoining Entities encompass lands and/or operate existing projects lying adjacent to the Project Site as shown on said Exhibit A; and

WHEREAS, in recent years, water banking, recovery and transfer programs in Kern County have become increasingly numerous and complex; and

WHEREAS, it is appropriate and desirable to mitigate or eliminate any short-term and long-term significant adverse impacts of new programs upon potentially affected projects and landowners within the boundaries of Adjoining Entities; and

WHEREAS, Adjoining Entities and Rosedale desire that the design, operation and monitoring of the Project be conducted and coordinated in a manner to insure that the beneficial effects of the Project to Rosedale are maximized but that the Project does not result in significant adverse impacts to water levels, water quality or land subsidence within the boundaries of Adjoining Entities, or otherwise interfere with the existing and ongoing programs of Adjoining Entities; and

WHEREAS, on October 26, 1995, the Kern Water Bank Authority and its Member Entities, as the "Project Participants," and Buena Vista Water Storage District, Rosedale-Rio Bravo Water Storage District, Kern Delta Water District, Henry Miller Water District and West Kern Water District, as the "Adjoining Entities," entered into a Memorandum of Understanding, similar to this Memorandum of Understanding, which provided among other things at Paragraph 8 that for "any future project within the Kern Fan Area, the Parties hereto shall use good faith efforts to negotiate an agreement substantially similar in substance to this MOU," and by entering into this MOU the Adjoining Entities find that this MOU satisfies such requirement for the Project; and

WHEREAS, Rosedale intends to operate its Project such that the same does not cause or contribute to overdraft of the groundwater basin; and

WHEREAS, in connection with its environmental review for the Project, Rosedale commissioned a hydrologic balance study for a period of years, which study shows that the District is not currently operating in a state of overdraft, and, further, Rosedale has projected said hydrologic balance study into the future, assuming completion of the Project, and said projection demonstrates that the District is not expected to operate in state of overdraft following implementation of the Project, which studies have not been independently verified by the Adjoining Entities; and

WHEREAS, in the hydrologic balance studies conducted by Rosedale in connection with the Project, the annual safe yield from the groundwater basin is assumed to be .3 acre-feet per acre times the gross developed acres in the District and no assumption is included with respect to groundwater inflow or outflow; and

WHEREAS, this MOU affects the Project and other similar banking programs operated for the benefit of third parties.

NOW, THEREFORE, BE IT RESOLVED that, based upon the mutual covenants contained herein, the parties hereto agree as follows:

1. Project Design and Construction. Rosedale has completed a preliminary Project Description of the Project described in Exhibit B hereto representing the contemplated facilities for the Project. Said preliminary description has been reviewed by the parties hereto. The foregoing shall not be interpreted to imply consent to any aspect of any future project not described in existing approved environmental documentation. Rosedale will construct the Project consistent with such preliminary description. Any major modifications of the facilities and/or significant changes from that described in Exhibit B and in the environmental documentation for the Project will be subject to

additional environmental review pursuant to CEQA and will be subject to review of ~~the~~ Monitoring Committee prior to implementation.

2. Project Operation. The Project shall be operated to achieve the maximum water storage and withdrawal benefits for Rosedale consistent with avoiding, mitigating or eliminating to the greatest extent practicable, significant adverse impacts resulting from the Project. To that end, the Project shall be operated in accordance with the following Project Objectives and Minimum Operating Criteria:

a. Project Objectives. Consistent with the Project description, Rosedale will make a good faith effort to meet the following objectives, which may or may not be met:

(1) The parties should operate their projects in such manner as to maintain and, when possible, enhance the quality of groundwater within the Project Site and the Kern Fan Area as shown in Exhibit C.

(2) If supplies of acceptable recharge water exceed recharge capacity, all other things being equal, recharge priority should be given to the purest or best quality water.

(3) Each project within the Kern Fan Area should be operated with the objective that the average concentration of total dissolved salts in the recovered water will exceed the average concentration of total dissolved salts in the recharged water, at a minimum, by a percentage equal to or greater than the percentage of surface recharge losses. The average shall be calculated from the start of each project.

(4) To maintain or improve groundwater quality, recovery operations should extract poorer quality groundwater where practicable. Blending may be used to increase recovery of lesser quality groundwater unless doing so will exacerbate problems by generating

unfavorable movement of lesser quality groundwater. It is recognized that the extent to which blending can help to resolve groundwater quality problems is limited by regulatory agency rules regarding discharges into conveyance systems used for municipal supplies, which may be changed from time to time.

(5) All groundwater pumpers should attempt to control the migration of poor quality water. Extensive monitoring will be used to identify the migration of poor quality water and give advance notice of developing problems. Problem areas may be dealt with by actions including, but not limited to:

(a) limiting or terminating extractions that tend to draw lesser quality water toward or into the usable water areas;

(b) increasing extractions in areas that might generate a beneficial, reverse gradient;

(c) increasing recharge within the usable water area to promote favorable groundwater gradients.

(6) It is intended that all recovery of recharged water be subject to the so-called "golden rule." In the context of a banking project, the "golden rule" means that, unless acceptable mitigation is provided, the banker may not operate so as to create conditions that are worse than would have prevailed absent the project giving due recognition to the benefits that may result from the project, all as more fully described at paragraph 2(b)12 below.

(7) The Project shall be developed and operated so as to prevent, eliminate or mitigate significant adverse impacts. Thus, the Project shall incorporate mitigation measures as necessary. Mitigation measures to prevent significant adverse impacts from occurring include but

are not limited to the following: (i) spread out recovery area; (ii) provide buffer areas between recovery wells and neighboring overlying users; (iii) limit the monthly, seasonal, and/or annual recovery rate; (iv) provide sufficient recovery wells to allow rotation of recovery wells or the use of alternate wells; (v) provide adequate well spacing; (vi) adjust pumping rates or terminate pumping to reduce impacts, if necessary; (vii) impose time restrictions between recharge and recovery to allow for downward percolation of water to the aquifer; and (viii) provide recharge of water that would otherwise not recharge the Kern Fan Basin. Mitigation measures that compensate for unavoidable adverse impacts include but are not limited to the following: (i) with the consent of the affected groundwater pumper, lower the pump bowls or deepen wells as necessary to restore groundwater extraction capability to such pumper; (ii) with the consent of the affected groundwater pumper, provide alternative water supplies to such pumper; and (iii) with the consent of the affected groundwater pumper, provide financial compensation to such pumper.

b. Minimum Operating Criteria.

(1) The Monitoring Committee shall be notified prior to the recharge of potentially unacceptable water, such as "produced water" from oilfield operations, reclaimed water, or the like. The Monitoring Committee shall review the proposed recharge and make recommendations respecting the same as it deems appropriate. Where approval by the Regional Water Quality Control Board is required, the issuance of such approval by said Board shall satisfy this requirement.

(2) Recharge may not occur in, on or near contaminated areas, nor may anyone spread in, on or near an adjoining area if the effect will be to mound water near enough to the contaminated area that the contaminants will be picked up and carried into the uncontaminated

groundwater supply. When contaminated areas are identified within or adjacent ~~to the~~ Project, Rosedale shall also:

(a) participate with other groundwater pumpers to investigate the source of the contamination;

(b) work with appropriate authorities to ensure that the entity or individual, if any, responsible for the contamination meets its responsibilities to remove the contamination and thereby return the Project Site to its full recharge and storage capacity;

(c) operate the Project in cooperation with other groundwater pumpers to attempt to eliminate the migration of contaminated water toward or into usable water quality areas.

(3) Operators of projects within the Kern Fan Area will avoid operating such projects in a fashion so as to significantly diminish the natural, normal and unavoidable recharge of water native to the Kern Fan Area as it existed in pre-project condition. If and to the extent this occurs as determined by the Monitoring Committee, the parties will cooperate to provide equivalent recharge capacity to offset such impact.

(4) The mitigation credit for fallowed Project land shall be .3 acre-feet per acre per year times the amount of fallowed land included in the Project Site in the year of calculation.

(5) The lands shown in Exhibit A may be utilized for any purpose provided, however, the use of said property by Rosedale for the Project shall not cause or contribute to overdraft of the groundwater basin.

(6) Each device proposed to measure recharge water to be subsequently recovered and/or recovery of such water will be initially evaluated and periodically reviewed by the

Monitoring Committee. Each measuring device shall be properly installed, calibrat~~ed,~~ rated, monitored and maintained by and at the expense of the owner of the measuring device.

(7) It shall be the responsibility of the user to insure that all measuring devices are accurate and that the measurements are provided to the Monitoring Committee at the time and in the manner required by the Monitoring Committee.

(8) A producer's flow deposited into another facility, such as a transportation canal, shall be measured into such facility by the operator thereof and the measurement reported to the Monitoring Committee at the time and in the manner required by such Monitoring Committee.

(9) The Monitoring Committee or its designee will maintain official records of recharge and recovery activities, which records shall be open and available to the public. The Monitoring Committee will have the right to verify the accuracy of reported information by inspection, observation or access to user records (i.e., P.G.&E. bills). The Monitoring Committee will publish or cause to be published annual reports of operations.

(10) Losses shall be assessed as follows:

(a) Surface recharge losses shall be fixed and assessed at a rate of 3%, which includes a "safety factor" of 1% of water diverted for direct recharge. An additional surface recharge loss of 3% shall be fixed and assessed against water directly recharged which is subsequently extracted for out-of-district use. Such initial 3% loss may be modified in the future if studies acceptable to the parties demonstrate that such modification is appropriate, providing that a 1% "safety factor" shall be maintained and the total loss when directly recharged water is subsequently extracted for out-of-district use shall not exceed 6%. Notwithstanding anything to the contrary provided herein, water banked in Rosedale for or on behalf of third parties ~~(i.e.~~, creating a third party bank account) shall be subject to surface recharge losses calculated at 6% of water diverted for direct recharge.

(b) To account for all other actual or potential losses (including migration losses), a rate of 4% of water placed in a bank account shall be deducted to the extent that Rosedale has been compensated within three (3) years following the end of the calendar year in which the water was designated as banked at the SWP Delta Water Rate charged by DWR at the time of payment; provided further, however, that the water purchased and subtracted from a groundwater bank account pursuant to this provision shall only be used for overdraft correction within the District purchasing the water.

(c) An additional 5% loss shall be assessed against any water diverted to the Project Site for banking by, for, or on behalf of any out-of-County person, entity or organization (except current SWP Agricultural Contractors).

(d) All losses provided for herein represent amounts of water that are non-bankable and non-recoverable by Rosedale.

(11) Recovery of banked water shall be from the Project Site and recovery facilities shall be located therein. Recovery from outside the Project Site may be allowed with the consent of the District or entity having jurisdiction over the area from which the recovery will occur and upon review by the Monitoring Committee.

(12) Recovery of banked water may not be allowed if not otherwise mitigated if it will result in significant adverse impacts to surrounding overlying users. "Adverse impacts" will be evaluated using data applicable in zones including the area which may be affected

by the Project of approximately five miles in width from the boundaries of the Project as designated by the Monitoring Committee. In determining "adverse impacts," as provided at this paragraph and elsewhere in this MOU, consideration will be given to the benefits accrued over time during operation of the Project to landowners surrounding the Project Site including higher groundwater levels as a result of operation of the Project. In determining non-Project conditions vs. Project conditions, credit toward mitigation of any otherwise adverse impacts shall be recognized to the extent of the 4% loss and 5% losses recognized under paragraphs 2.b.(10)(b) and (c), for the mitigation credit recognized under paragraph 2.b.(4), if any, and to the extent of recharge on the Project Site for overdraft correction.

(13) To the extent that interference, other than insignificant interference, with the pumping lift of any existing active well as compared to non-Project conditions, is attributable to pumping of any wells on the Project Site, Rosedale will either stop pumping as necessary to mitigate the interference or compensate the owner for such interference, or any combination thereof. The Monitoring Committee will establish the criteria necessary to determine if well interference, other than insignificant interference, is attributable to pumping of Project wells by conducting pumping tests of Project wells following the installation of monitoring wells (if not already completed) and considering hydrogeologic information.

(14) The Kern Fan Element Groundwater Model, with input from Rosedale and the Adjoining Entities, and utilizing data from a comprehensive groundwater monitoring program, may be used by the Monitoring Committee as appropriate to estimate groundwater impacts of the Project.

(15) The parties recognize that the Project shall be operated=with a positive balance, i.e., there shall be no "borrowing" of water for recovery from the basin.

3. Project Monitoring. Adjoining Entities agree to participate in a comprehensive monitoring program and as members of a Monitoring Committee, as hereinafter more particularly described, in order to reasonably determine groundwater level and water quality information under Project and non-Project conditions. The monitoring program will more particularly require the following:

a. Monitoring Committee: Rosedale and the Adjoining Entities shall form a Monitoring Committee for the Project upon terms and conditions acceptable to the participants. The Monitoring Committee shall:

(1) Engage the services of a suitable independent professional groundwater specialist who shall, at the direction of the Committee, provide assistance in the performance of the tasks identified below;

(2) Meet and confer monthly or at other intervals deemed to be appropriate in furtherance of the monitoring program;

(3) Establish a groundwater evaluation methodology or methodologies;

(4) Prepare a monitoring plan and two associated maps, "Well Location, Water Quality Network," and "Well Location, Water Level Network," which plan and maps depict the location and types of wells anticipated to be used in the initial phase of groundwater monitoring (said plan and maps are expected to be modified from time to time as the monitoring program is developed and operated);

(5) Specify such additional monitoring wells and ancillary equipment as are deemed to be necessary or desirable for the purposes hereof;

(6) Prepare annual water balance studies and other interpretive studies, which will designate all sources of water and the use thereof within the study area;

(7) Develop criteria for determining whether excessive mounding or withdrawal is occurring or is likely to occur in an area of interest;

(8) Annually or as otherwise needed determine the impacts of the Project on each of the Adjoining Entities by evaluating with and without Project conditions; and

(9) Develop procedures, review data, and recommend Project operational criteria for the purpose of identifying, verifying, avoiding, eliminating or mitigating, to the extent practicable, the creation of significant imbalances or significant adverse impacts.

b. Collection and Sharing of Data. The Adjoining Entities will make available to the Monitoring Committee copies of all relevant groundwater level, groundwater quality, and other monitoring data currently collected and prepared by each. Rosedale shall annually report, by areas of interest, water deliveries for banking and other purposes, groundwater withdrawals from bank accounts, transfers and other changes in account balances.

c. Monitoring Costs.

(1) The cost of constructing monitoring wells and ancillary equipment within Rosedale shall be borne by Rosedale. The cost of any new or additional monitoring wells and ancillary equipment outside the boundaries of Rosedale shall be borne as may be determined by separate agreement of Rosedale and Adjoining Entities.

(2) Each of the parties shall be responsible for the personnel costs of its representative on the Monitoring Committee. In addition, the Adjoining Entities shall be responsible for all costs of monitoring operations and facilities within their respective boundaries and Rosedale shall be responsible for all costs of monitoring operations and facilities within the Project Site.

(3) All other groundwater monitoring costs, including employment of the professional groundwater specialist, collection, evaluation and analyses of data as adopted by the Monitoring Committee, shall be allocated among and borne by the parties as they shall agree among themselves. Cost sharing among Adjoining Entities shall be as agreed by them. Any additional monitoring costs shall be determined and allocated by separate agreement of those parties requesting such additional monitoring.

4. Modification of Project Operations. The Monitoring Committee may make recommendations to Rosedale, including without limitation recommendations for modifications in Project operations based upon evaluation(s) of data which indicate that excessive mounding or withdrawal is occurring or is likely to occur in an area of interest. The Monitoring Committee and its members shall not act in an arbitrary, capricious or unreasonable manner.

5. Dispute Resolution.

a. Submission to Monitoring Committee. All disputes regarding the operation of the Project or the application of this MOU, or any provision hereof, shall first be submitted to the Monitoring Committee for review and analysis. The Monitoring Committee shall meet and review all relevant data and facts regarding the dispute and, if possible, recommend a fair and equitable resolution of the dispute. The Monitoring Committee and its members shall not act in an arbitrary, capricious or unreasonable manner. In the event that (1) the Monitoring Committee fails to act as herein provided, (2) any party disputes the Monitoring Committee's recommended resolution or (3) any party fails to implement the Monitoring Committee's recommended resolution within the time allowed, any party to this MOU may seek any legal or equitable remedy available as hereinafter provided.

b. Arbitration. If all of the parties agree that a factual dispute exists regarding any recommendation of the Monitoring Committee made pursuant hereto, or implementation thereof, such dispute shall, be submitted to binding arbitration before a single neutral arbitrator appointed by unanimous consent and, in the absence of such consent, appointed by the presiding judge of the Kern County Superior Court. The neutral arbitrator shall be a registered civil engineer, registered geologist, or other person agreeable to the parties, preferably with a background in groundwater hydrology. The arbitration shall be called and conducted in accordance with such rules as the contestants shall agree upon, and, in the absence of such agreement, in accordance with the procedures set forth in California Code of Civil Procedure section 1282, et seq. Any other dispute may be pursued through a court of competent jurisdiction as otherwise provided by law.

c. Burden of Proof. In the event of arbitration or litigation under this MOU, all parties shall enjoy the benefit of such presumptions as are provided by law but, in the absence thereof, neither party shall bear the burden of proof on any contested legal or factual issue.

d. Landowner Remedies. Nothing in this MOU shall prevent any landowner within the boundaries of any party from pursuing any remedy at law or in equity in the event such landowner is damaged as a result of projects within the Kern Fan Area.

6. Term. The Effective Date of this MOU shall be January 1, 2003 regardless of the date of actual execution. This MOU shall continue in force and effect from and after the Effective Date

until terminated by (1) operation of law, (2) unanimous consent of the parties, or (3) abandonment of the Project and a determination by the Monitoring Committee that all adverse impacts have been fully eliminated or mitigated as provided in this MOU.

7. Complete Agreement/Incorporation Into Banking Agreements. This MOU constitutes the whole and complete agreement of the parties regarding Project operation, maintenance and monitoring. Rosedale shall incorporate this MOU by reference into any further agreement it enters into respecting banking of water in or withdrawal of water from the Project Site.

8. Future Projects. With respect to any future project within the Kern Fan Area, the Parties hereto shall use good faith efforts to negotiate an agreement substantially similar in substance to this MOU.

9. Notice Clause. All notices required by this MOU shall be sent via first class United States mail to the addresses shown on the signature page of this agreement and shall be deemed delivered three days after deposited in the mail. Notice of changes in the representative or address of a party shall be given in the same manner.

10. California Law Clause. All provisions of this MOU and all rights and obligations of the parties hereto shall be interpreted and construed according to the laws of the State of California.

11. Amendments. This MOU may be amended by written instrument executed by all of the parties. In addition, recognizing that the parties may not now be able to contemplate all the implications of the Project, the parties agree that on the tenth anniversary of implementation of the Project, if facts and conditions not envisioned at the time of entering into this MOU are present, the parties will negotiate in good faith amendments to this MOU. If the parties cannot agree on whether conditions have changed necessitating an amendment and/or upon appropriate amendments to the

MOU, such limited issues shall be submitted to an arbitrator or court, as the case may be, as provided above.

12. Successors and Assigns. This MOU shall bind and inure to the benefit of the successors and assigns of the parties.

13. Severability. The rights and privileges set forth in this MOU are severable and the failure or invalidity of any particular provision of this MOU shall not invalidate the other provisions of this MOU; rather all other provisions of this MOU shall continue and remain in full force and effect notwithstanding such partial failure or invalidity.

14. Force Majeure. All obligations of the parties shall be suspended for so long as and to the extent the performance thereof is prevented, directly or indirectly, by earthquakes, fires, tornadoes, facility failures, floods, drownings, strikes, other casualties, acts of God, orders of court or governmental agencies having competent jurisdiction, or other events or causes beyond the control of the parties. In no event shall any liability accrue against a party, or its officers, agents or employees, for any damage arising out of or connected with a suspension of performance pursuant to this paragraph.

15. Counterparts. This MOU, and any amendment or supplement thereto, may be executed in two or more counterparts, and by each party on a separate counterpart, each of which, when executed and delivered, shall be an original and all of which together shall constitute one instrument, with the same force and effect as though all signatures appeared on a single document. In proving this MOU or any such amendment, supplement, document or instrument, it shall not be necessary to produce or account for more than one counterpart thereof signed by the party against whom enforcement is sought.

IN WITNESS WHEREOF the parties have executed this MOU as of ______________, 2004 (Effective Date) at Bakersfield, California.

ROSEDALE-RIO BRAVO WATER STORAGE DISTRICT
P. O. Box 867
Bakersfield, CA 93302-0867

By: ______________________

By: ______________________

ROSEDALE RANCH I.D.
NORTH KERN WATER STORAGE DISTRICT
P. O. Box 81435
Bakersfield, CA 93380-1435

By: ______________________

By: ______________________

SEMITROPIC WATER STORAGE DISTRICT
P. O. Box Z
Wasco, CA 93280-0877

By: ______________________

By: ______________________

BUENA VISTA WATER STORAGE DISTRICT
P. O. Box 756
Buttonwillow, CA

By: ______________________

By: ______________________

HENRY MILLER WATER DISTRICT
P. O. Box 9759
Bakersfield, CA 93389-9759

By:______________________________

By:______________________________

BERRENDA MESA WATER DISTRICT
2100 F Street, Suite 100
Bakersfield, CA 93301

By:______________________________

By:______________________________

KERN COUNTY WATER AGENCY
P. O. Box 58
Bakersfield, CA 93302-0058

By: Gene A. Lundquist

By: President

KERN WATER BANK AUTHORITY
P. O. Box 80607
Bakersfield, CA 93380-0607

By:______________________________

By:______________________________

IMPROVEMENT DISTRICT NO. 4
KERN COUNTY WATER AGENCY
P. O. Box 58
Bakersfield, CA 93302-0058

By: Gene A. Lundquist

By: President

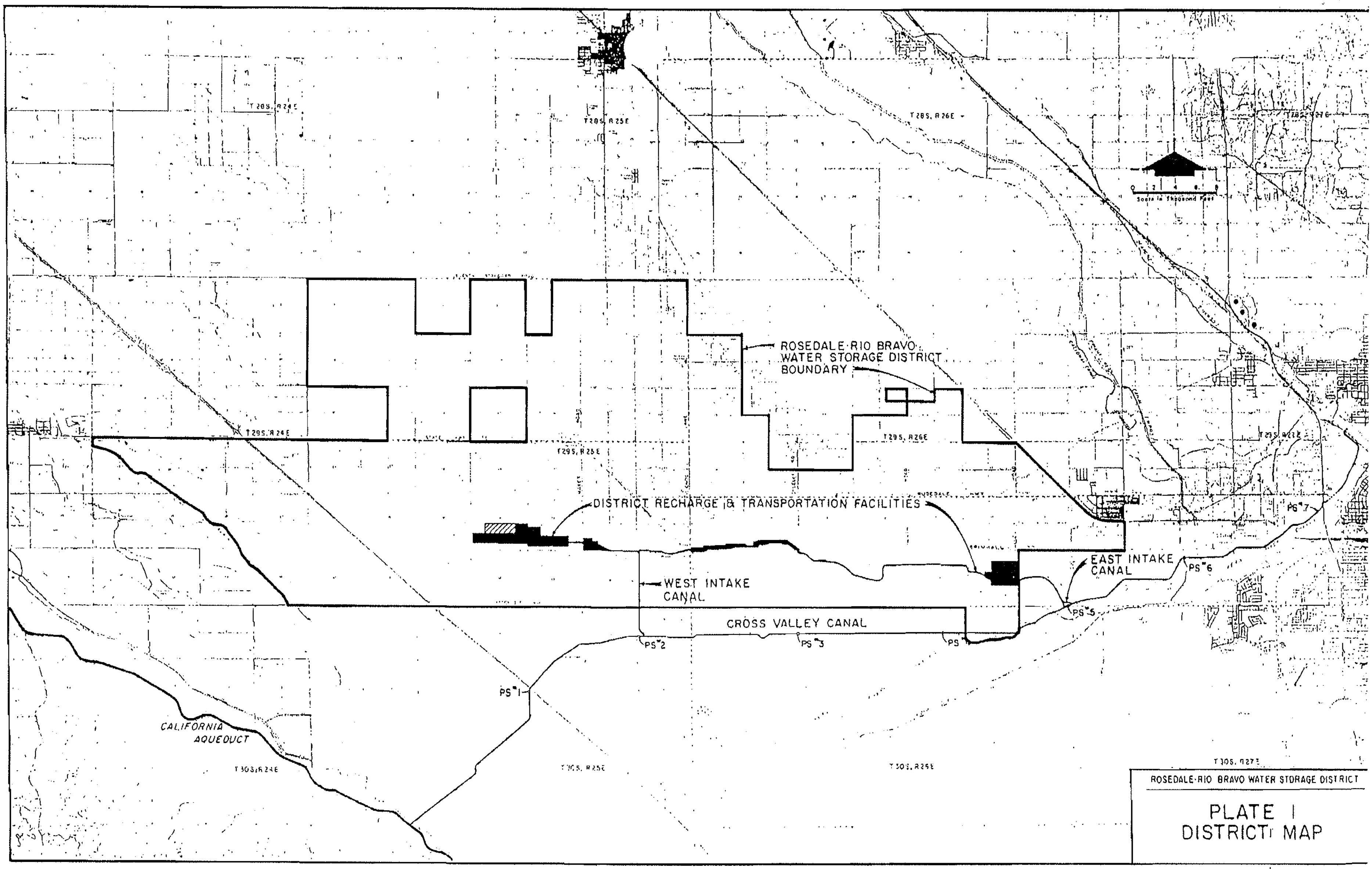
WEST KERN WATER DISTRICT
P. O. Box 1105
Taft, CA 93268-1105

By:________________________________

By:________________________________

RRB banking MOU - sales included - final.wpd

EXHIBIT 'A'



ROSEDALE-RIO BRAVO WATER STORAGE DISTRICT

PLATE I
DISTRICT MAP

EXHIBIT 'B'

Appendix F

Strand Ranch Well Placement and Drawdown Analysis

Sierra Scientific Services

An Evaluation of Well Placements and Potential Impacts of the Proposed Strand Ranch Well Field, Kern County, California.

20 December, 2007

prepared for:

Irvine Ranch Water District
P. O. Box 57000
15600 Sand Canyon Avenue.
Irvine, Ca 92619 - 7000
Attn: Mr. Paul Weghorst,
Principal Water Resources Manager
(949) 453 - 5632

prepared by:

Sierra Scientific Services
1800 30th Street, Suite 400
Bakersfield, CA 93301-1932
Attn: Robert A. Crewdson, Ph.D.
(661) 377 - 0123

Table of Contents

List of Figures.

List of Tables.

List of Exhibits.

Note: The Exhibit 5 Catalog is presented in a large, separately-bound volume which is available at the main office of the Irvine Ranch Water District in Irvine, Ca, or the main office of the Rosedale - Rio Bravo Water Storage District in Bakersfield, Ca. A table of contents of the Exhibit 5 Catalog is presented at the end of this Report in place of the complete Catalog.

Sierra Scientific Services

An Evaluation of Well Placements and Potential Impacts of the Proposed Strand Ranch Well Field, Kern County, California.

1. Summary of Findings

The purpose of this Report is to present the findings of a water-level-drawdown impact evaluation for a proposed well field which is a part of the Strand Ranch aquifer storage and recovery (ASR) project. The study includes the computer simulation of predicted water level drawdowns in the local aquifer due to project pumping and the evaluation of the predicted impacts within the area of influence. The study also includes the computer simulation and evaluation of predicted water table mounding due to project recharge as part of a total-project-impact analysis. The Strand Ranch project area covers nearly a full section of land, a square area of approximately 611 acres. The study area includes the project site plus the eight (8) contiguous adjoining sections, i.e., a square study area covering a total of nine (9) square miles. The Strand Ranch project site is surrounded by other existing ASR projects which overlie the prolific fresh water aquifer referred to locally as the Kern Fan in Kern County, California.

We calculated and summarized the drawdowns and mounding in several ways by mapping the actual drawdown as a function of location and distance from the operating wells, by calculating the average drawdown within the well field and within each of the eight adjacent sections, and by calculating the specific drawdowns at selected locations of interest in the surrounding sections.

Well Field and Aquifer Model.

For this study, we calculated the water level drawdowns for three hypothetical well-field operating scenarios of 9-, 7-, or 5- wells. Each scenario is designed to recover 17,500 af of ground water from the underlying aquifer in a year, with all wells pumped at a nominal 5 cfs. The criteria which we used for well placements serve to: 1. minimize well interference, 2. distribute the drawdown impacts as uniformly as possible across the largest possible area, and 3. minimize the drawdown impacts to non-project wells in the surrounding area. Based on these criteria, we used a uniform square grid of 9 possible well locations with a well spacing of

1/3-mile (1,760 ft) and a property line setback of 1/6-mile (880 ft). These dimensions are consistent with existing well-field practices in other ASR projects located in the local area.

The Kern Fan aquifer behaves and is modeled as a 3-layer, semi-confined, i.e. "leaky", aquifer in which the shallow zone is unconfined, the deep zone is semi-confined, and the intermediate zone acts as a leaky aquitard between the other two. The base case aquifer parameters were the same for each case, i.e., a 300-ft thick, semi-confined aquifer with T = 17,100 ft^2/d, S = 0.02, and porosity = 30%; an overlying aquitard with L' = 0.000475 d^{-1} which is gives a Hantush leakage factor of B = 6,000 ft; and an overlying unconfined aquifer with a specific yield of Sy = 21%.

The unimpacted, natural groundwater gradient was assumed to be zero unless otherwise specified. For capture zone and particle trajectory calculation we used a groundwater gradient of -25 ft/mi to the northwest (-0.0048 at a left aximuth of 135 degrees from east) and we assumed a corresponding reference groundwater elevation at 100 ft below GL at the southeast corner of the project area (i.e., the SE cor Sec 02, T30s, R25e). We calibrated the results by varying selected parameters to provide a sensitivity analysis to estimate the effects of parameter uncertainty. The modeling parameters have been summarized in Table 1 and described in detail in the text and Exhibit 2.

Calculated Drawdowns.

We calculated the leaky- aquifer, transient and steady-state (maximum) water level drawdowns, capture zones, and particle trajectories using the commercially-available analytic computer model "WinFlow" by Environmental Solutions, Inc. We present a discussion of computer models in Exhibit 1, aquifer parameters and parameter values in Table 1 and Exhibit 2, limitations of the analysis in Exhibit 3, and a catalog of all model outputs in Exhibit 5. We present the primary results of interest below.

Nine- well scenario: q = 90 af/d, pumping t = 194 d, V = 17,500 af/yr.

The hypothetical steady-state drawdowns created by the Strand Ranch, *9-well, 194-day*, pumping scenario are presented on the map in Figure 5 and summarized in Tables 2 & 3. At steady-state, the average drawdown under the project site is 43 ft and the average drawdowns in the surrounding 8 sections are in the range of 12 - 20 ft. The drawdowns along the perimeter of the study area are in the range of 5 - 9 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter. The drawdowns for the 9-well case superimposed on a northwesterly groundwater gradient are shown on the map in Figure 9.

Under these assumptions, the area will achieve steady-state within about 100 days after pumping begins and the water levels will begin to recover after 194 days when pumping ceases. As long as the leaky-aquifer assumptions continue to be met, the water levels in the study area will recover to pre-pumping levels in another 100 days or less, in the absence of other influences.

<u>Seven - well scenario:</u> q = 70 af/d, pumping t = 250-day, V = 17,500 af/yr.

The hypothetical steady-state drawdowns created by the Strand Ranch, *7-well, 250-day,* pumping scenario are presented on the map in Figure 6 and summarized in Tables 2 & 3. At steady-state, the average drawdown under the project site is 34 ft and the average drawdowns in the surrounding 8 sections are in the range of 9 - 14 ft. The drawdowns along the perimeter of the study area are in the range of 3 - 8 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter.

Under these well field assumptions, the area will achieve steady-state within about 100 days after pumping begins and the water levels will begin to recover after 350 days when pumping ceases. As long as the leaky-aquifer assumptions continue to be met, the water levels in the study area will recover to pre-pumping levels in another 100 days or less, in the absence of other influences.

The hypothetical drawdowns created by the Strand Ranch *7-well, 250-day scenario* are approximately 78% of the hypothetical drawdowns for the 9- well scenario but the duration of impact lasts about 56 days longer because the wells must operate longer to recover the same total volume of water (17,500 af/yr) at the lower recovery rate (70af/d vs. 90 af/d).

<u>Five - well scenario:</u> q = 50 af/d, pumping t = 350-day, V = 17,500 af/yr.

The hypothetical steady-state drawdowns created by the Strand Ranch, *5-well, 350-day,* pumping scenario (wells 1, 3, 5, 7, 9) are presented on the map in Figure 7 and summarized in Tables 2 & 3. At steady-state, the average drawdown under the project site is 24 ft and the average drawdowns in the surrounding 8 sections are in the range of 7 - 11 ft. The drawdowns along the perimeter of the study area are in the range of 2 - 6 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter.

Under these well field assumptions, the area will achieve steady-state within about 100 days after pumping begins and the water levels will begin to recover after 350 days when pumping ceases. As long as the leaky-aquifer assumptions continue to be met, the water levels in the study area will recover to pre-pumping levels in another 100 days or less, in the absence of other influences.

The hypothetical drawdowns created by the Strand Ranch *5-well, 350-day scenario* are approximately 56% of the hypothetical drawdowns for the 9- well scenario but the duration of impact lasts about 156 days longer because the wells must operate longer to re-cover the same total volume of water (17,500 af/yr) at the lower recovery rate (50 vs 90 af/d).

We have also calculated the hypothetical, steady-state drawdowns for an alternate Strand Ranch, *5-well, 350-day*, pumping scenario the same as above except using wells at locations 1,2,3,4,5 instead of 1,3,5,7,9. The drawdowns for this case are presented on the map in Figure 8 and summarized in Tables 2 & 3. At steady-state, the average drawdown under the project site is 24 ft and the average drawdowns in the surrounding 8 sections are in the range of 7 - 11 ft. The drawdowns along the perimeter of the study area are in the range of 2 - 6 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter.

The project has considerable flexibility in delivering less than the full recovery rate of 45 cfs and/or the annual recovery volume of 17,500 af. The project may meet reduced delivery rates and volumes by choosing to pump for less time, and/or at lower pumping rates, and/or using fewer wells. Each of these possible alternatives provides reduced drawdowns, somewhat smaller areal distributions, and faster aquifer- recovery times.

<u>Capture Zone.</u>

For 300 days of pumping, the hypothetical capture perimeter surrounding the entire well field extends only a few hundred ft outward from the individual wells and remains entirely within the property boundary of the Strand Ranch. For a hypothetical 1000 days (approx. 3 yr) of continuous pumping, the hypothetical capture perimeter extends about 1,800 ft from the individual wells. For a hypothetical 3650 days (10 yr) of continuous pumping, the capture zone would extend about 2,300 ft down-gradient to the northwest and would extend about 4,500 ft up-gradient to the southeast under conditions of long-term groundwater gradient of 25 ft/mi to the northwest. Pumping by non-project wells in the surrounding areas will change the shape and extent of this capture zone, as shown in the various model runs.

A capture zone analysis requires that we model the aquifer behavior as realistically as possible, since true particle trajectories will respond to all influences on the potentiometric pressure field and not just those generated by the Strand Ranch wells. Therefore, the most realistic scenario assumes that the Strand Ranch wells will most likely be pumping in a dry year when all of the neighboring wells are pumping as well. The combined pumping effects of these wells superimposed on the natural groundwater gradient will determine the locations of capture zone and particle trajectories with time.

The water level elevation map in Figure 10 shows the steady-state impacts of the nine Strand Ranch wells and eleven Kern Water Bank wells superimposed on the local groundwater gradient. The five wells located at the center and corners of the Strand Ranch well field (wells 1, 3, 5, 7, 9) have 1,000-day reverse particle trajectories attached to them which define the shape and areal extents of the "3-year" capture zones for continuous pumping at these locations. For reference purposes, the section corners have been labeled on the map. We have mapped the locations of the capture zone perimeter for pumping times of 300-, 1000-, 1825-, and 3650-days superimposed on 10-year continuous particle trajectories in Figure 11.

We have also mapped (Figure 12) the 10-year forward particle trajectories of a hypothetical line source located in the southwest quarter of section 12, T30s, R25e under conditions of continuous pumping of both the Strand Ranch and Kern Water Bank wells. Any groundwater contamination which comes from a source located on or near this line will follow the same trajectories. A slug or plume of contamination will eventually be captured by wells located on the Kern Water Bank and/or Strand Ranch depending on the particular location of the source and its downgradient trajectories.

Based on available existing water quality data, the shallow aquifer under the project site (compared to the nearby, unimpacted shallow aquifer) has elevated concentrations of total dissolved solids and several constituents of concern due to the inflow of a brine plume from an unspecified, up-gradient source or sources in or near the southwest quarter of Section 12, T30s/25e. This brine plume represents a source of water quality degradation that falls within the predicted capture zone of the well field under conditions of natural groundwater gradient and under conditions of pumping. There is no recognized way of positioning the proposed Strand Ranch wells to avoid the water quality impacts of this brine plume. The quantitative analysis of the potential impacts of this brine plume on the Strand Ranch well field is outside the scope of this study.

Calculated Recharge Mounding.

We calculated the unconfined- aquifer, transient, water table drawdowns using the commercially-available analytic computer model "WinFlow" by Environmental Solutions, Inc. We calculated the transient water level rises due to mounding assuming that the project recharges 17,500 af in a single episode using 450 acres of ponds. For the range of expected infiltration rates of 0.20, 0.25, and 0.30 ft/d, a recharge episode will last 129 - 194 days. We present the primary results of interest below.

For the three recharge scenarios, the calculated maximum mound heights under the project range from 32 - 40 ft and the maximum water level rises in the surrounding 8 sections ranges from 6 - 14 ft.

As discussed in the Report, the positive impact of recharge mounding fully compensates for recovery drawdown in all except the "least-favorable" case of a recharge/recovery cycle at minimum recharge rates and maximum recovery rates. In this one case, the maximum uncompensated net temporary drawdown in the surrounding eight sections is in the range of -6 to -7 ft. All other, more-favorable, scenarios result smaller net water level declines and/or net water level rises at all locations surrounding the project site for comparable time periods.

Project Impact.

The proposed Strand Ranch ASR project operation is designed to always maintain a positive project balance, i.e., a volume of water must always be stored in the aquifer prior to removing a like volume from the aquifer. ASR projects usually operate by putting water into the ground in a wet year and then recovering it as needed in some future dry year, so there is little likelihood of recharge and recovery happening simultaneously. As long as the project puts as much water in the ground as it takes out, the net basin impact from water level drawdown will be pre-compensated for by the water-level rise due to recharge mounding, so there will be no net long term effect on the basin no matter how far apart recharge and recovery are separated in time.

In the case of the proposed Strand Ranch project, both recharge and recovery facilities will be co-located on the project site such that the approximately equal and opposite impacts of both recharge and recovery will be superimposed on the same area and same aquifer zones.

The Project operators have voluntarily established operating limits which preclude the occurrence of an unacceptable, unbalanced recharge/recovery cycle. The project is voluntarily designed so that 1. the Strand Ranch project will not have more than 50,000 af of water in basin storage, and 2. the project will not recharge or recover more than a maximum of 17,500 af of groundwater per year during normal operations. The computer models of both recharge and recovery have demonstrated that by capping the maximum inflow/outflow at 17,500 af/yr, that 1. the beneficial impacts of recharge are approximately equal to the potentially detrimental impacts of recovery, and 2. by spreading the recovery of the maximum allowable volume of water in storage over a 3-year period the individual and combined net impacts of the total operation avoids and prevents unacceptable impacts to the aquifer and the basin.

<u>Conclusions and Recommendations.</u>

We conclude that the Strand Ranch well-field scenarios minimize the respective predicted drawdown impacts by putting the maximum available distances between wells over the widest available area by using well spacings and property line setbacks which are no less than those being used successfully in other ASR projects in the Kern Fan project area. We conclude that the project design results in approximately balanced recharge/recovery cycles so that the transient water level rises due to recharge mounding episodes are approximately equal and opposite to the transient water level declines due to recovery drawdown episodes.

We conclude that for this project to operate as predicted and desired, the total recharge to this area must start out and remain in long term balance with total recovery in this area, as the project is designed to do.

We conclude that under existing and foreseeable circumstances, the Strand Ranch, 9-well, 45 cfs, maximum-recovery scenario is an acceptable short-term and long-term operating scenario which does not create a net impact on the basin if recharge precedes recovery, as proposed. All other Strand Ranch scenarios using fewer wells, and/or lower total recovery rates, and/or lower total recovery volumes are also acceptable by the same criteria.

We conclude that the brine plume which is flowing under the Strand Ranch from an unspecified upgradient source or sources is a cause for concern which cannot be mitigated through well placements within the project area. However, the plume is a residual effect from oilfield-brine discharge sources which are no longer active and both periodic recharge and periodic shallow groundwater extraction by the Kern Water Bank on adjacent lands is remediating the plume by diluting and permanently removing groundwater with elevated TDS content from within the plume perimeter. We note that the Kern Water Bank's operation of these wells is voluntary; the KWB was not responsible for the brine discharge nor are they being held responsible for its cleanup. Future Strand Ranch project operations will have the same beneficial impacts on the brine plume.

We recommend that the project test each new water well individually with a testing program which will provide for aquifer parameter measurement as well as pump parameter measurement. Such data will be useful and essential for a future aquifer model calibration. We recommend that the project partners consider contracting with SSS to help design, observe, and interpret the well tests.

We recommend that the project impacts be carefully monitored from startup so that we can calibrate and verify the results of this work program and then make refinements in our model of the aquifer behavior for future use.

We recommend installing monitoring wells to satisfy four different purposes, including well testing, model calibration and verification, long- term operational water level monitoring, and contaminant- detection monitoring. We recommend as many monitoring well installations as are necessary to cover all of these functions at all important locations and in all necessary aquifer zones. It may be necessary to install some monitoring wells which are useful for only one of these functions, since a single well placement may not be effective for all purposes. We recommend that the project consider designing the completion depth interval of each monitoring well depending on the intended purpose for the well. We also recommend that the project be willing to use multiple monitoring wells which are completed in different depth intervals where potentially effective or necessary.

We recommend that the project consider using the drawdown maps from this study to locate the placement of monitoring wells for water level monitoring especially in and around the recharge/recovery zones. We recommend that the project consider using the particle trajectory and capture zone maps from this study to locate the placement of monitoring wells for contaminant detection monitoring, especially to the east of the well field. We again recommend that the project consider restricting the completion depth interval of each monitoring well depending on the intended purpose for the well.

Crewdson, Robert, A., 20 December, 2007, An Evaluation of Well Placements and Potential Impacts of the proposed Strand Ranch Well Field, Kern County, California., Sierra Scientific Services, Bakersfield, CA.

An Evaluation of Well Placements and Potential Impacts
of the Proposed Strand Ranch Well Field, Kern County, California.

2. Introduction

Purpose.

The main purpose of this Report is to describe the water level drawdown impacts which are expected to occur as a result of the operation of the Strand Ranch Aquifer Storage and Recovery Project. The potential drawdown impacts of interest are the impacts created by pumping the proposed Strand Ranch recovery wells. The locations of interest include the project site and the eight sections adjacent to the project and more specifically any existing water wells in those sections. We have evaluated and summarized these drawdowns in several ways by mapping the actual drawdown as a function of location and distance from the operating wells, by calculating the average drawdown within the well field and within each of the eight adjacent sections, and by calculating the specific drawdowns at selected locations in the surrounding sections.

The findings of this study may be used to 1. evaluate the alternatives for numbers and locations of water recovery wells in the future Strand Ranch well field, 2. evaluate the numbers and locations of monitoring wells which are desired or required for purposes of water level and water quality monitoring, and 3. evaluate the potential interactions and impacts between the Strand Ranch project and adjacent entities.

Project Scope - Aquifer Storage and Recovery.

Aquifer storage and recovery (ASR) is the generic term which describes the practice of deliberately putting surface water into a groundwater aquifer through infiltration basins with the intention of recovering a like volume of water from the aquifer at a later date. Such a practice presents a great opportunity to increase the local and statewide capacity to store water. ASR projects help regulate the water supply and demand over time by storing excess water when it is available in wet years for future recovery when water is needed in dry years.

In Kern County, California, there are 3 main components to every ASR facility: infiltration basins, water wells, and a conveyance system. The infiltration basins, also referred to as recharge basins[1], are ponds which are constructed to allow ponded water to infiltrate into the groundwater basin. The water wells, also referred to as recovery wells[2], are conventional high-flow water wells used to pump water out of the underlying aquifer. The project conveyance system consists of one or more canals, ditches, or pipelines used to deliver water between the ASR facility and the local or regional water conveyance infrastructure.

The Kern County water community generally refers to ASR projects as "banking" projects. According the Kern County Water Agency, "These banking programs are essential to Kern County's water management and future growth"[3] and this is broadly true of the entire State of California water infrastructure. As used in Kern County, the term "banking" is loosely used to describe the act of physically putting water into the underlying aquifer and crediting the owner with the right to remove a like volume of water from the aquifer at a later date. This credit allows the owner to show such a volume of banked water as part of its current water

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[1] We prefer the terms "infiltration basin" or "percolation basin" rather than "recharge basin" since the former terms are neutral and descriptive while the latter term needlessly implies, contrary to intent, that we are putting water back into the aquifer ***after*** it has been taken out, as has historically been the case in some conjunctive-use projects in Kern County, Ca. The primary distinction, in our opinion, is that the concept of "recharge" might be appropriate in a conjunctive-use context where water borrowed from the basin must subsequently be replaced, i.e., the aquifer must be replenished or recharged as a means of overdraft correction whereas "groundwater banking", by definition, requires storing water prior to removing it. Nevertheless, we recognize the common local use of "recharge" to mean any addition of water to an aquifer.

[2] We prefer the term "water well" rather than "recovery well" since the former term is neutral and descriptive while the latter term needlessly suggests, contrary to intent, that such a "recovery" well may be different than other water wells and perhaps restricted to the extraction of some particular water or water for some particular use.

[3] Lloyd Fryer. 2005. Kern County Groundwater Banking Projects. KCWA brochure.

supply. If such water has been "banked" on behalf of another party, then it is considered to be real water held in trust for that party who has an absolute right of recovery.

Local Operating Rules. The local water community in Kern County has established certain conventions regarding the design, operation, and monitoring of aquifer storage and recovery projects, i.e., "water banking" operations. The rules are the guiding principles which are contained in the Memorandums of Understanding (MOUs) between Kern County project operators and adjacent entities. The rules provide for creating intended project benefits while eliminating or minimizing potentially significant adverse impacts. The MOUs elaborate on these principles which are paraphrased below (the numbers below are for reference for our convenience only):

1. A project should not degrade the basin and should enhance it when possible;
2. A project should minimize the impacts on the environment and adjacent entities;
3. A project should provide mitigation for unavoidable adverse impacts;
4. A project mitigation can give consideration to the compensating aspects of recharge and recovery operations;
5. A project site should be monitored for water levels and water quality;
6. A project should take water out where it puts water in;
7. A project should account for losses to the basin.

Project Background.

Location. The Irvine Ranch Water District (IRWD) is currently in the process of developing a ±600 acre parcel in Kern County, California, as an Aquifer Storage and Recovery (ASR) Project. The parcel of interest is located in Section 2, Township 30s, Range 25e, MDBM, located at the southwest corner of Stockdale Highway and Enos Lane, several miles west of the City of Bakersfield. The ±600-acre Strand Ranch ASR project will be the latest among several existing ASR projects in the area which currently cover approximately 20,000+ acres and include more than 120 wells. The project site is surrounded in all four compass directions by existing ASR facilities belonging to the Kern Water Bank Authority or to the Rosedale - Rio Bravo Water Storage District. The parcel has been known historically as the Strand Ranch, so-named for the sand fairways crossing the property, so the project is informally referred to as the Strand Ranch ASR project.

Facilities. For this study we have assumed that the proposed project is designed to include approximately 450 acres of recharge ponds at full build-out which are expected to be able to recharge as much as 150 af per day. The estimated maximum site recharge capacity is 57,500 af per year, assuming a 365-day, wet-year, water supply and an average infiltration rate of 0.35 ft/d. The project site currently has approximately 117 ac of existing recharge ponds which were operated in 2006 on a pilot-study basis.

The Strand Ranch project plans to deliver water to and from the project site through the Cross Valley Canal which runs through the Strand Ranch property. The project owner is currently cooperating with the Kern County Water Agency for the installation of a CVC turnout to service the project site. During the 2006 pilot phase, the project received water deliveries through a cooperative agreement with the Kern Water Bank.

The site currently contains five or more irrigation wells which were installed by the previous owners of the Strand Ranch and are capable of recovering groundwater at this time. The project owner proposes to recondition or replace existing wells, and/or install recovery wells, as necessary or as beneficial, to meet their proposed operating parameters. To date, no recovery wells or pipelines have been installed on the property but the operational objective of the Strand Ranch ASR well field is to recover water which has been previously stored in the underlying groundwater aquifer. The project design objective is to store a sufficient volume of water in the aquifer over the long term to be able to recover a maximum 17,500 af/yr with a total in-ground storage limit of 50,000 af.

Aquifer. The site is flat at an elevation of about 320 ft above msl. The site overlies the prolific aquifers which comprise the so-called Kern Fan which, geologically speaking, is a thick pile of interbedded, fine- to coarse- grained, fluvial/alluvial sediments. The shallow aquifer is recharged by natural and manmade percolation of (mostly) Kern River water. Recharge occurs in the river bottom and nearby recharge ponds which form a 15-mile long, linear recharge axis trending southwest across the southern San Joaquin Valley starting in the city limits of Bakersfield, Ca. When we refer to the Kern Fan in this Report we will generally be referring to the ±15- mile wide elongate area which straddles the recharge axis and includes the river channel, ASR project sites, and related surface infrastructures.

The Strand Ranch ASR Project is near, but northwest of, the recharge axis of the Kern Fan recharge mound. The depths to groundwater under the Project site fluctuate significantly due to the rise and fall of the Kern Fan recharge mound under the influence of the regional climatic wet/dry cycle. During consecutive dry years the groundwater may be 150 - 170 ft deep such as in 1990 - 1994, whereas during consecutive wet years the groundwater under the site may be 20 - 70 ft deep such as in 1995 - 1998. The unimpacted, natural groundwater gradient under the Project site in dry years trends northwesterly at -10 to -15 ft/mi WNW and in wet years trends northwesterly at -20 to -30 ft/mi NW.

Surface Water Supply. The three potential sources of surface water which might be brought to the property include high-flow water from the Kern River, water from the Federal Central Valley Project (CVP) via the Friant- Kern Canal, and/or water from the California State Water Project (SWP) via the California Aqueduct, etc. The source of both the Kern River water and CVP water is runoff from the winter snowpack from the highlands of the southern Sierra Nevada mountain range. The primary water source for the SWP is runoff from the greater volcanic highlands surrounding Mt Shasta in northern California. The waters from all three sources are very good quality when they reach their intended points of use within Kern County.

Work Program.

The components of the work program for this study included designing realistic well-field alternatives based on the well-field spacing and operating practices within existing local ASR projects, determining the aquifer parameters for the study area, calculating the water level drawdowns and particle flow-trajectories for base case and non-base case scenarios, and evaluating the project water level impacts, including consideration of the beneficial impacts of project recharge operations. This Report presents the findings of the work program.

Personnel.

Dr. Robert A. Crewdson is a Bakersfield, California consultant doing business as Sierra Scientific Services (SSS). SSS specializes in quantitative ground water hydrology, applied potential theory and time series analysis, quantitative ground water flow analysis, water quality geochemistry, well testing and monitoring, contaminant transport modeling, and aquifer properties testing. Dr. Crewdson is a research associate and adjunct professor at California

State University Bakersfield where he has taught hydrology, contaminant transport, geochemistry and geophysics in upper division and graduate level courses.

SSS would like to thank Kellie Welch of the Irvine Ranch Water District and Jennifer Jacobus of ESA, Inc. for their help preparing several maps and figures in this Report.

Methodology.

SSS obtained and reviewed well field data, historical recharge, pumping volume and recovery rate data, and water level hydrographs for the ASR projects located on the Kern Fan supplied by IRWD and as published in the KCWA 2001Kern Fan Area Operations and Monitoring Report, April, 2005 and from other data sources generated for the bimonthly Kern Fan Monitoring Committee. SSS used these data to define alternative hypothetical well-field scenarios for the Strand Ranch ASR project which would be consistent with existing well field practices in these other ASR projects. SSS obtained and reviewed the available sources of aquifer parameter data which are referenced in this Report and selected a suite of aquifer parameter values for use in the drawdown calculations. SSS used the "WinFlow" digital computer program by Environmental Simulations, Inc. to model the two dimensional groundwater flow, including the calculation of transient and steady-state water level drawdowns and the calculation of particle flow trajectories for all of the cases of interest.

An Evaluation of Well Placements and Potential Impacts
of the Proposed Strand Ranch Well Field, Kern County, California.

3. Discussion

Section I - Project and Study Area.

The Strand Ranch (SR) project covers essentially all of Section 02, T30s, R25e. The drawdown- impact study area covers a 3x3 sq. mi area which is centered on the project site in section 02 and includes the surrounding eight contiguous sections, 34, 35, 36 (T29s,R25e) and 1, 3, 10, 11, 12 (T30s, R25e). The three sections to the north (34, 35, 36) are part of the Rosedale - Rio Bravo Water Storage District (RRB). These sections include 3 existing farm irrigation wells but no RRB district project wells. Parts or all of the other five sections to the east, south, and west (1, 3, 10, 11, 12) are part of the Kern Water Bank (KWB). These sections contain eleven (11) operable banking project recovery wells.

For this study, one hypothetical project well-field alternative is 90 af/d (approx. 45cfs) which includes nine wells each pumping water at a nominal rate of at 5 cfs. The proposed maximum annual recovery of 17,500 af/yr requires pumping for 194 days. The two other hypothetical well-field alternatives we considered are 7 wells pumping at 70 af/d for 250 days or 5 wells pumping at 50 af/d for 350 days. The final number and locations of wells in the proposed Strand Ranch well field have not yet been determined.

The surrounding area contains three known private irrigation or domestic water wells within the Rosedale - Rio Bravo Water Storage (RRBWSD) district approximately ½ - 1 mile from the project site and eleven known banking project recovery wells which belong to the Kern Water Bank Authority, two of which are located very close to the property boundary between the Strand Ranch and the Kern Water Bank. The three private wells have an estimated pumping capacity of 10 cfs and the eleven KWBA wells have a published average pumping capacity of 62 cfs. Under the Strand Ranch (SR) hypothetical operating scenario of 45 cfs, the total recovery capacity in the 9 sq. mi. study area is 117 cfs, equivalent to 232 af/d. This maximum recovery scenario represents 38% of the total recovery capacity in the study area.

Under the hypothetical 5-well and 7-well operating scenarios of 25 and 35 cfs each, the project recovery would represent 26% or 33%, respectively, of the total recovery capacity in the study area.

Water level changes in the study area can be potentially effected by any or all of these wells. We also note, based on historical data, that the basinwide water level response to the climatic wet/dry cycle alone can be larger than the pumping drawdowns and may dominate the water level fluctuations in some years, independent of the project operations. Since project impacts may well occur at the same time as the water level impacts from other causes, the combined year-to-year water level declines due to both climate and non-project pumping may be significantly greater than the declines we have projected due to project pumping alone.

The potential drawdown impacts of interest are the impacts created by pumping the Strand Ranch recovery wells. These impacts include both permanent, basinwide impacts and local, temporary impacts and, according to the local MOU, the analysis of total net project impact may also consider the compensating, beneficial impacts of water level rises due to recharge mounding. The locations of interest include the eight sections adjacent to the project. We have evaluated and summarized these drawdowns in several ways by mapping the predicted drawdowns within the well field, by calculating the average drawdown within the well field and within each of the adjacent eight sections, and by calculating the drawdowns at specific locations of interest within the study area. We have evaluated water level rises due to recharge mounding in the same way as a part of a total net project impact analysis.

Apart from selecting the proposed well locations, the drawdown impact analysis is the main objective of this evaluation. This analysis assumes that the wells are drilled, completed, and developed properly so that they are efficient and productive water wells, limited only by the delivery capacity of the aquifer. The drawdown impact analysis requires several types of essential information including operating parameters, well parameters, aquifer model and aquifer parameters. We describe each of these parameter sets below.

Section II - Well Placement Analysis.

Placement criteria. The three primary criteria for locating the Strand Ranch water recovery wells are to meet project objectives and to 1. minimize well interference, 2. minimize the magnitude of the water level drawdown at all locations by distributing the drawdown impacts as uniformly as possible across the largest possible area, and 3. minimize the drawdown impacts to non-project wells in the surrounding area. The first two criteria are best met by placing the wells on the nodes of a uniform grid at the largest possible spacing and operating all wells simultaneously at the same flow rate. The third is best met by orienting and sizing the grid so that every possible well node is no closer to the nearest surrounding well of concern than a minimum specified property-line setback distance.

There are several secondary constraints and operating criteria which limit the selection of the proposed project well locations including: well spacing, voluntary property line setback distance, water quality issues, and accommodating the existing and proposed surface facilities including the CVC and the project recharge ponds and levees.

Based on our review of the well fields in other nearby ASR projects, we can achieve acceptable well spacings for purposes of meeting the primary criteria and be consistent with existing well placement practices, by using well spacings of 1/4 to 1/3-mile (1,320 to 1,760 ft) and a property-line setback distance of 1/8 to 1/6-mile (660 to 880 ft). Based on our review of these other fields, existing well placements in certain locations have ignored primary spacing and/or setback criteria in favor of optimizing the placement with respect to secondary criteria such as proximity to conveyance systems, total gathering system pipeline length, and/or drainage of otherwise inaccessible areas, all of which are related to capital and operating costs, and other factors. Therefore, all proposed well-field designs are based on 9 possible well locations on an equi-spaced 3x3 grid (i.e., a 9-spot pattern) with 1/3-mile spacings and 1/6-mile property line setbacks.

Proposed Water Recovery Operations. For the purposes of this study, we have selected three hypothetical well-field configurations for impact analysis on the Strand Ranch project site. All three well-field patterns are based on the positions of an equi-spaced "9-spot" pattern of NS/EW rows of wells centered on the project site. The first well-field scenario is 9 wells fully occupying the "9-spot" pattern. An alternate, 5-well field uses 5 wells located at the corner- and center- locations of the 9-spot pattern, and an alternate 7-well field uses 7 wells located at all locations except the southwest and south-central positions.

The proposed wells are designed to be 1,760 ft away from each other and 1,760 ft or more away from the nearest non- project wells based on a voluntarily 880-ft setback from the Strand Ranch property line. The projected recovery capacities of the three hypothetical well fields are 90af/d, 70 af/d, and 50 af/d for 9, 7, and 5 wells operating at a nominal 5 cfs each. The operating scenarios involve continuous pumping to recover a maximum 17,500 af/yr from the groundwater aquifer. This represents projected pumping durations of 194 days, 250 days, and 350 days for the 9, 7, and 5-well scenarios respectively.

The project has considerable flexibility in delivering less than the full recovery rate of 45 cfs and/or the annual recovery volume of 17,500 af. The project may meet reduced delivery rates and volumes by choosing to pump for less time, and/or at lower pumping rates, and/or using fewer wells. Each of these possible alternatives provides reduced drawdowns, somewhat smaller-, or differently located-, areas of impact, and faster aquifer- recovery times.

The project may have the operational flexibility to operate in cooperation with nearby project operators so as to mitigate, minimize or eliminate the mutual impacts and interactions between parties. One additional potential mitigation measure may include exercising an opportunity to recover project water from up to three wells located in a proposed Rosedale - Rio Bravo WSD well field about 1.4 miles north-northwest of the Strand Ranch well field. The hypothetical impacts of such recovery pumping are substantially removed from the Strand Ranch project site and adjacent properties; nevertheless, we have modeled the drawdown from four such scenarios and have included that analysis in Exhibit 4. The water level impact analysis for all on-site operations are presented in subsequent sections of this Report.

<u>Total Study-area Recovery Capacity.</u> The total recovery capacity in the 9-sq.mi. study area due to the proposed SR wells and the other existing wells is an estimated 117 cfs, which includes 45 cfs for the Strand Ranch 9-well maximum- recovery scenario, 62 cfs from the 11 surrounding KWB wells, and 10 cfs from the three RRB irrigation wells. The hypothetical future SR maximum recovery scenario represents 38% of the total recovery capacity in the study area . Alternately, the hypothetical 7-well and 5-well SR scenarios, at 25 and 35 cfs respectively, would represent 26% or 33% of the total recovery capacity in the study area.

The final numbers and locations of wells in the proposed Strand Ranch well field have not been determined as of this Study. But the new wells will represent only about 5% of the more than 120 existing or currently planned project recovery wells in the ASR projects on the overall Kern Fan.

Well Placement and Water Quality. Based on available existing water quality data, the shallow aquifer under the project site (compared to the nearby, unimpacted shallow aquifer) has residual, elevated concentrations of total dissolved solids and several constituents of concern due to the inflow of an old brine plume from an unspecified, historic, up-gradient source or sources in or near Section 12, T30s/25e. This brine plume represents a source of water quality degradation that falls within the predicted capture zone of the well field under conditions of natural groundwater gradient and under conditions of pumping. There is no recognized way of positioning the proposed Strand Ranch wells to avoid the water quality impacts of this brine plume. The quantitative analysis of the potential impacts of this brine plume on the Strand Ranch well field is outside the scope of this study.

Section III - Aquifer Model and Parameter Selection.

There are several different computation methods for predicting water-level drawdown from a pumping well in space and time and every method requires that the user select the equations which are most appropriate for the user's preferred model of the aquifer. In essence, the user must try to select the set of mathematical expressions which best represent the user's physical model of the aquifer. The calculated results, if done correctly, always represent the mathematical model and also represent the real aquifer behavior to the extent that the parameters, simplifications and assumptions of the mathematical model reflect the true workings of nature. The selection of the mathematical model and the equations, the accuracy of the parameter values, and the representativeness of the calculated output all reflect the correctness of- and uncertainty in- the judgments of the user. These judgments cannot be made by the computer and the two critical judgments include the choice of mathematical model and the choice of aquifer parameters.

The Real Aquifer. Based on our analysis of the local hydrogeology in the Strand Ranch project area, the local aquifer is a semi-confined (leaky) aquifer which is recharged from the sides and from the overlying layers. For a very small area such as the Strand Ranch project site, it is relatively easy to define a constant-property aquifer model which is representative of the entire area of interest. Our interpretations and our choices of model and parameter values differ from those of Schmidt in 1997 & 1998 and of the Department of Water Resources (DWR) in 1995, which we discuss in Exhibits 2 and 3. The aquifer consists of a sequence of nearly- horizontal, laterally discontinuous, interbedded, unconsolidated, sandy and silty sediments but there is no widespread, laterally continuous impermeable confining layer anywhere under the area of interest. Horizontal ground water flow occurs almost entirely within the sandy units. The shallow sands behave as an unconfined aquifer, but deeper sands show increasing amounts of delayed yield and confinement, according to KCWA hydrographs.

The total thickness of the commonly-used part of the aquifer is approximately 700 ft and, for modeling purposes, assumed to consist of shallow, intermediate, and deep producing zones. The shallow zone exhibits unconfined-aquifer behavior and is approximately 250 ft thick. The middle zone which exhibits intermediate behavior is considered to be the retarding layer and is approximately 100 ft thick. The deep zone exhibits short-term confined behavior and long-term semi-confined behavior and is approximately 300 ft thick. Essentially all of the existing recovery wells on the Kern Fan are completed across the intermediate and deep zones and exhibit semi-confined, aka "leaky", aquifer water-level behaviors. We have tabulated the aquifer properties which we have used in our modeling in Table 1 and discussed them in Exhibit 2.

Because the inter-bedded silts have some permeability of their own, and because pumping in the deeper zones causes significant downward vertical gradients, the deeper sands obtain a significant fraction of their recharge from the overlying layers. This "leakage recharge" through the permeable silts is augmented by higher- speed, vertical flow at the lateral margins of the silty layers through the more permeable sand facies between layers. The multi-zone hydrographs which are prepared and presented by the Kern County Water Agency on a monthly basis corroborate the widespread and persistent presence of downward vertical gradients between successively deeper depth intervals which are indicative of leaky aquifers.

We also note, based on historical data, that the basinwide water level response to the climatic wet/dry cycle alone can be larger than the pumping drawdowns and may dominate the water level fluctuations in some years, independent of the project operations. Since project impacts may well occur at the same time as impacts from other causes, the combined year- to-year water level declines due to both climate and non- project pumping may be significantly greater than the declines we have predicted due to project pumping alone.

The Model Aquifer. For this scope of work, we have a choice of computational method (analytical or numerical) and a choice of three mathematical aquifer models, i.e., a confined aquifer, an unconfined aquifer, or a semi-confined, or "leaky", aquifer. We chose to use "Winflow", a commercially-available analytical computational model written by ESI, as discussed in Exhibit 1.

Based on the observed stratigraphy and aquifer hydrology, the aquifer underlying the project site and study we chose to use a semi-confined-aquifer model. For the purpose of computer modeling, we represented the local aquifer as three zones; a shallow, 250-ft thick, unconfined aquifer, an intermediate, 100-ft thick "leaky" aquitard, and a deep, 300-ft thick semi-confined aquifer. We assume in the computer model that all project water recovery wells are completed across the full 300-ft thickness of the semi-confined zone. We have summarized the relevant aquifer parameters in the next section of this report and have discussed them in more detail in Exhibit 2.

There are other modeling variables besides the physical aquifer parameters which affect, and could perhaps even dominate, the water levels under the site, and which are easy to calculate but difficult to forecast in advance. The natural factors include the depth to the water table at project startup, the magnitude and direction of the ground water gradient, and the large water level fluctuations within the recharge area due to the climatic wet/dry cycle. The manmade variables include non-project impacts caused by other recharge or pumping operations in the surrounding area. The evaluation of these variables is outside the scope of work, however, they are not relevant to the basic determination of water level drawdown impacts due to Project well field operations. We have included a general discussion of the limitations of computer modeling in Exhibit 3.

Aquifer Parameters. For the leaky aquifer model, we must specify the aquifer dimensions, regional gradient, aquifer storage properties, and aquifer flow properties in both the horizontal and vertical directions. There is a scarcity of reliable parameter data in the Kern Fan area. We have reviewed all of the available data and have found just enough data to make an estimate of every required parameter. Because of the lack of replicate data, there is an unknown amount of uncertainty in the representativeness of these single parameter values, which is in addition to the uncertainty in the accuracy of these measurements themselves. We have accommodated the recognized uncertainty by repeatedly running the computer model with different sets of aquifer parameter values to generate sets of predicted drawdowns for the full range of possible parameter values in the Kern Fan area. We have discussed the aquifer parameters in more detail in Exhibit 2 and elements of the concept of uncertainty in the Exhibits 1 - 3.

From top to bottom, the shallow, unconfined zone is 250-ft thick, the middle "leaky" zone is 100-ft thick, and the deep semi-confined zone is 300 ft thick. All wells are assumed to be completed across the full 300-ft thickness of the bottom, semi-confined zone. All zones are assumed to have an average porosity of 30%.

The base case parameter values for the deep, semi-confined zone are as follows: the value of horizontal hydraulic conductivity is $K_h = 57$ ft/day, and the sensitivity analysis was run for $40 < K < 100$ ft/day; the value of specific storage is $S_s = 6.67 \times 10^{-5}$ ft^{-1} and was not re-calculated in the sensitivity analysis although the range of possible values could be half to twice the selected value. These valuers of K_h and S_s give equivalent values of semi-confined aquifer transmissivity and storativity of $T = 17{,}100$ ft^2/day and $S = 0.02$.

The base case parameter values for the middle, "leaky" zone are as follows: the value of leakance is assumed to be $L' = 0.000475$ d^{-1} which yields a Hantush leakage factor of $B = 6{,}000$ ft, and the sensitivity analysis was run for $B = 3200, 6000, 10{,}000$ ft. These values of B are equivalent to values of weighted-average vertical hydraulic conductivities (K_v') in the 100-ft thick aquitard of $K_v' = 0.17, 0.0475,$ and 0.017 ft/day. However, for reasons of equivalence, we place little significance in these specific values of K_v' and prefer to limit the discussion of aquitard behavior to expected leakance in the range $0.00017 < L' < 0.0017$.

The base case value of average specific yield for the shallow unconfined zone is 21%. This parameter is not actually involved in the drawdown models of this study since none of the calculated cases actually dewaters the shallow aquifer.

For the calculation of drawdown impacts, we have initially assumed that the regional gradient in the test area is zero so that all model impacts are superimposed on an initially flat water table. We set our reference elevation to be zero at the initial water table rather than at ground level or at mean sea level so that all calculated drawdowns are relative to the initial water table. This device allows us to easily observe just the predicted pumping- induced drawdown at any location without the complicating effects of the natural gradient.

However, in order to perform particle trajectory and capture zone analyses, we must superimpose the calculated pumping- induced drawdowns on a realistic approximation of the natural water table gradient. We have based our approximations on observed historical water table behavior in the study area. We assume a groundwater gradient of -0.0048 at a left azimuth angle of 135 degrees from east which is equivalent to a water table slope of 25 ft per mile to the northwest. We set our reference water level elevation at a depth of 100 ft at the southeast corner of section 02, T30s, R25e, which is the southeast corner of the Strand Ranch project site.

Section IV - Drawdown Analysis.

When we speak of *water level*, we are always referring to the water level which would be observed in a hypothetical monitoring well which is completed in the aquifer at the specified location and depth interval of interest. The water level in such a monitoring well represents the elevation of the potentiometric surface, sometimes referred to as the pressure head, in the aquifer at that location. A map of such water levels represents the distribution of pressure head in the aquifer. When we speak of *drawdown*, we are always referring to a decline in potentiometric water level caused by one or more pumping wells.

When an episode of groundwater pumping removes water from the underlying aquifer the potentiometric water level changes in response to the decreasing volume of water in aquifer storage. This water level behavior has both transient and permanent components, including the temporary creation and then dissipation of a local cone of depression ending with a permanent, small, net drop in the basinwide water table. We can predict the height, areal extent, and rate of change of this falling, rising, and then re-equilibrating water table if we know the aquifer properties and the location, volumetric rate, and duration of pumping.

Expected Results. The drawdowns related to the proposed Strand Ranch pumping operations are temporary rather than permanent water level impacts. We expect at any moment after pumping has begun that a cone of depression will form around each well and that the cone of depression will deepen and expand outward with time, subject to certain limits. This depression is a drop in the pressure levels (equivalent to potentiometric water levels in properly-placed monitoring wells) within the aquifer but there is no corresponding creation of an actual physical void space of the same shape within the aquifer under semi-confined (or confined) conditions. The drop in pressure within this cone of depression is what causes groundwater to flow along inward radial paths to the well. The actual region of the aquifer from which water is removed by pumping is called the "capture zone". The shape of the capture zone is a vertical cylinder centered on the well and the radius of the capture zone is much smaller than the radius of the cone of depression. As steady pumping continues, the capture zone increases in radius, albeit at a continuously decreasing rate of expansion since the radius is a function of the square root of pumping time and not directly of time itself. When pumping ceases, the cone of depression immediately begins to shrink inward toward the central well until the pressure levels have recovered to their pre-pumping state and the cone of depression is gone.

A cone of depression in a semi-confined aquifer is a temporary condition in which the depression deepens and widens only as long as the total well-field pumping rate exceeds the downward vertical recharge from the overlying layers. Once those rates are equal (vertical recharge rate increases as the size of the depression increases), the depression stops growing. Then when pumping ceases, vertical recharge continues, causing the depression to shrink until gone and the water levels are indistinguishable from the background water table behavior. Since there is now less water in the basin than before pumping, all else equal, the average water level in the basin is slightly lower than before pumping took place.

We expect at any moment, that the drawdowns will be larger close to the wells and smaller farther away from the wells. We expect at any location that pressure drawdown increases as the duration of pumping increases. We also expect for any specified time and location, that the drawdown will be larger for higher pumping rates and smaller for lower pumping rates. We also expect that for any location that is within the radii of influence of more than one pumping well, that the observed drawdown will be the sum of the individual drawdowns caused by every pumping well superimposed at that location.

What may not be as intuitive is the expected drawdown behavior depending on the choice of aquifer model. If the aquifer is fully confined or fully unconfined, the drawdowns will continue to decline indefinitely and the radius of the capture zone expands indefinitely. If the aquifer is semi-confined with leakage recharge from the overlying layers as we expect in this area, then the observed qualitative behavior will be more complicated. For a short period of time, the aquifer will behave as a confined aquifer, meaning that the observed drawdowns near each of the wells will decline quickly and with the same time - distance relationship as is predicted for a confined aquifer with the same values of T & S. Thereafter, the piezometric water levels will decline at a decreasingly slower rate than predicted by the confined- aquifer model until the water levels stop falling altogether. Once the water levels quit falling, the capture zone will have reached its maximum radius and will quit expanding. At this time, all recharge will flow vertically downward into the top surface of the cylindrical capture zone and no flow will come from inward radial flow through its sides, i.e., there is no mining of water from the adjacent areas outside the capture zone.

After an undetermined time period of leaky behavior during which there is little or no observed drawdown despite continued pumping, we expect that the water table will once again start to decline at a rate which is consistent with the de-watering of the overlying unconfined aquifer. The durations of each of these behavioral phases may be estimated but the calculated times of transition are not particularly precise because of the inability to predict future recharge. This project can be in leaky steady state for a very long time if the shallow aquifer is consistently recharged. Once this program has begun, a properly designed well- testing and monitoring program will provide a wealth of new understanding of the aquifer, well beyond what we are able to model with the small parameter set which is available at this time. We such a program, we will be able to perform aquifer parameter test within the project area to verify ad improve our current, limited knowledge of the aquifer.

The predicted drawdowns from this work program are significantly different than the predicted drawdowns from three other recent impact analyses for entities on the Kern Fan by other workers in five respects. First, SSS modeled the aquifer as a leaky aquifer rather than as a confined aquifer. Second, SSS used the superposition method versus the so-called centroid method used in the other studies. Third, SSS's parameter values are different than those of the other studies, and incidentally are different in such a way as to increase the calculated drawdowns, all else being equal. Fourth, the leaky aquifer model which SSS used predicts that the water levels will decline and then stabilize at a static, steady- state drawdown at least for a while, compared to the other forecasts which predict that water levels will continue to decline as long as pumping is continued. Fifth, for SSS's choices of aquifer model and aquifer parameters, the predicted drawdowns are significantly less than the predicted drawdowns from these other studies.

Modeling Scenarios. The first hypothetical operating scenario is to pump 9 wells at a combined rate of 90 af/d (based on a nominal rate of 5 cfs per well) for 194 days to recover a total 17,500 af per year. For a given well-field configuration, the project has considerable flexibility in delivering less than the hypothetical full 9-well, recovery rate of 45 cfs and/or the annual recovery volume of 17,500 af. The project may also meet reduced delivery rates or volumes by choosing to pump for less time, and/or at lower pumping rates, and/or using fewer wells. Each of these possible alternatives provides reduced drawdowns, somewhat different drawdown distributions, and faster aquifer- recovery times. The two alternate scenarios of primary interest in this study are: pumping 7 wells at a combined rate of 70 af/d for 250 days to recover a total 17,500 af in a year, or pumping 5 wells at a combined rate of 50 af/d for 350 days to recover a total 17,500 in a year.

In each case, the operating well field establishes a steady-state condition of no further drawdown between 30 and 100 days of pumping due to leaky recharge. Therefore, pumping more than 100 days and even multi- year continuous pumping will not increase the drawdown as long as the project maintains its recharge commitment and the immediate area also continues to receive sufficient total recharge to re-supply all non-project wells in the area. The key to moderating the aquifer behavior is to keep the local area adequately recharged over time. If recharge does not match recovery, then the predicted drawdowns within the aquifer after 300 days of pumping may be as much as twice as much as predicted or more, depending on the rate of depletion of the shallow, unconfined aquifer. However, by design and by requirement, this project will always recharge prior to recovery.

For 300 days of pumping, the hypothetical capture perimeter surrounding the entire well field extends only a few hundred ft outward from the individual wells and remains entirely within the property boundary of the Strand Ranch. For a hypothetical 1000 days (approx. 3 yr) of continuous pumping, the hypothetical capture perimeter extends about 1,800 ft from the individual wells. For a hypothetical 3650 days (10 yr) of continuous pumping, the capture zone would extend about 2,300 ft down-gradient to the northwest and would extend about 4,500 ft up-gradient to the southeast under conditions of dry-year groundwater gradient of 25 ft/mi to the northwest.

For the given set of aquifer conditions, the water-level drawdowns caused by the Strand Ranch recovery well operations vary with our choices aquifer parameters, well parameters, pumping duration, and location. Therefore, there is no way to represent the multiple potential impacts with a single number unless we specify a single set of aquifer and well parameters, a single pumping duration, and a single location.

We can reduce the number of possible operating scenarios by using a single "base case" operating scenario. We can reduce the time variable by using a single pumping duration, and we have chosen to compute drawdown for a time after which the drawdowns at all locations have reached "steady-state", i.e., maximum drawdown. At this point, the evaluation of impacts is reduced to observing the predicted drawdowns simply as a function of location.

The three main cases of interest include the 9-well scenario, the 7-well scenario, and the 5-well scenario, each of which is evaluated with and without the presence of a superimposed natural groundwater gradient. All drawdowns for all cases and all locations within the study area are presented in a Catalog of Drawdown Maps in Exhibit 5, one case at a time.

Computed Results. The basic output from each drawdown analysis is a contour map of the predicted water levels in and around the area of the well field. Each map shows the well locations, the contours representing the water levels for a specified set of pumping parameters, and flowpath particle trajectories, if included, for a specified duration of pumping. The computer-generated maps cover a square, 3x3- mile area centered on the project area. Using local (east, north) coordinates in units of feet, the local origin (0,0) is at the intersection of Stockdale Hwy and Enos Lane, the southwest map corner is located at (-10,600, -10,600), and the northeast corner (+5,400, +5,400) since the model uses an 80x80- cell model space with each cell representing 200x200 ft in real space. The map scale of the computer printouts is approximately 1 inch = 2290 ft. Additional map information is included at the beginning of Exhibit 5 where we have compiled a catalog of all maps for all scenarios in a catalog of results. The Catalog includes more modeling scenarios than were necessary for this study. They were run as a diligent effort to investigate transient conditions, non-base case parameter impacts, sensitivity analysis, comparisons with alternate aquifer models, etc. The maps which are included as Figures in this Report cover everything discussed in the text and are derived from the model runs in the Catalog.

For this study, we have calculated the water level drawdowns for the three main hypothetical well-field operating scenarios of 9-, 7-, or 5- wells each, each of which is designed to recover 17,500 af of ground water from the underlying aquifer in a year. All three scenarios used the same set of aquifer parameters. We calculated additional results by varying selected parameters to provide a sensitivity analysis.

The base case aquifer parameters were the same for every case, i.e., a 300-ft thick, semi-confined aquifer with T = 17,100 ft^2/d, S = 0.02, and porosity = 30%; an overlying aquitard with L' = 0.000475 d^{-1} which is gives a Hantush leakage factor of B = 6,000 ft; and an overlying unconfined aquifer with Sy = 15%. The unimpacted, natural groundwater gradient was assumed to be zero unless otherwise specified. For capture zone and particle trajectory calculation we used a groundwater gradient of -25 ft/mi to the northwest (-0.0048 at a left aximuth of 135 degrees from east) and we assumed a corresponding reference groundwater elevation at 100 ft below GL at the southeast corner of the project area (i.e., the SE cor Sec 02, T30s, R25e). All of the modeling parameters have been summarized in Table 1 and are discussed in detail in Exhibit 2..

We present the calculated drawdown results for the three hypothetical operating scenarios in the next three sections below.

Nine- well scenario: q = 90 af/d, pumping t = 194 d, V = 17,500 af/yr.

The hypothetical steady-state drawdowns created by the Strand Ranch, *9-well, 194-day*, pumping scenario are presented on the map in Figure 5 and summarized in Tables 2 & 3. At steady-state, the average drawdown under the project site is 43 ft and the average drawdowns in the surrounding 8 sections are in the range of 12 - 20 ft. The drawdowns along the perimeter of the study area are in the range of 5 - 10 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter. The drawdowns for the 9-well case superimposed on a northwesterly groundwater gradient are shown on the map in Figure 9.

Under the base case assumptions, the area will achieve steady-state within about 100 days after pumping begins and the water levels will begin to recover after 194 days when pumping ceases. As long as the leaky-aquifer assumptions continue to be met, the water levels in the study area will recover to pre-pumping levels in another 100 days or less, in the absence of other influences.

<u>Seven - well scenario:</u> q = 70 af/d, pumping t = 250-day, V = 17,500 af/yr.

The hypothetical steady-state drawdowns created by the Strand Ranch, *7-well, 250-day*, pumping scenario are presented on the map in Figure 6 and summarized in Tables 2 & 3. At steady-state, the average drawdown under the project site is 34 ft and the average drawdowns in the surrounding 8 sections are in the range of 9 - 17 ft. The drawdowns along the perimeter of the study area are in the range of 3 - 8 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter.

Under the modified well field assumptions, the area will achieve steady-state within about 100 days after pumping begins and the water levels will begin to recover after 350 days when pumping ceases. As long as the leaky-aquifer assumptions continue to be met, the water levels in the study area will recover to pre-pumping levels in another 100 days or less, in the absence of other influences.

The hypothetical drawdowns created by the Strand Ranch *7-well, 250-day scenario* are approximately 78% of the hypothetical drawdowns for the 9- well scenario but the duration of impact lasts about 56 days longer because the wells must operate longer to recover the same total volume of water (17,500 af/yr) at the lower recovery rate (70af/d vs. 90 af/d).

<u>Five - well scenario:</u> q = 50 af/d, pumping t = 350-day, V = 17,500 af/yr.

The hypothetical steady-state drawdowns created by the Strand Ranch, *5-well, 350-day*, pumping scenario (wells 1, 3, 5, 7, 9) are presented on the map in Figure 7 and summarized in Tables 2 & 3. At steady-state, the average drawdown under the project site is 24 ft and the average drawdowns in the surrounding 8 sections are in the range of 7 - 11 ft. The drawdowns along the perimeter of the study area are in the range of 2 - 6 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter.

Under the modified well field assumptions, the area will achieve steady-state within about 100 days after pumping begins and the water levels will begin to recover after 350 days when pumping ceases. As long as the leaky-aquifer assumptions continue to be met, the water levels in the study area will recover to pre-pumping levels in another 100 days or less, in the absence of other influences.

The hypothetical drawdowns created by the Strand Ranch *5-well, 350-day scenario* are approximately 56% of the hypothetical drawdowns for the 9- well scenario but the duration of impact lasts about 156 days longer because the wells must operate longer to recover the same total volume of water (17,500 af/yr) at the lower recovery rate (50 vs. 90af/d).

Base Case Specific Capacity of the Pumped Wells. Specific capacity (SC) is defined as the ratio of pumping rate to drawdown within a pumping well and is used by local engineers as a measure of well performance from which other parameters are calculated. Unfortunately SC is not a constant and varies with pumping time, length of completion interval, hole diameter, and well efficiency, so it is not an effective measure of anything without making the corrections for each of these factors. We can calculate the theoretical specific capacity (SC) of the project wells for the steady- state leaky aquifer condition from the selected base case parameters for purposes of preliminary pump parameter selection. Normally for pump design purposes, we would recommend using actual drawdown data from nearby pumping wells as the best predictor of well performance, but we can calculate a value as well.

For the base case semi-confined aquifer parameters, we estimate the expected *steady-state* project- well specific capacity to be about SC = 0.14 cfs/ft, which is equivalent to 63 gpm/ft, for a 100% efficient well. For all pumping times less than the time required to reach steady- state, the observed SC will appear to be larger and, in the first few hours and days, perhaps much larger than this predicted final value.

Sensitivity Analysis. Because of the uncertainties in the actual aquifer conditions, the actual operating drawdowns when the well field is finally installed and operated may be different than the calculated base case values. We have already acknowledged that there is considerable uncertainty in the few data available to us. Since the accuracy of the impact calculations for the leaky aquifer model depends primarily on the values of T and B, we have varied the base case parameters within the credible ranges of possible values and have re-calculated the drawdowns for these other parameter values (Figure 13 and Table 4). We used the Hantush & Jacob, 1955 formula to calculate the steady-state drawdowns for various T & B for leaky-aquifer conditions.

We selected a base case value of aquifer transmissivity T = 17,100 ft^2/d for the computer modeling based on a hydraulic conductivity of 57 ft/d and an aquifer thickness of h = 300 ft. This T-value is at the lower end of the reported range of possible T-values in the Kern Fan area. If the true aquifer transmissivity (T) is higher than our base case value, then the actual observed drawdowns will be less than predicted drawdowns, all else equal. We have calculated the hypothetical steady-state drawdowns for the 9-well, 194-day scenario using T-values ranging from 12,000 ft^2/d to 30,000 ft^2/d. If the true transmissivity is15,000 ft^2/d rather than 17,100 ft^2/d, then the actual drawodows across the study area will be about 15% higher than predicted but if the actual transmissivity is 24,000 - 30,000 ft^2/d, then the actual drawdowns across the study area will be only 72% - 58%, respectively, of the predicted drawdowns. Since the sensitivity to T is a multiplicative effect, the greatest differences will tend to occur in the areas of greatest drawdown and vice versa, that is, an error in T-value make the biggest difference in and near the well field, and have a decreasing difference between predicted and corrected drawdowns with distance away from the project area.

We selected a base case value of aquitard leakage factor B = 6,000 ft for the computer modeling based on an aquitard leakance of L' = 0.000474 d^{-1}. This mid-range L- value is consistent with the expected vertical hydraulic conductivities for sandy silts and/or silty sands of the Kern Fan area. If the true aquitard leakage factor (B) is lower than our base case value, then the real aquifer is less-confined than calculated which would cause smaller drawdowns than calculated for B = 6,000. If the true aquitard leakage factor (B) is higher than our base case value, then the real aquifer is more-confined than calculated which would cause larger drawdowns than calculated for B = 6,000. If the actual leakage factor is B = 3,200 ft (L' = 0.0017 d^{-1}), then the actual drawdowns across the study area will be about 2.5 ft less than predicted and if the actual leakage factor is B = 10,000 ft (L' = 0.00017 d^{-1}), then the actual drawdowns across the study area will be about 2.1 ft more than predicted. Since the sensitivity to B is an additive effect, the same differences will tend to occur across the entire area of interest, that is, an error in B-value makes the same difference in and near the well field as it does between predicted and corrected drawdowns in the surrounding sections.

Section V - Flow Trajectory and Capture Analysis.

Particle trajectories. A particle trajectory represents the hypothetical flowpath of a water molecule under ideal flow behavior, i.e., ignoring the effects of dispersion, flowpath tortuosity, heterogeneity, etc. We can calculate particle trajectories in downgradient or upgradient directions, which we refer to as forward or reverse particle tracking, respectively. In our computational models we assume that the aquifer is horizontally isotropic so that particle trajectories are always perpendicular to water level contours. For this project we used reverse particle trajectories to determine the shapes and extents of the capture zones for each of the pumping wells in the well field for different pumping durations. We also used one forward-particle tracking model to the general pathway of contaminant flow from the southwest quarter of section 12, T30s, R25e. An important use of particle trajectory mapping is for designing contaminant- detection monitoring programs so that the operator can place the monitoring wells in the likely flowpaths from known or suspected contaminant sources.

Capture zones. A capture zone is the enclosing perimeter of the actual bulk volume of the aquifer from which a pumping well extracts water over a specified time period. The shape and lateral extent of a capture zone is very different than that of the cone of depression. For a confined or semi- confined aquifer, the capture zone is a vertical cylinder centered on the well and bounded by the confining layers at the top and bottom of the aquifer. The radius of the capture zone increases as long as pumping continues. The shape of the capture zone will be distorted by the presence of other wells and/or recharge boundaries but it will always have a fully enclosing perimeter. The method of reverse particle tracking will always provide a means to map the shape and extent of the capture zone for a specified pumping duration.

Mapping a capture zone analysis requires that we model the aquifer behavior as realistically as possible, since true particle trajectories will respond to all influences on the real potentiometric pressure field and not just those generated by the Strand Ranch wells. Therefore, we assume that the most realistic scenario will occur in a dry year when the Strand Ranch wells will most likely be pumping and all of the neighboring wells are pumping as well. The combined pumping effects of these wells superimposed on the natural groundwater gradient will determine the locations of capture zone and particle trajectories with time.

The water level elevation map in Figure 10 shows the steady-state impacts of the nine Strand Ranch wells and eleven Kern Water Bank wells superimposed on the local groundwater gradient. The five wells located at the center and corners of the Strand Ranch well field (wells 1, 3, 5, 7, 9) have 1,000-day reverse particle trajectories attached to them which define the shape and areal extents of the "3-year" capture zones for continuous pumping at these locations.

For reference purposes, the section corners have been labeled on the map. We have mapped the locations of the capture zone perimeter for pumping times of 300-, 1000-, 1825-, and 3650-days superimposed on 10-year continuous particle trajectories in Figure 11.

The individual capture zones of widely-spaced wells, such as in the Strand Ranch project, do not merge unless pumping continues for a relatively long time . The importance of mapping the capture zone is for purposes of evaluating water quality, particularly the potential for contaminant capture. We have mapped (Figure 11) the approximate locations of the particle trajectories and expanding capture zone for continuous pumping of both the Strand Ranch and Kern Water Bank wells for pumping times of 300-, 1000-, 1825-, and 3650- days for an aquifer with a northwesterly water table gradient, as described below.

For 300 days of pumping, the hypothetical capture perimeter surrounding the entire well field extends only a few hundred ft outward from the individual wells and remains entirely within the property boundary of the Strand Ranch. For shorter pumping durations, such as our hypothetical 9- and 7-well operating scenarios, the capture zones around each well would be proportionately smaller. For a hypothetical 1000 days (approx. 3 yr) of continuous pumping, the hypothetical capture perimeter extends about 1,800 ft from the individual wells. For a hypothetical 3650 days (10 yr) of continuous pumping, the capture zone would extend about 2,300 ft down-gradient to the northwest and would extend about 4,500 ft up-gradient to the southeast under conditions of groundwater gradient of 25 ft/mi to the northwest. Pumping by non-project wells in the surrounding areas will change the shape and extent of this capture zone, as shown in the various model runs.

We have also mapped (Figure 12) the 10-year forward particle trajectories of a hypothetical line source located in the southwest quarter of section 12, T30s, R25e under conditions of continuous pumping of both the Strand Ranch and Kern Water Bank wells. Any groundwater contamination which comes from a source located on or near this line will follow the same trajectories. A slug or plume of contamination will eventually be captured by wells located on the Kern Water Bank and/or Strand Ranch depending on the particular location of the source and its downgradient trajectories.

The time it takes contaminants to flow from the source to the well field perimeter will be approximately equal to the capture-zone time-radius (approx. 8 years under continuous pumping of all wells) that crosses the source area assuming that the contaminant moves at the same speed as the groundwater. For many contaminant constituents, this assumption is false, since the processes of dispersion, retardation, and attenuation slow the flow velocity of contaminants in ground water. There are no rules of thumb in this regard without specifying the contaminant of concern, but the capture zones which are based on the flow velocity of the ground water form the base case of any contaminant capture analysis. Sierra Scientific Services has performed contaminant transport modeling for other clients, but it is outside this scope of work.

Section VI - Recharge Mound Analysis.

When an episode of groundwater recharge adds water to the underlying unconfined aquifer the water table changes in response to the increasing volume of water in aquifer storage. This water level behavior has both transient and permanent components, including the temporary rise and fall of a local water mound ending with a permanent, small, net rise in the basinwide water table. We can predict the height, areal extent, and rate of change of this rising, falling, and then re-equilibrating water table if we know the aquifer properties and the location, volumetric rate, and duration of recharge.

Expected Results.

The initial recharge will create a fully-saturated, vertical column of water through the vadose zone from the base of the recharge pond to the top of the water table. This column of "falling" water is not part of a recharge mound per se. Once the flow front reaches the water table, a water mound will begin to develop above the water table as downward-moving water spreads out laterally into available space. The mound will continue to rise and widen as recharge progresses until the rate of lateral mound outflow matches the rate of downward vertical recharge.

The mound is a temporary condition in which the mound rises and widens only as long as the continuing downward vertical flow of water into the mound exceeds the lateral flow out of the mound. Once those rates are equal, the mound stops rising but continues to widen. Then when recharge ceases, lateral outflow continues, causing the mound to flatten and widen until the mound is indistinguishable from the background water table. Since there is now more water in the basin than before recharge, all else equal, the average water level in the basin is slightly higher than before recharge took place.

The pond infiltration rate will be a maximum at the beginning of recharge and will decrease continuously and perhaps quickly (perhaps over a few days or a couple of weeks) until the pond infiltration rate is numerically equal to the vertical hydraulic conductivity of the underlying flow path. The infiltration rate will remain steady at this value as long as the water table (and associated capillary fringe) is far below the base of the infiltration pond. As the water table rises during the time of recharge, the infiltration rate will also decrease accordingly as the volume of available, unsaturated storage space decreases. If and when the rising water table approaches the ground surface, the infiltration rate will be a minimum equal to some fraction of the value of the hydraulic conductivity of the underlying flow path.

Modeling Scenarios.

The hypothetical base case recharge scenario is to maintain water in approximately 450 acres of recharge ponds on the Strand Ranch at an overall average infiltration rate (IR) estimated to be between 0.2 - 0.4 ft/d. The duration of recharge will depend on the availability of a surface water supply. In a maximum recharge scenario, recharge ceases when the cumulative recharge volume equals 17,500 af in a given year, which requires recharge durations in the range of 100 - 200 days for the reported range of parameter values. We assume in our model for convenience and without a loss of generality that the recharge pond is circular with a radius of 2,500 ft and centered in the Project site.

The key parameter controlling pond recharge is the long term infiltration rate which we have estimated to be in the range from 0.2 - 0.4 ft/d on the Strand Ranch property, assuming that the ponds are maintained in a clog-free state. The lowest recharge rate will occur when the water table is very shallow and highest recharge rate will occur when the water table is very deep. With respect to design, operations, and impact issues the critical project recharge performance is the recharge which occurs at the lowest infiltration rate.

During 2006, the project operated a pilot recharge test which consisted of filling a 117-acre pond from mid-July to mid-December. By September, the pond inflow had stabilized at a steady recharge rate of 12 cfs, meaning that 23.8 af of water per day infiltrated from the 117 ac pond, giving a computed infiltration rate of IR = 0.20 ft/d. Since the water table for the entire duration of the pilot test was very shallow (less than a few feet deep) we conclude that the observed infiltration rate of 0.2 ft/d was a minimum rate and that future operations with a deeper water table will experience higher infiltration rates, perhaps as high as 0.40 ft/d. For modeling purposes, we made mound calculations for infiltrations rates of 0.20, 0.25, and 0.30 ft/d since all critical issues are related to mounding in the lower range of possible infiltration rates.

For this study, we calculated the water level rises for a 450-acre recharge pond which is designed to put 17,500 af of ground water into the underlying aquifer in a single recharge episode per year. All three scenarios used the same set of aquifer parameters. We calculated additional results by varying selected parameters to provide a sensitivity analysis.

Except for the infiltration rate, the base case aquifer parameters were the same for every case, i.e., a 300-ft thick, unconfined aquifer with K = 57 ft/d, Sy = 0.21, and porosity = 30%. The unimpacted, natural groundwater gradient was assumed to be zero and we assumed a corresponding reference groundwater elevation at 100 ft below GL at the southeast corner of the project area (i.e., the SE cor Sec 02, T30s, R25e). The modeling parameters have been summarized in Table 1.

Computed Recharge Results.

The basic output from each mound analysis is a contour map of the predicted water levels in and around the area of the recharge pond. Each map shows the pond location, the recovery well locations for convenience, and contours representing the water levels for a specified set of recharge parameters. The computer-generated maps cover the same square, 3x3- mile area as used for the drawdown analyses. The map scale of the computer printouts is approximately 1 inch = 2290 ft. Additional map information is included at the beginning of Exhibit 5 where we have compiled all maps for all scenarios in a catalog of results.

Pond recharge at IR = 0.20 ft/d: q = 90 af/d, recharge t = 194 d, V = 17,460 af/yr.

The maximum water level rises created by the Strand Ranch, *90-af/d, 194-day,* recharge scenario are presented on the map in Figure 14 and summarized in Tables 5 & 6. The average water level rise under the project site is 32 ft and the average rises in the surrounding 8 sections are in the range of 6 - 13 ft. The drawdowns along the perimeter of the study area are in the range of 1 - 5 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter. These water level rises are within a few percent of the maximum, steady-state mounding rises which are predicted for this scenario under infinite recharge duration. However, the mound in this scenario will begin to decline as soon as recharge has stopped at t = 194 days.

<u>Pond recharge at IR = 0.25 ft/d:</u> q = 112.5 af/d, recharge t = 155 d, V = 17,438 af/yr.

The maximum water level rises created by the Strand Ranch, *112.5-af/d, 155-day* recharge scenario are presented on the map in Figure 15 and summarized in Tables 5 & 6. The average water level rise under the project site is 36 ft and the average rises in the surrounding 8 sections are also in the range of 6 - 13 ft. The drawdowns along the perimeter of the study area are in the range of 1 - 5 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter. These water level rises would continue to rise if recharge continued after t = 155 days, and are not close to the steady-state mound heights which are predicted for this scenario under infinite recharge duration. However, the mound will begin to decline as soon as recharge has stopped at t = 155 days.

<u>Pond recharge at IR = 0.30 ft/d:</u> q = 135 af/d, recharge t = 129 d, V = 17,444 af/yr.

The maximum water level rises created by the Strand Ranch, *135-af/d, 129-day,* recharge scenario are presented on the map in Figure 16 and summarized in Tables 5 & 6. The average water level rise under the project site is 40 ft and the average rises in the surrounding 8 sections are in the range of 6 - 14 ft. The drawdowns along the perimeter of the study area are in the range of 1 - 5 ft and drawdowns decrease to negligible levels with increasing distance from the perimeter. These water level rises would continue to rise if recharge continued after t = 129 days, and are not close to the steady-state mound heights which are predicted for this scenario under infinite recharge duration. However, the mound will begin to decline as soon as recharge has stopped at t = 129 days.

We also note that if the actual infiltration rate is higher than IR = 0.30 ft/d, then the project will be able to recharge water at a higher volumetric rate than we have modeled here (135 af/d at IR = 0.30 ft/d) and the time needed to recharge 17,500 af/yr will be less than t = 129 days.

Based on the results of modeling, we observe that the water level rises in the 8 sections surrounding the project site project area for all 3 scenarios are almost identical, i.e., in the range of 6 - 13 ft, even though the recharge occurs at different rates for different durations for the three scenarios. We note that the predicted maximum water level rises from recharge mounding under the adjacent lands are essentially the same regardless of the infiltration rate, for these cases where the total recharge volume is the same.

7

Maximum Recharge.

The 30-year period from 1969 - 1998, was a period of above-average high flows and floods on the Kern River and CVP Friant-Kern systems. There were nine such high-flow episodes during that time period in which Kern County suffered damages and/or water left the county and was lost to local beneficial use[4]. Based on the experiences of this period, Kern County has placed a high priority on using all available facilities to minimize the potential impacts of high-flow/flood conditions and minimize the amount of water which is lost to beneficial use by diverting as much water as possible from the Kern river channel under such conditions. The capacity to divert water from the Kern River channel has substantially increased since 1990 by the development of recharge facilities for district water banking programs. The benefits of diverting high-flow water to recharge ponds include lowering the threat of flooding, improving the in-ground water supplies for districts which rely on conjunctive use programs to deliver water to their farmers, reducing overdraft through losses to the basin paid by project operators, and capturing water for unrestricted local use, water which might otherwise have left the county.

In the case of the proposed Strand Ranch project, the addition of 450 acres of recharge ponds represents a significant increase in potential local flood mitigation by high-flow capture and recharge. To our knowledge, Kern County has never restricted or prevented the use of any recharge pond for the unrestricted capture of high-flow water. The benefits to the County and the basin are large, obvious, but relatively infrequent. Nevertheless, we include here a water level impact analysis for a maximum recharge scenario in which 450 acres of recharge ponds are kept full for a period of 365 days at maximum recharge rates. Since we do not yet know what the maximum recharge rate might be on the Strand Ranch project site, we have done four such analyses for infiltration rates of IR = 0.20, 0.30, 0.35, and 0.40 ft/d.

[4]KCWA. August 27,2001. Initial Water Management Plan. Public Review Draft. p. T26.

Maximum recharge-1: IR= 0.20 ft/d, q= 90 af/d, recharge t= 365 d, V= 32,850 af/yr.

Maximum recharge-2: IR= 0.30 ft/d, q= 135 af/d, recharge t= 365 d, V= 49,275 af/yr.

Maximum recharge-3: IR= 0.40 ft/d, q= 180 af/d, recharge t= 365 d, V= 65,700 af/yr.

The water level rises created by the preceding three hypothetical maximum recharge scenarios are presented on the maps in Figures 17 - 19 and in Tables 9 - 10. The average water level rise after 365 days of recharge under the project site for each IR scenario is 39-, 58-, or 76-ft, respectively. The average rises in the surrounding 8 sections are in the range of 11 to 19-, 18 to 28-, or 23 to 36-ft, respectively. These full-year water-level rises are approximately 6-, 13-, or 18- ft higher in the surrounding 8 sections than would be encountered for recharge at the same infiltration rates (Figures 20 - 22), respectively, except that each scenario had stopped after 17,500 af had been recharged (as presented in earlier in this report).

A natural, high-flow event of sufficient magnitude to generate a 365-day capture and recharge episode may have a recurrence probability of only once-per-century, more or less, so any such event is unlikely to occur over a given 30-year project forecast. Nevertheless, given the reduced storage capacity in the Lake Isabella reservoir due to engineering issues, the lower Kern River may experience more-frequent, higher-volume releases of water during a multiple wet-year period than might otherwise be the case. These mounding calculations demonstrate that the range of water level impacts from any realizable 365-day recharge scenario are not objectionably different than other, smaller-recharge scenarios of the same rate but of shorter duration currently under consideration.

Section VII - Total Project Water Level Impact Analysis.

The following analysis assumes that all of the proposed operational design recharge- and recovery- rates and caps apply to the project operation except that there is no cap on the capture and recharge of high-flow water, such as is discussed in the preceding section.

The essence of full ASR project operation is the ongoing cycle of adding water to- and subsequently removing water from- aquifer storage. These processes have both local and basinwide impacts. The basinwide impact is a small, widespread, cumulative, and permanent, water level rise. The magnitude of the basinwide water level rise is proportional to the cumulative net volume of water which is left in the basin over time and is insensitive to the number, frequency, or size of the many individual project recharge and recovery episodes. The basinwide project impact is positive meaning that the project permanently adds water to the basin and that a water level rise is considered to be beneficial.

In contrast, the local impacts are larger, localized, and temporary but recurring. Adding water to the local aquifer causes a temporary water level mound and removing water from the local aquifer causes a temporary water level depression. Such a mound or depression only lasts as long as a recharge or recovery operation takes place, respectively, plus a re-equilibration time during which the mound or depression dissipates. The magnitude of an individual local mound or depression is proportional to the *rate* at which water is added to or removed from the local aquifer, i.e., the higher the volumetric flow rate in or out of the aquifer (in acre-feet per day) the greater the temporary water level impact, all else equal. A water level mound or depression may be seen as either a beneficial or detrimental impact depending on whether the operations would be seen as improving or worsening some pre-existing condition, such as water levels being already too high or too low to begin with.

In Kern County, there are three potential water level impacts of concern, one of which is a long-term, basinwide impact and two of which are short-term, local impacts. The long-term basinwide impact of concern is a dewatering of the aquifer. The short-term local impacts of concern include raising the water table close to the ground surface such that crops or manmade structures may be threatened, or lowering the aquifer water levels such that local water wells go dry and/or it costs more to pump water from the greater depths. The most frequent and greatest single impact of concern to landowners in Kern County is the increased cost to pump water wells due to manmade water level declines.

Permanent Water Level Impacts. By design and by requirement, the Strand Ranch Project must first put water into aquifer storage before it can recover any groundwater from storage. Moreover, since the Project is not allowed to borrow water from the basin, i.e., the project may not remove more water than its net current balance, the project will start with and always maintain a positive balance[5] relative to the basin. If we were to look only at the impact of

[5] Strictly speaking, the Project must maintain a non-negative balance, locally referred to as a "positive balance", a condition

groundwater pumping, we would only see the impacts due to the extraction of groundwater. But in the context of the total project, it is clear that the project will only take water out of the basin that will have been previously put in so that the basin never has less water in storage than would have been there in the absence of the project.

According to the local MOUs, a project which directly recharges water for an out-of-county entity must permanently leave 5% of all such water in the ground. This volume of water is referred to as a *"loss to the basin"* and is a form of in-kind usage tax paid by all banking projects on all out-of-county water as a component of basinwide overdraft correction. For the Strand Ranch project it is likely that the great majority of all future stored and recovered water will be for the Irvine Ranch Water District which is an out-of-county entity. Therefore, this 5% loss to the basin may represent a significant volume of water. For example, if IRWD were to store and recover an average of 50,000 af every decade, then the cumulative losses paid to the basin would amount to 2,500 af per decade. This water is non-bankable and non-recoverable by IRWD. This "loss to the basin" represents a real, beneficial, cumulative, and permanent addition of water to the basin by the proposed Strand Ranch ASR project.

The permanent water level impacts are related to the project volumetrics. Over the long term, the addition and removal of like volumes of project water from the basin would result in no net cumulative change in basinwide water levels. However, as a result of the 5% losses paid to the basin, there will be a small, permanent rise in basinwide water levels. In the hypothetical case of adding an average 2,500 af per decade, the average long-term water level rise under the Kern Fan recharge area would be about 0.10 ft. This permanent water level rise is so small only because of the great size of the basin. Still, we conclude that even with the addition of significant amounts of water (2500 af/decade) to the basin, there is only a negligibly small but positive long term water level impact of the project on the basin.

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which is assumed to also include or allow the condition of zero balance.

Aquifer Dewatering. Since the proposed Strand Ranch project and other existing ASR projects must always maintain a positive balance relative to the basin, overall basin overdraft simply cannot occur as a result of direct-recharge ASR project operations. Never-theless, the potential still exists for an ASR project to dewater a portion of the aquifer if the location of groundwater recovery is in a completely different location and/or is completely isolated from the location of groundwater recharge. Such a condition might also exist if an ASR project includes in-lieu banking[6] operations which may have the effect of changing the time and location of recharge and/or recovery from when or where it would otherwise have occurred, perhaps causing an unbalanced groundwater extraction and local dewatering.

In the case of the proposed Strand Ranch project, both recharge and recovery facilities will be co-located on the project site such that the approximately equal and opposite impacts of both recharge and recovery will be superimposed on the same area and same aquifer zones. The requirement that the Strand Ranch project always maintain a positive balance relative to the basin precludes the potential dewatering impacts of in-lieu banking from occurring. Therefore, we conclude that conditions do not exist at the Strand Ranch site which could permit dewatering of the aquifer by these mechanisms.

The potential also exists for an ASR project to dewater a portion of the aquifer if the climatic wet/dry cycle causes, or if the ASR project operator chooses to operate, a severely unbalanced recharge and recovery cycle. For example, consider a hypothetical scenario in which an ASR project stored 50,000 af of water in the aquifer and then removed 47,500 af (50kaf net of 2.5 kaf losses to the basin) under the following conditions. Let us suppose that over a 7-year period, the Project stored, on average,10,000 af per year in each of five years for a total of 50,000 af of water in storage. For the duration of the wet period, the impact on the basin would be as if the project recharged at an average rate of 7,100 af per year. The

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[6] In-lieu banking, as practiced in Kern County, includes the act of consuming bankable surface water instead of (in-lieu of) delivering it to ASR ponds for recharge and/or the act of delivering surface water from some alternate source to an end-user instead of (in-lieu of) pumping it out of groundwater storage. With these types of physical water movements it is possible to operate a banking program in which storage and/or recovery may occur without any water actually entering or leaving the aquifer, and such operations must be associated with bookkeeping transactions which move water credits between different accounts.

accumulation of a cumulative water supply in periodic, small increments is typical of the Kern County climatic cycle.

However, let us also suppose that after 3 critically dry years during which water levels declined and during which the water owners used up all of their other available sources of water, the project then extracted all 47,500 af in storage in a single year. This recovery rate is over 6 times higher than the average recharge rate and since impacts are proportional to rates, recovery may be expected to produce drawdown impacts that may be six times greater in magnitude than the beneficial impacts of recharge. We call this an unbalanced recharge/ recovery cycle because the rate of recharge and the rate of recovery are so different.

The impacts of such an unbalanced recharge/recovery cycle cannot be fully evaluated without specifying all of the actual aquifer parameters, but for the aquifer underlying the Kern Fan, there is every likelihood that the unbalanced groundwater extraction could dewater at least the shallow zone of the aquifer. This water level drawdown, like other drawdowns, is local and temporary and will re-equilibrate with time. In this hypothetical case, however, the magnitude of this individual drawdown episode is of sufficient magnitude to temporarily dewater the aquifer which might be of sufficient concern to establish other limiting criteria on an individual impact event.

The foregoing hypothetical example of multi-year climatic wet or dry cycles is based on the actual wet/dry cycles that Kern County has experienced since 1960, and particularly since 1995 when major water-banking operations began in Kern County. In the future, if such a climatic wet/dry cycle causes several ASR projects on the Kern Fan to operate unbalanced recharge and recovery cycles at the same time, then the composite impacts of all such operations may dewater much of the Aquifer under the Kern Fan for a considerable time period until an equilibration of basinwide proportions can take place.

In the case of the proposed Strand Ranch project, the operators have voluntarily established operating limits which preclude the occurrence of an unacceptable, unbalanced recharge/recovery cycle. The project is voluntarily designed so that 1. the Strand Ranch project will not have more than 50,000 af of water in basin storage, and 2. the project will not recharge or recover more than a maximum of 17,500 af of groundwater per year during normal operations. The computer models of both recharge and recovery have demonstrated that by capping the maximum inflow/outflow at 17,500 af/yr, that 1. the beneficial impacts of recharge are approximately equal to the potentially detrimental impacts of recovery, and 2. by spreading the recovery of the maximum allowable volume of water in storage over a 3-year period the individual and combined net impacts of the total operation avoids and prevents unacceptable extreme impacts to the aquifer and the basin.

Temporary Water Level Impacts. The impact of recharge is a temporary, local rise in water levels and the impact of recovery is a temporary, local drop in water levels. ASR projects usually operate by putting water into the ground in a wet year and then recovering it as needed in some future dry year, so there is little likelihood of recharge and recovery happening simultaneously. The two potential temporary impacts of concern include the decline in water levels due to project pumping and a rise in the water table up to the ground surface due to project recharge. A manmade water level drawdown increases the vertical distance that groundwater must be lifted and therefore increases the cost to pump a well over what would otherwise have occurred. A standing water table within a few feet of the ground surface creates potentially adverse impacts to many types of crops and to the foundations of manmade structures including building and/or tower foundations, roads, and lined and unlined canals, ponds, and ditches.

Water Level Declines. Since the Strand Ranch project is fundamentally designed to store and recover like volumes of water within the same project area, at similar rates, and at different times but over periods of similar duration, the expected impacts from recharge and then recovery are approximately equal and opposite. This is not to say that the recharge impacts and recovery impacts therefore "cancel" each other out, especially since they impact somewhat different aquifer zones, occur separately in time and not simultaneously, and perhaps under different types of pre-existing conditions. Nevertheless, the local MOUs have made a provision (rule 4) that the beneficial impacts from recharge may be taken into consideration if and when it is necessary to consider mitigating the detrimental drawdown impacts of pumping. To the extent that this is an agreed-upon local principle which has been established among the participants of the banking project MOUs, then we can evaluate the potential drawdown impact by evaluating the cumulative net impact within the context of the total Strand Ranch project impact.

As previously discussed, the project has been designed so that the maximum expected recharge or recovery volumes are both equal to 17,500 af/yr and the total volume might be 50,000 af every decade. The expected project recharge rates range from 90 - 150 af/d and the expected recovery rates range from 50 - 90 af/d. Since the expected recharge rates are slightly higher than the expected recovery rates, the project will be in recharge 10 - 15% of the time, in recovery 15 - 20% of the time, and idle 65 - 75% of the time. Since we do not know in advance what the actual aquifer parameters will be, we can predict a least-favorable impact scenario by assuming minimum recharge rates and maximum recovery rates. For the Strand Ranch project, this would be a recharge scenario of storing 17,500 af in the aquifer at a rate of 90 af/d for 194 days (194.4 days to be exact) and a recovery scenario of pumping 17,500 af from the aquifer, coincidentally, also at a rate of 90 af/d for 194 days.

Based on the computer modeling, the transient water table mound is comparable in shape, magnitude, and duration to the cone of depression due to pumping but of opposite sense, i.e., rising-then-falling water levels rather than falling-then-rising water levels. All else, equal, if we consider a drop in water levels due to pumping to be a negative impact then we may consider a rise in water levels due to recharge to be a positive impact. The question is therefore, If the cycle of recharge and recovery operations causes both positive and negative water level changes of comparable size and duration, then can we say that there is little or no net impact on water wells in the area?

The local MOU provides for such consideration. Based on one possible interpretation of "rule 4" of the MOU, one foot of daily water level rise due to project recharge may be considered as a possible mitigation of one foot of daily water level decline due to project pumping. If we apply such an interpretation to the total net impact from the Strand Ranch "least-favorable" hypothetical scenario, then there may be a near-project, maximum overall -6 to -7 ft temporary decline in water levels which remains uncompensated by any equivalent water level rise. Such an uncompensated, temporary water level decline might exist in 2 years out of ten in each of the eight sections surrounding the project. In all more-favorable, hypothetical, scenarios (with higher-than-minimum recharge rates and/or lower-than-maximum recovery rates) the total net impact from project recharge and recovery operations is calculated to be nearly completely balanced or actually to have created a net positive mitigation in excess of the total temporary drawdown at all locations in all surrounding sections, depending on the specific scenario (Tables 7, 8).

Near-surface Water Levels. A hypothetical standing water table within a few feet of the ground surface creates potentially adverse impacts to many types of crops and to the foundations of manmade structures including building and/or tower foundations, roads, and lined and unlined canals, ponds, and ditches. Within a year or two, row crops and almond trees will no longer exist on the Strand Ranch so there will be no possible agricultural impact from a shallow water table under the Strand Ranch. The only structure of concern which will remain on or near the Strand Ranch project site is the KCWA Cross Valley Canal that might be impacted by a shallow water table. The KCWA operates a monitoring program using an array of shallow piezometers along the Cross Valley Canal (CVC) to monitor water levels for potential conditions of concern.

In 2006, the Strand Ranch constructed and operated a pilot recharge facility on the site. As it so happened, the water table in 2006 was already within 1 - 2 ft of the ground surface on the Strand Ranch due to extended, large-volume, recharge operations on the Kern Fan by other project operators. This very shallow standing water table was already being monitored for potential impacts to the CVC. The constructors of the pilot-test recharge ponds encountered the water table when they excavated about 3 ft deep into the shallow sediment to make the ponds. When excavation was completed, the site had standing water along the new pond levees[7] from the presence of the very shallow water table. The pilot recharge test lasted about 5 months (mid-July - mid-December, 2006) and stored approximately 3,000 af in the ground. This recharge did not serve to raise the pre-existing water table since it was already at the ground surface but it extended by some undetermined amount, the length of time required for the shallow strata to dewater after recharge on the Kern Fan stopped. During this entire period, the KCWA did not issue any requests for mitigation or notices of observed impacts to the CVC, as far as we know.

The proposed operation of the Strand Ranch project is of sufficiently small recharge volume that it cannot threaten to create such a shallow water table unless a project recharge episode between about 10 - 17.5 kaf occurs at a time when the pre-existing water table is already less than about 30 ft deep due to other causes. Such a pre-existing, shallow water table

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[7] Robert Coffee, RRBWSD operations manager, verbal communication, November, 2007.

has only occurred twice since 1960 (1999 and 2006) and will not recur unless and until a multi-year climatic wet period creates sufficient surface water supplies to re-fill the Kern Fan recharge mound. Based on the experience of 2006, we conclude that a shallow water table can exist under the Strand Ranch property without necessarily observing any adverse impacts, at least not necessarily regarding mitigation for the durations of shallow table table of a year or less. Nevertheless, a monitoring program is already in place which specifically tests for conditions which might have a potentially adverse impact on the Cross Valley Canal.

Summary of Project Impact Findings.

Basinwide, Permanent Impact. The proposed Strand Ranch ASR project operation is designed to always maintain a positive project balance, i.e., a volume of water must always be stored in the aquifer prior to removing a like volume from the aquifer. The long-term basinwide water level impact from the project is a negligibly small rise in overall water levels due to the MOU-required permanent addition of a few thousand acre-feet of overdraft correction water to the basin over the project life. There is no possibility of overdraft or aquifer dewatering under any proposed Strand Ranch scenario.

Local, Temporary Mounding Impact. The project has the potential to temporarily raise the local water table a maximum of 30 to 40 ft under the project site and 6 to 14 ft in the surrounding eight sections due to project recharge operations. The water level rise only lasts for the duration of recharge and begins to re-equilibrate to its previous level when recharge ceases. Such a rise in water levels is considered to be beneficial except, perhaps, if the water table rises so high that it rises up to or close to the ground surface under the project site only if the pre-existing water table is already very shallow due to non-project causes. This condition is unlikely and mitigation monitoring already exists on the project site. One such episode occurred during a pilot recharge test in 2006 and no adverse impacts were observed or reported in the area.

Local, Temporary Drawdown Impact. The project has the potential to temporarily lower the local water levels a maximum of -24 to -43 ft under the project site and a maximum of -7 to -20 ft at operating non-project water well locations in the vicinity of the project. These temporary, localized impacts can occur even though there is a continuous, permanent, long-term, net increase in the total amount of water left in the basin. Such a temporary lowering of water levels lasts only as long as pumping lasts plus a recovery period. Such a drawdown is considered to be an undesirable impact because a non-project operating well would experience a higher lifting cost to pump water than would be the case in the absence of project pumping. However, this impact may be mitigated by the beneficial impacts of mounding as summarized below.

Compensated Net Local, Temporary Project Impacts. As previously discussed, the positive impact of recharge mounding fully compensates for recovery drawdown in all except the "least-favorable" case of a recharge/recovery cycle at minimum recharge rates and maximum recovery rates. In this one case, the maximum uncompensated net temporary drawdown in the surrounding eight sections is in the range of -6 to -7 ft. All other, more-favorable, scenarios result smaller net water level declines and/or net water level rises at all locations surrounding the project site for comparable time periods.

Comparative Project Impacts. The local project mounding and drawdown water-level impacts are small, local, and temporary relative to the 100+ ft magnitude of the historically observed water level fluctuations due to the climatic wet/dry cycle. The impacts of the proposed Strand Ranch Project are also small relative to the scale of impacts due to some other banking project and district operations on the Kern Fan and in Kern County which store and recover larger water volumes at higher rates. The project mounding and drawdown impacts are temporary; for example, the drawdown impacts from one seasonal pumping cycle will fully equilibrate prior to the beginning of the next seasonal pumping cycle. The project impacts are local in the sense that there is no significant water-level impact beyond 1 - 1.5 miles from the project site.

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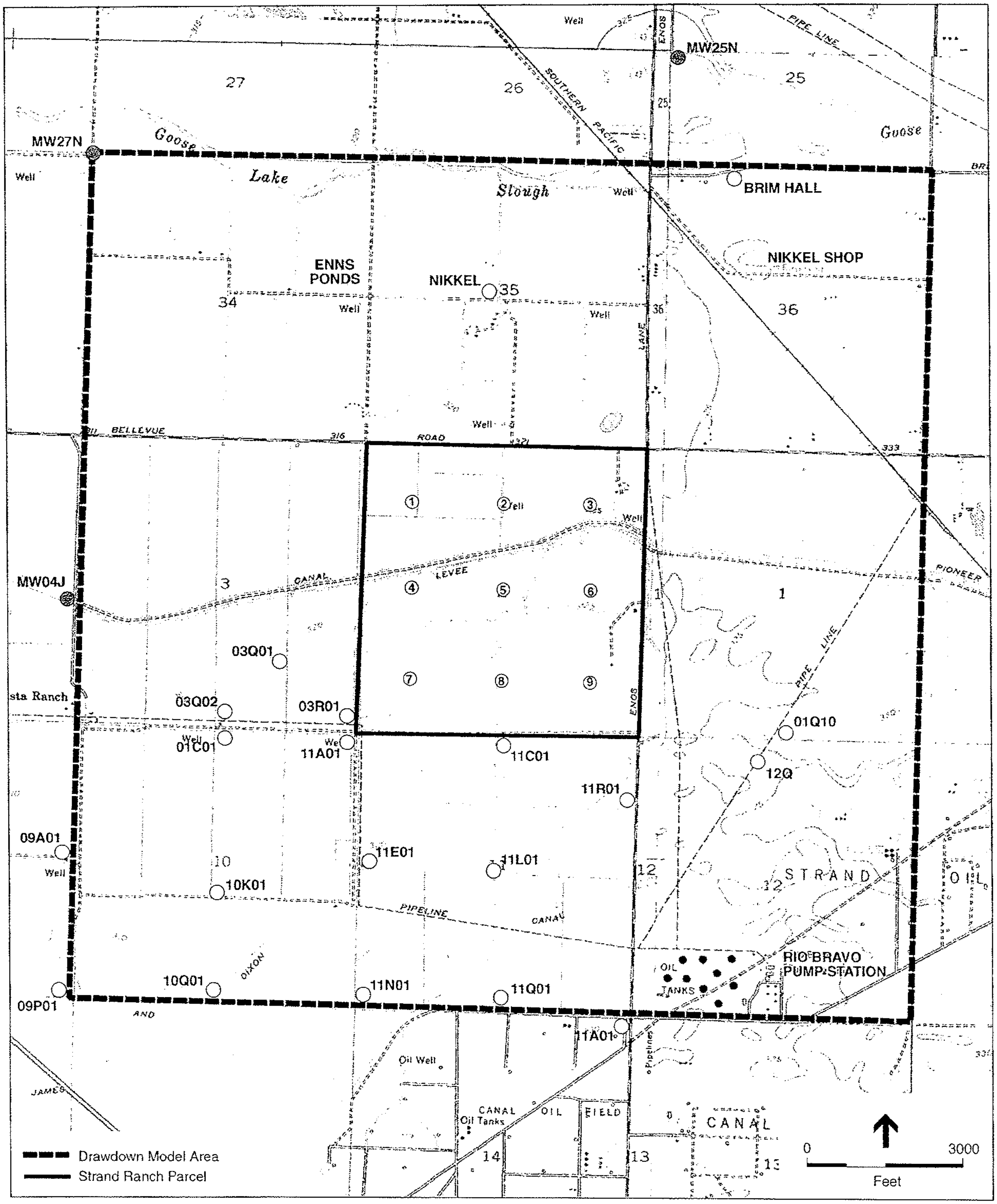
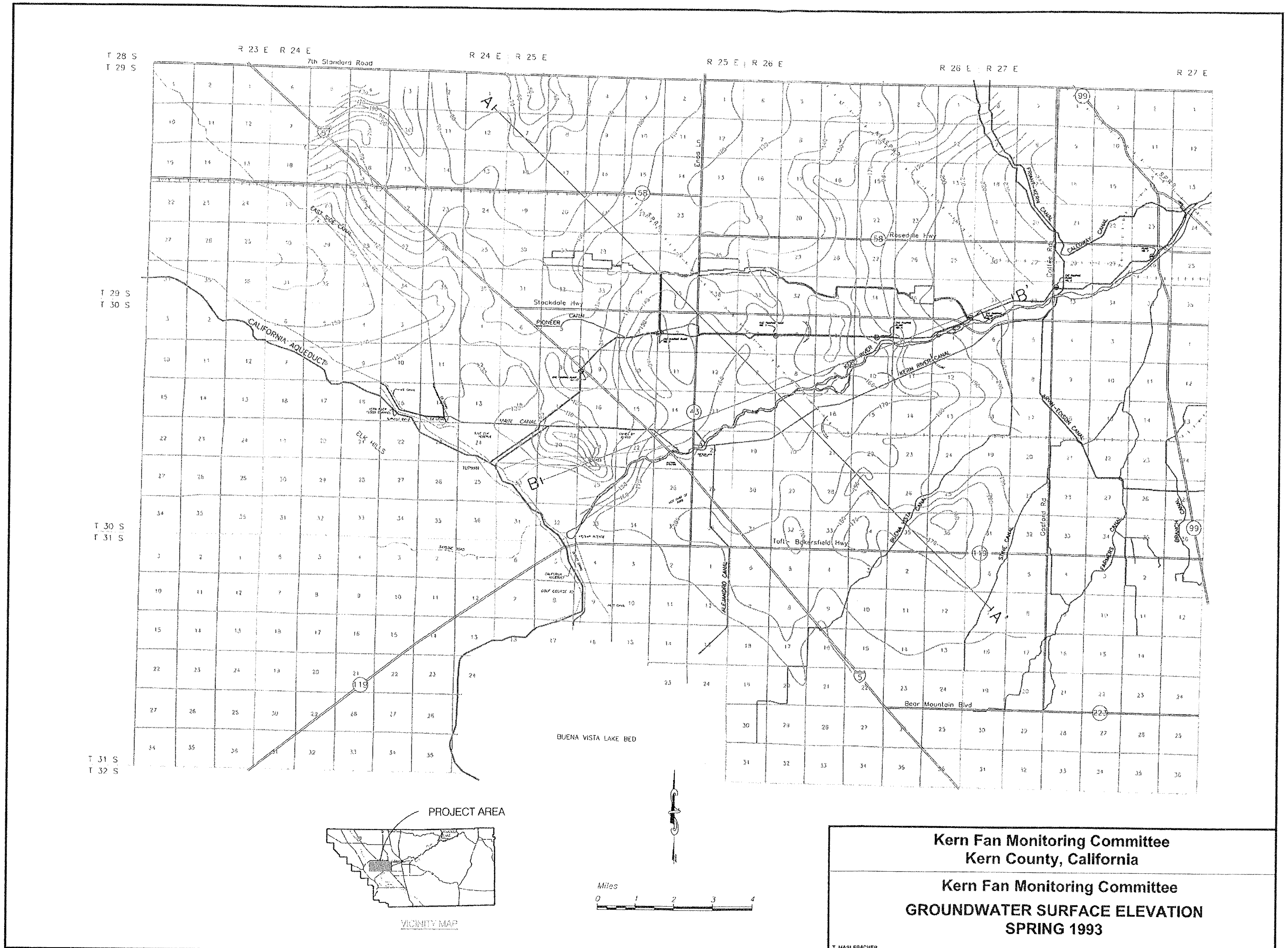
Figures.



SOURCE: USGS; ESA, 2007.

Irvine Ranch Water District . 205426

Figure 1
Project Location



Kern Fan Monitoring Committee
Kern County, California

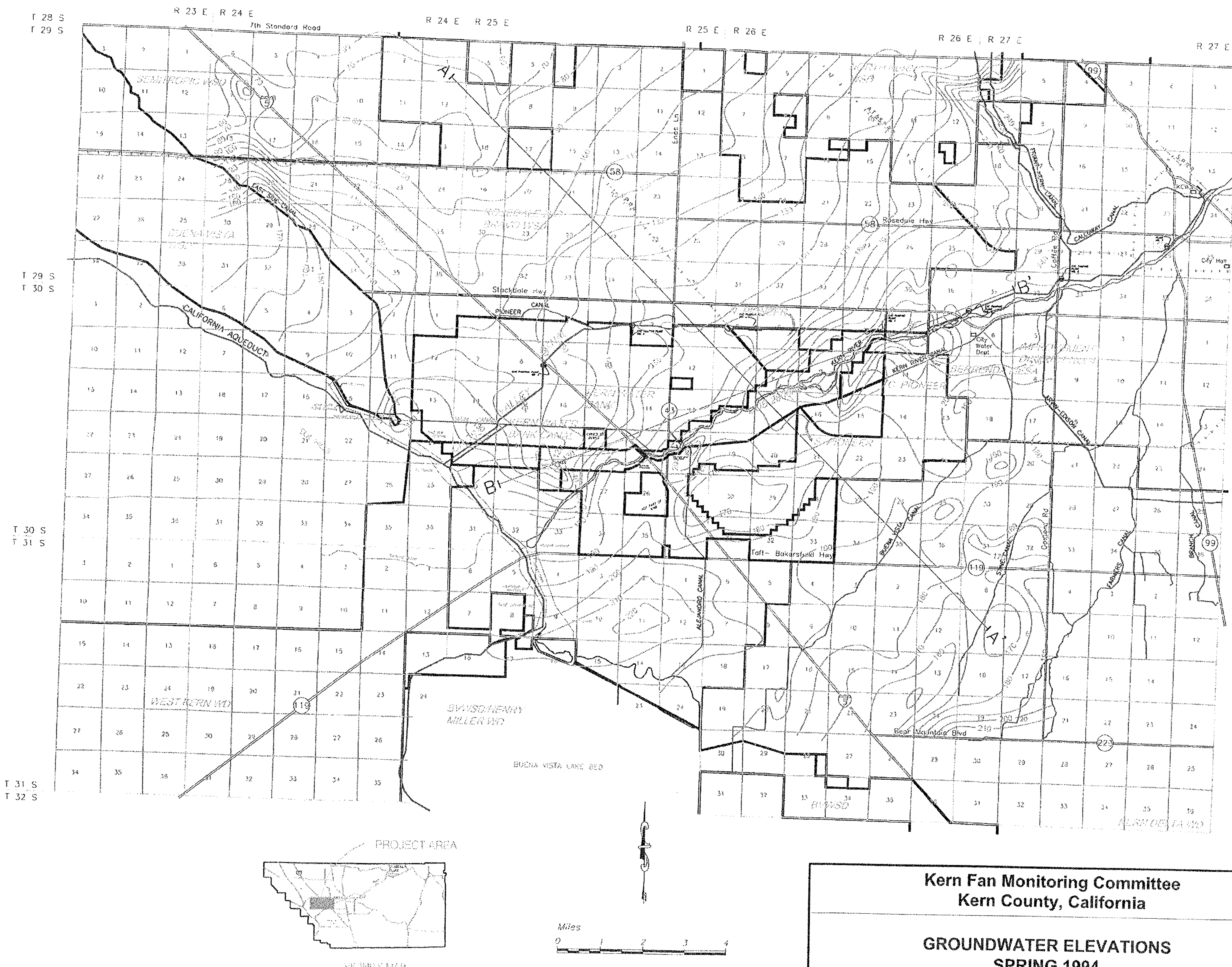
Kern Fan Monitoring Committee

GROUNDWATER SURFACE ELEVATION
SPRING 1993

T. HASLEBACHER

APRIL, 1993

FIG 2



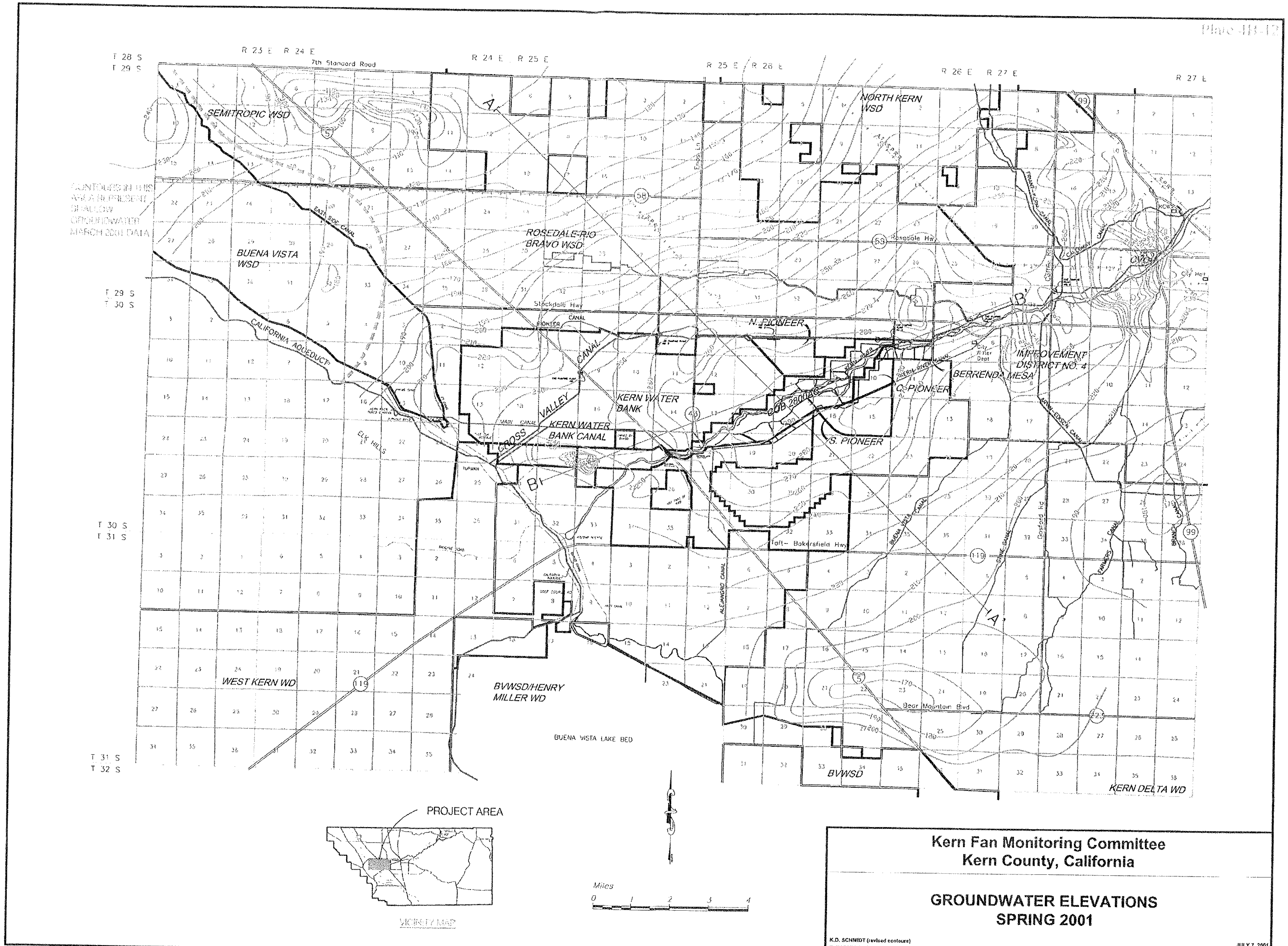
Kern Fan Monitoring Committee
Kern County, California

GROUNDWATER ELEVATIONS
SPRING 1994

T. HASLEBACHER

DECEMBER 1996

FIG 3



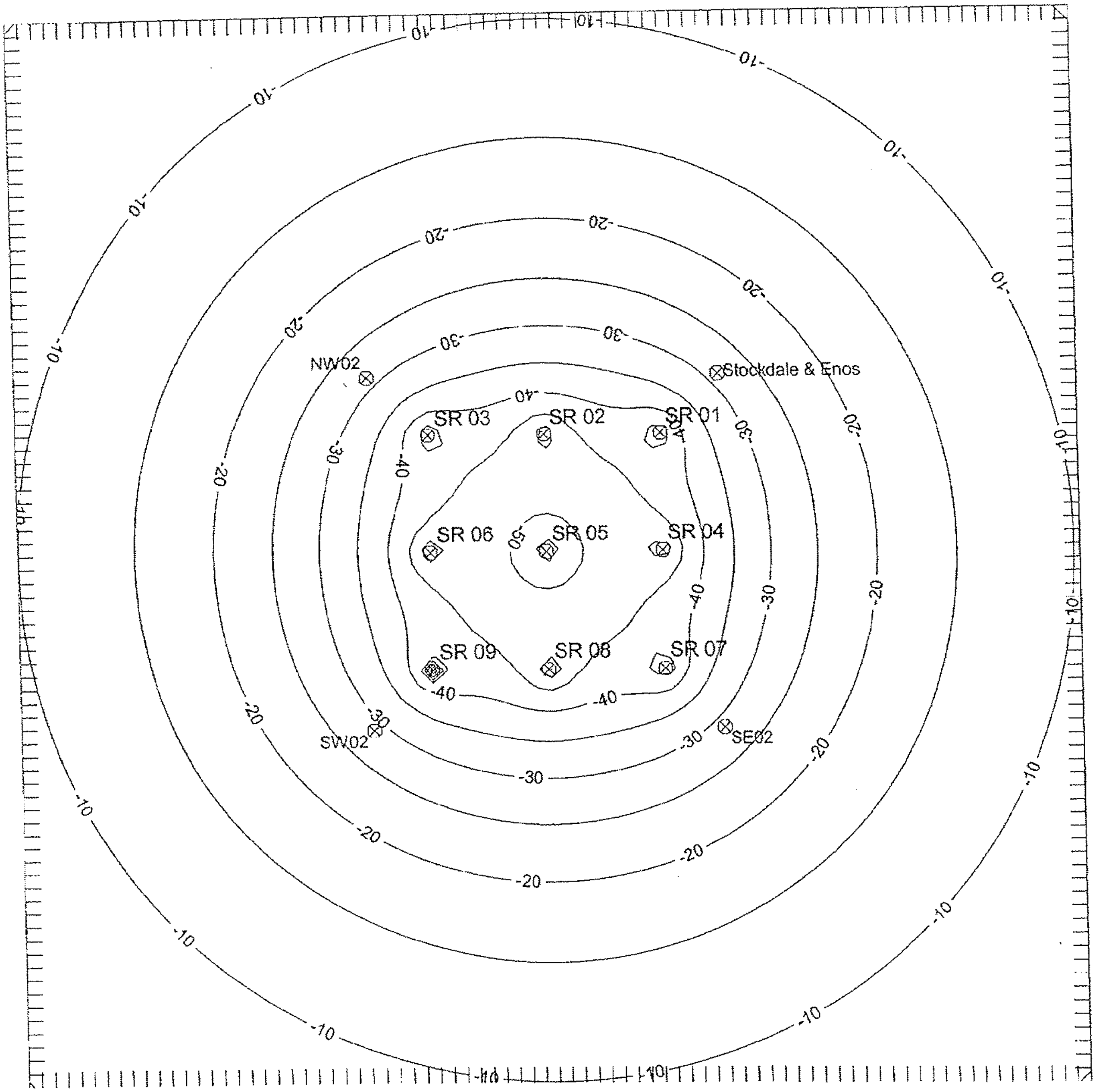
Kern Fan Monitoring Committee
Kern County, California

GROUNDWATER ELEVATIONS
SPRING 2001

K.D. SCHMIDT (revised contours)
T. HASLEBACHER

JULY 7, 2001
MAY, 2001

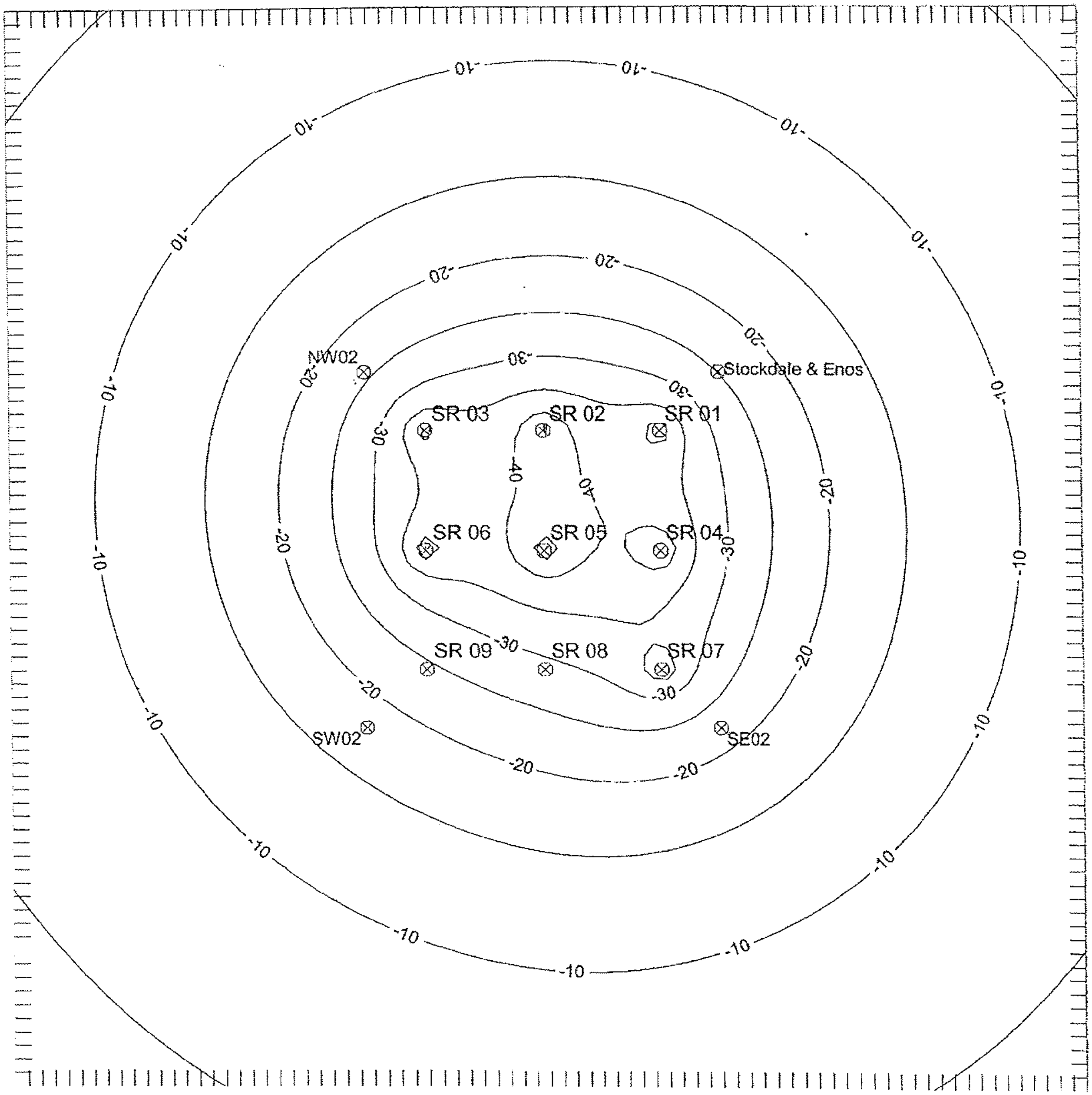
FIG 4



SOURCE: Geomatrix, 2007.

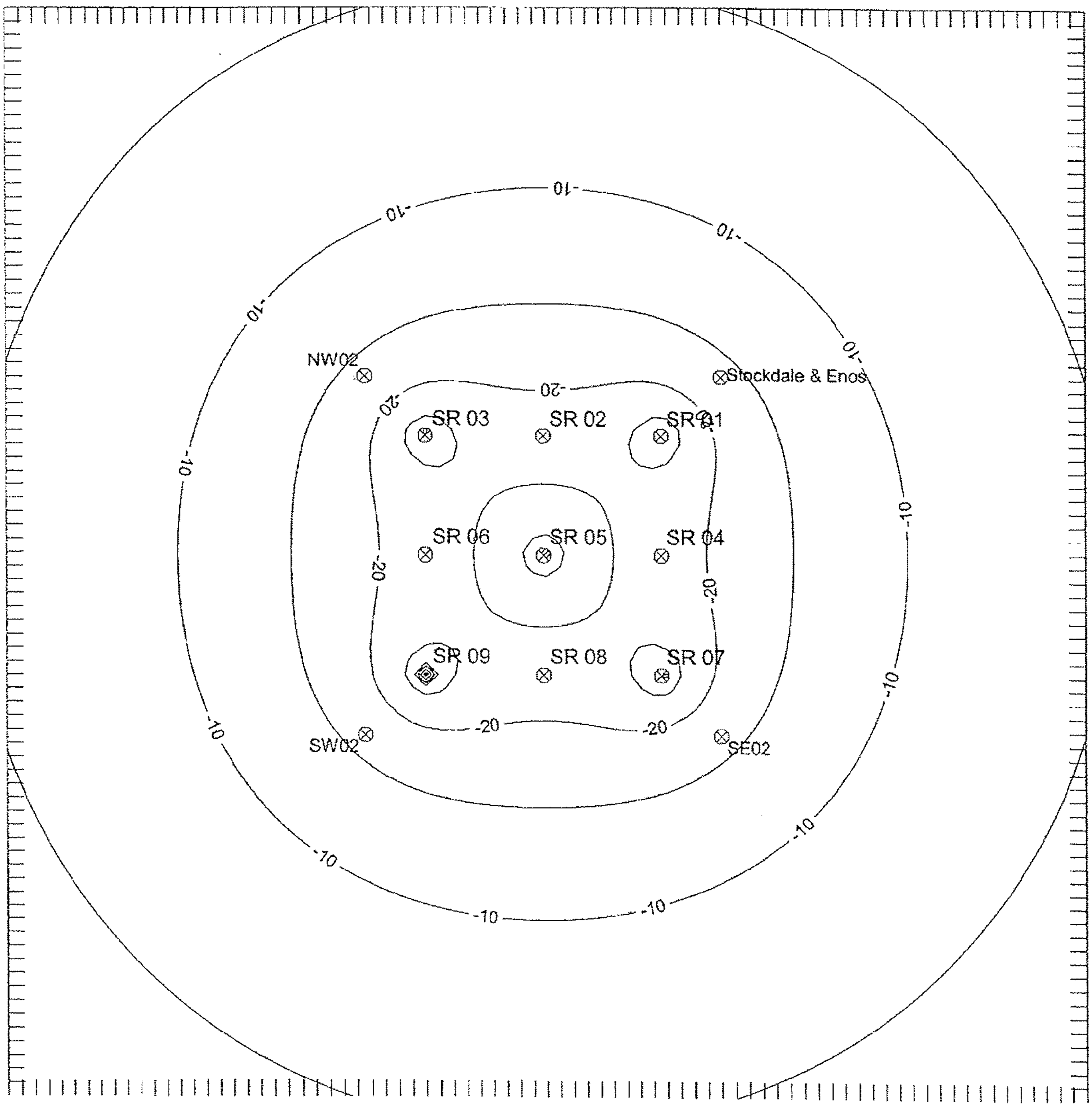
Irvine Ranch Water District . 205426

Figure 5
Predicted Water Level Drawdown Map,
9-Well Scenario (Wells 1-9),
Base Case Aquifer Parameters



SOURCE: Geomatrix, 2007.

Figure 6
Predicted Water Level Drawdown Map,
7-Well Scenario (Wells 1-7),
Base Case Aquifer Parameters

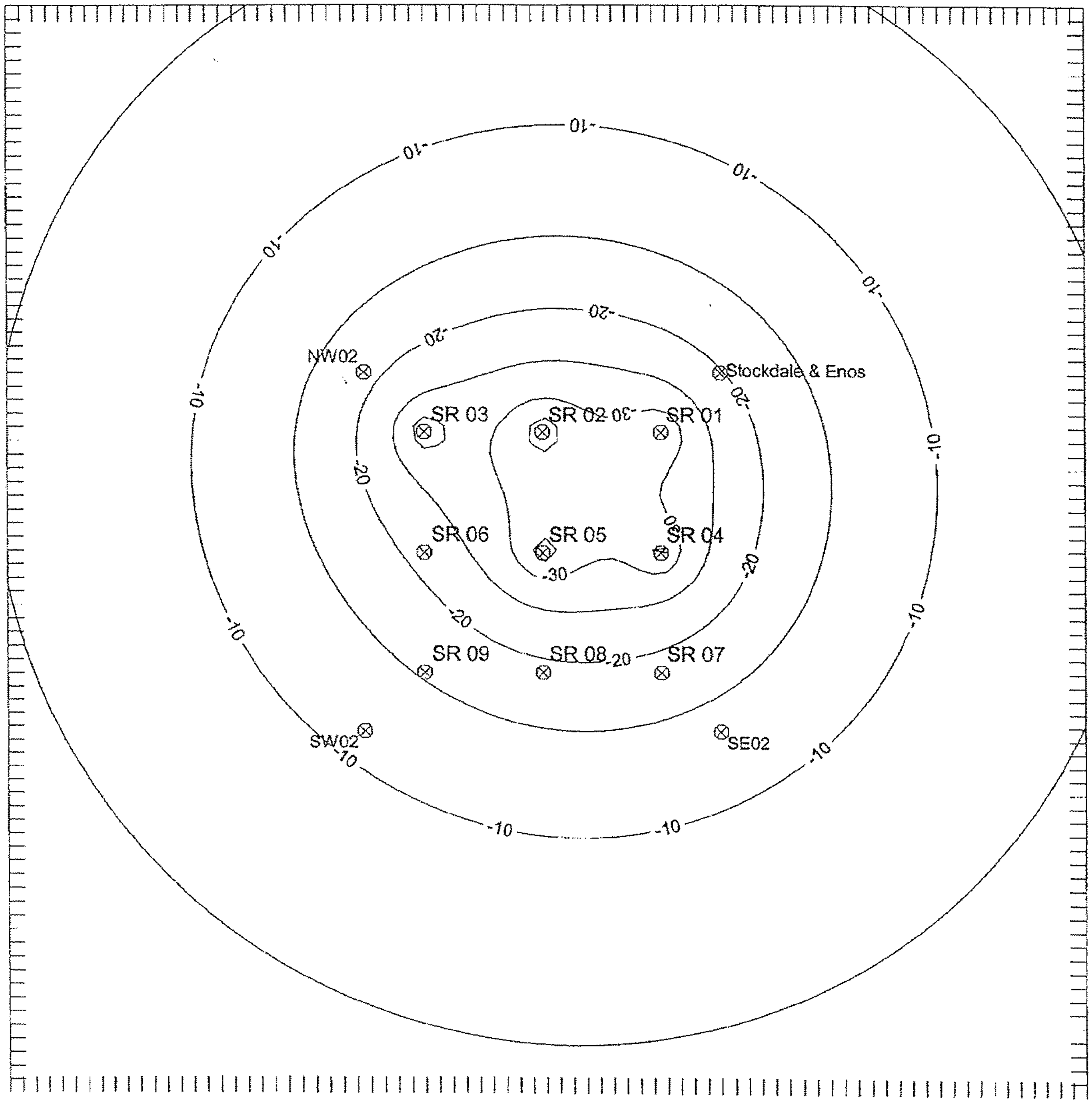


SOURCE. Geomatrix, 2007.

Irvine Ranch Water District . 205426

Figure 7

Predicted Water Level Drawdown Map, 5-Well Scenario (Wells 13579), Base Case Aquifer Parameters



SOURCE: Geomatrix, 2007.

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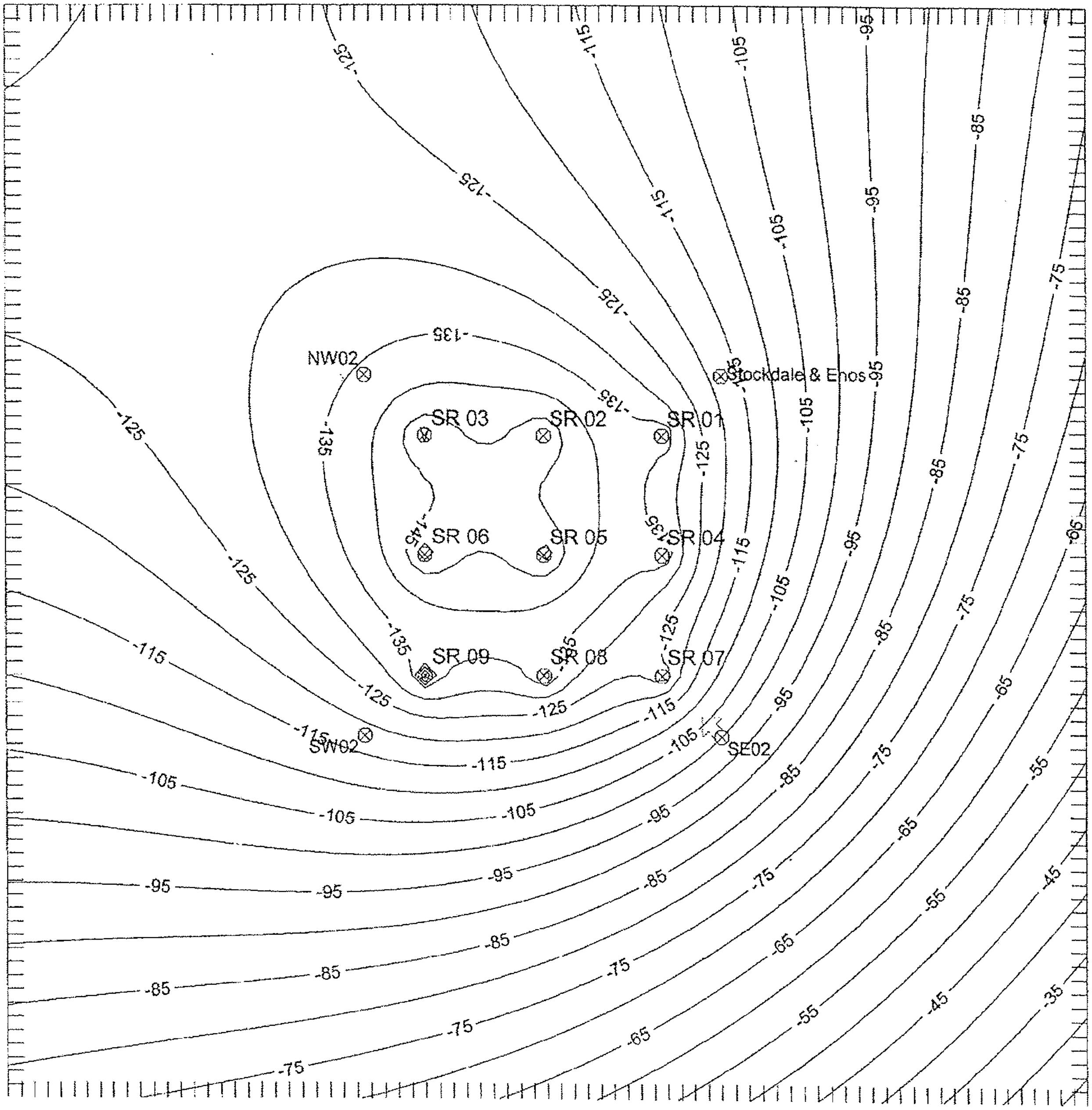
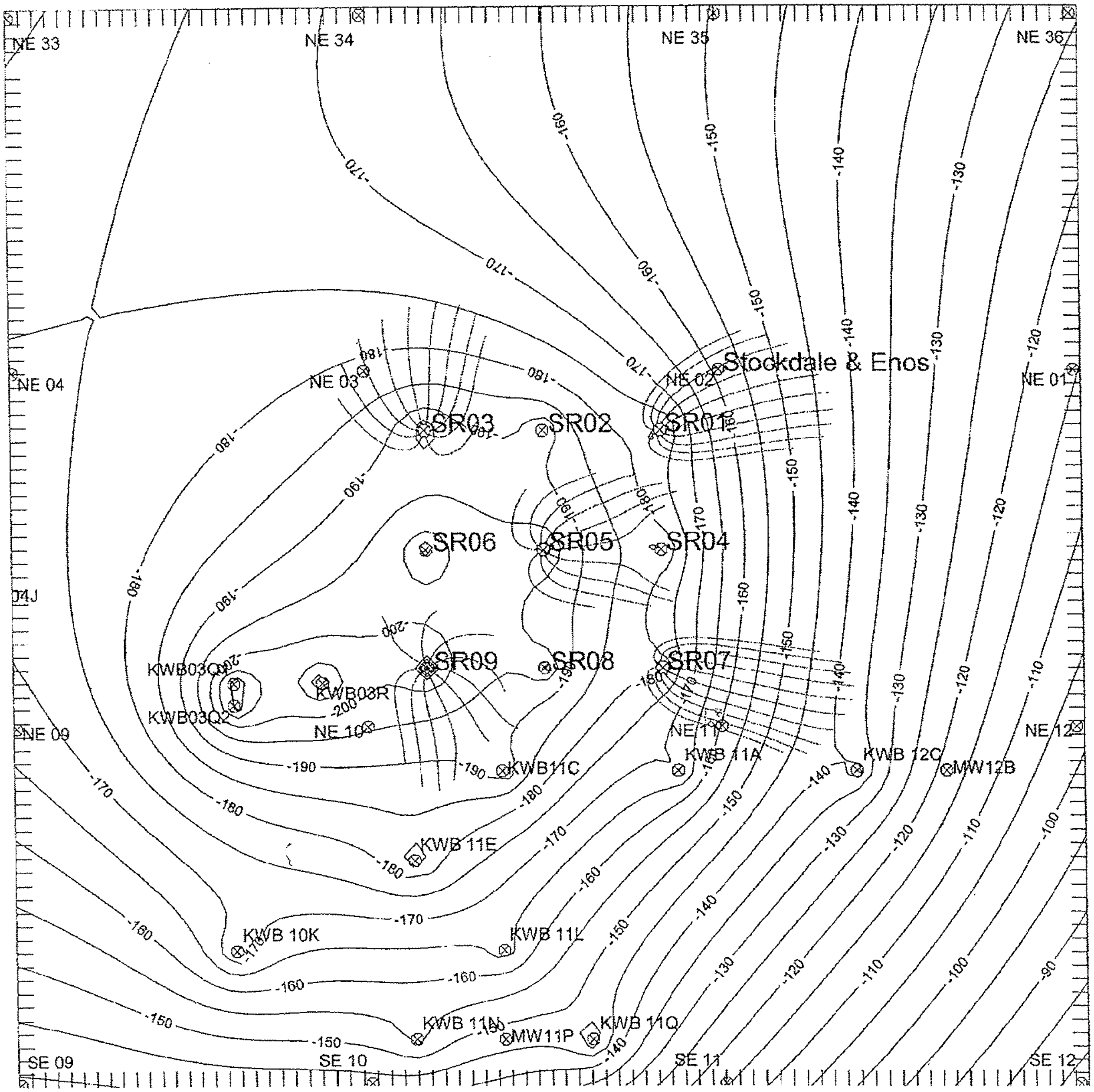
Figure 8
Predicted Water Level Drawdown Map,
5-Well Scenario (Wells 12345),
Base Case Aquifer Parameters



SOURCE: Geomatrix, 2007.

Irvine Ranch Water District . 205426

Figure 9
Predicted Water Level Elevation Map,
9-Well Scenario (Wells 1-9),
Base Case Aquifer Parameters with Wet-Year Groundwater Gradient

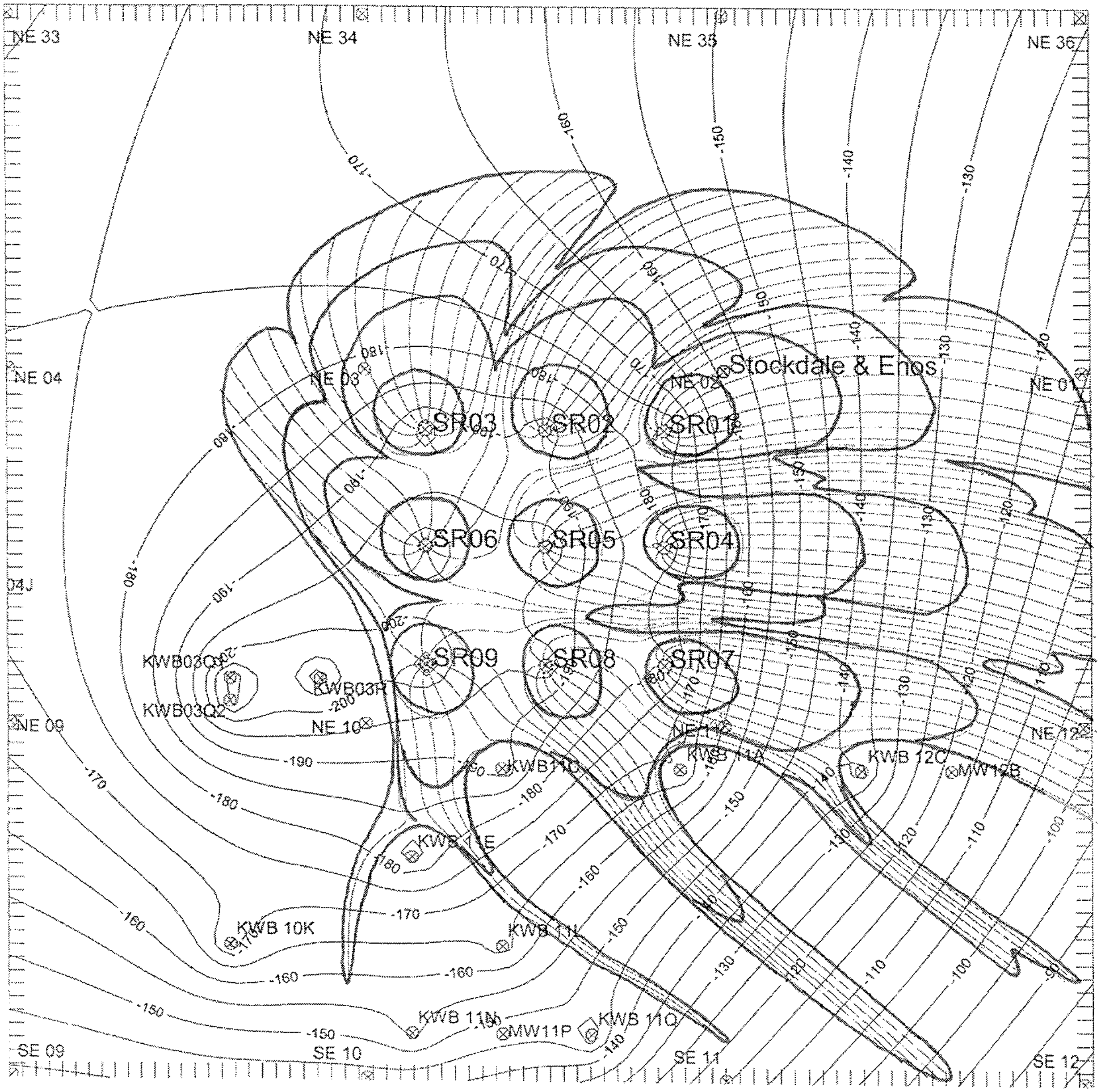


SOURCE: Geomatrix, 2007.

Irvine Ranch Water District . 205426

Figure 10

Predicted Water Level Elevation Map, 20-Well Scenario (Wells 1-9 and KWB Wells 1-11), Base Case Aquifer Parameters with Wet-Year Groundwater Gradient

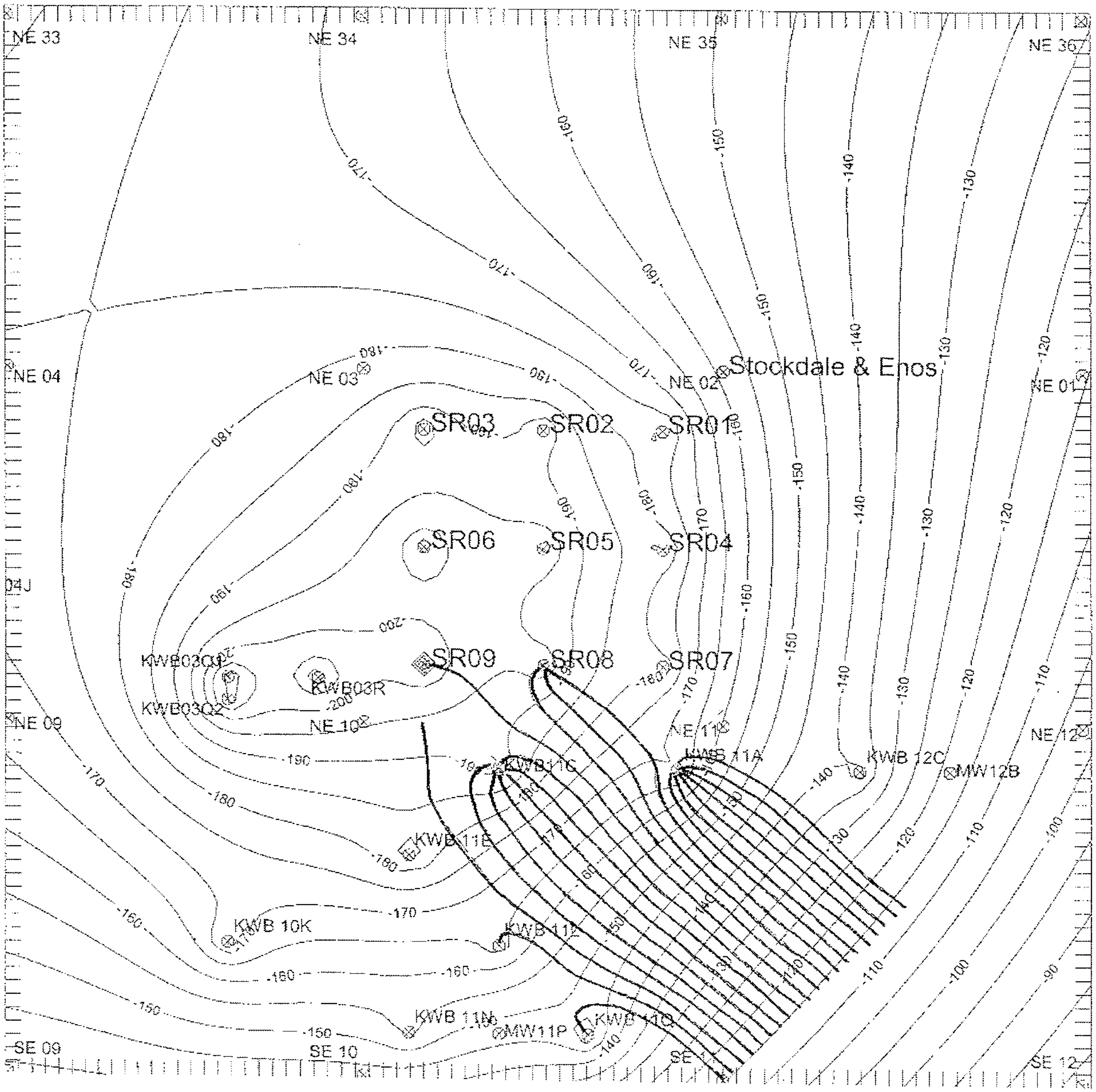


SOURCE: Sierra Scientific Services, 2007

Irvine Ranch Water District . 205426

Figure 11

Particle Trajectory and Capture Zone Perimeter Map;
t = 300, 1000, 1825, and 3650d



SOURCE: Sierra Scientific Services, 2007

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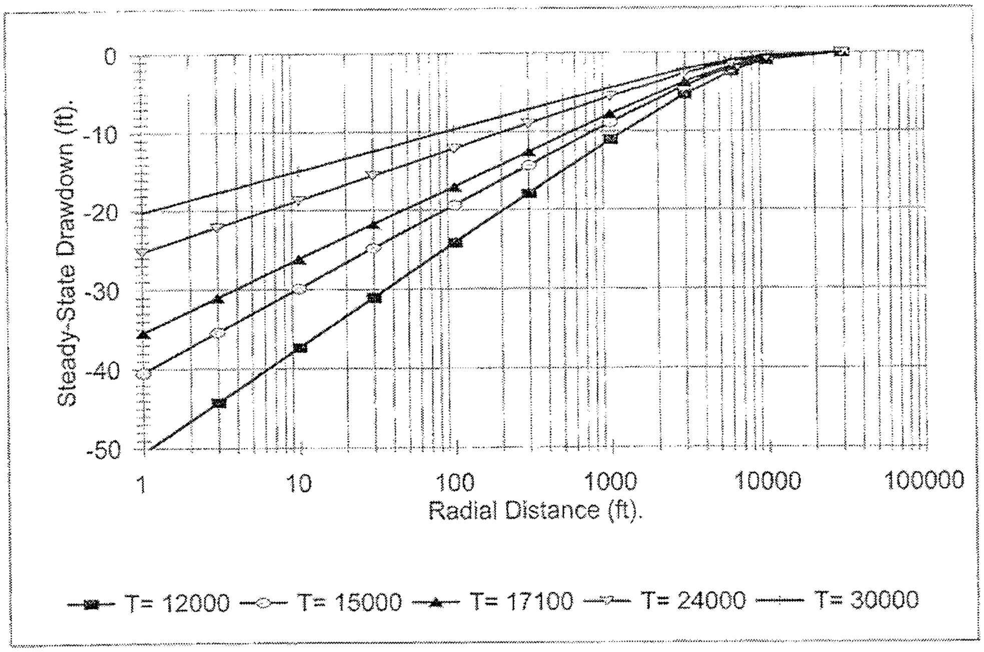
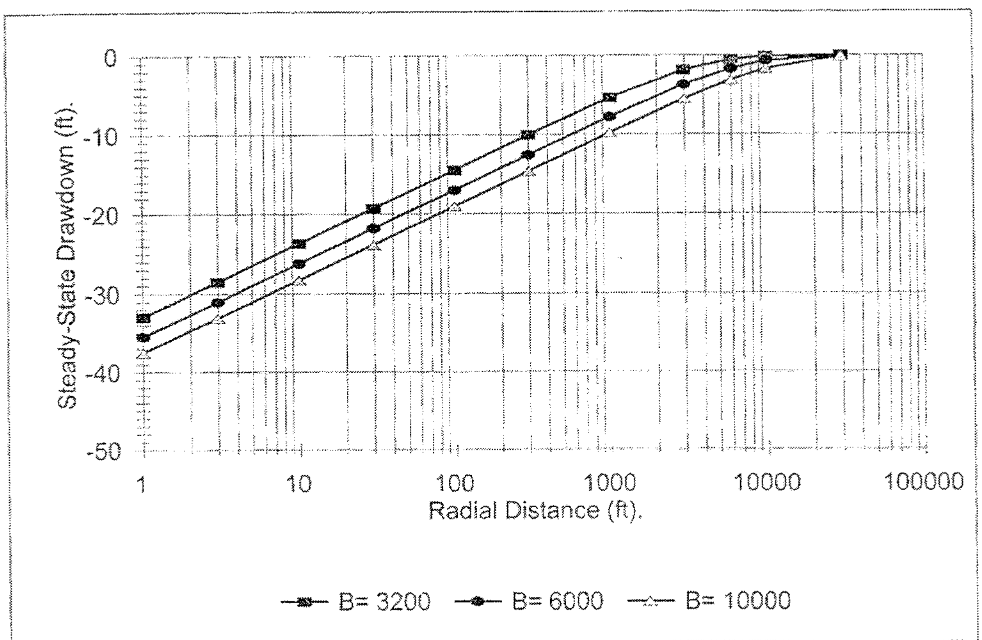
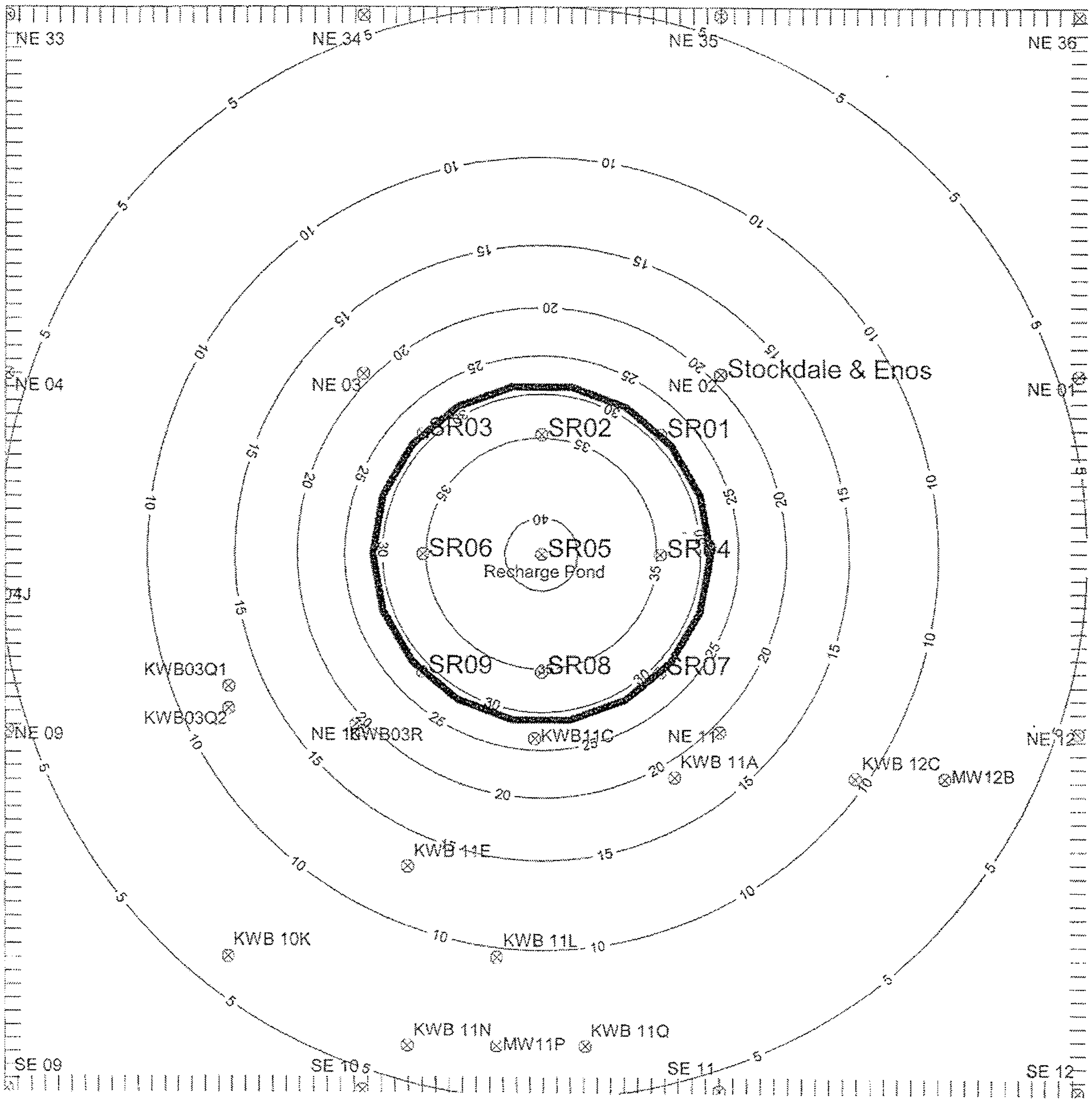
Figure 12
Particle Trajectory Map;
Hypothetical Contaminant Source in
Sec 02, T30s, R25e





SOURCE: Sierra Scientific Services, 2007

Figure 13
Strand Ranch Base Case Sensitivity Analysis
Steady-State Drawdowns for
Variations in T or B



SOURCE: Sierra Scientific Services, 2007

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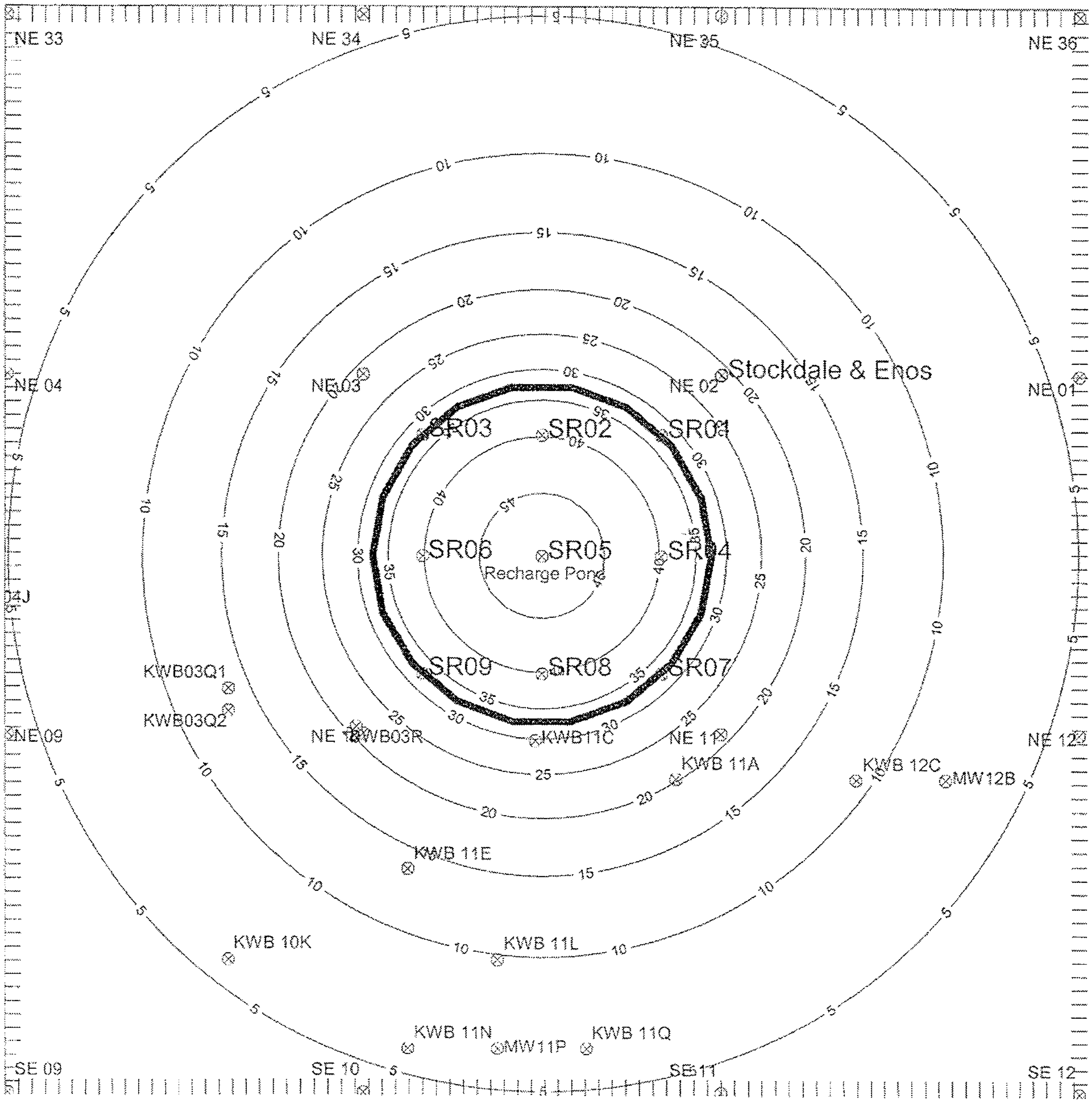
Figure 14
Water Level Rise Map,
Pond Recharge at IR = 0.20,
Base Case Aquifer Parameters



SOURCE: Sierra Scientific Services, 2007

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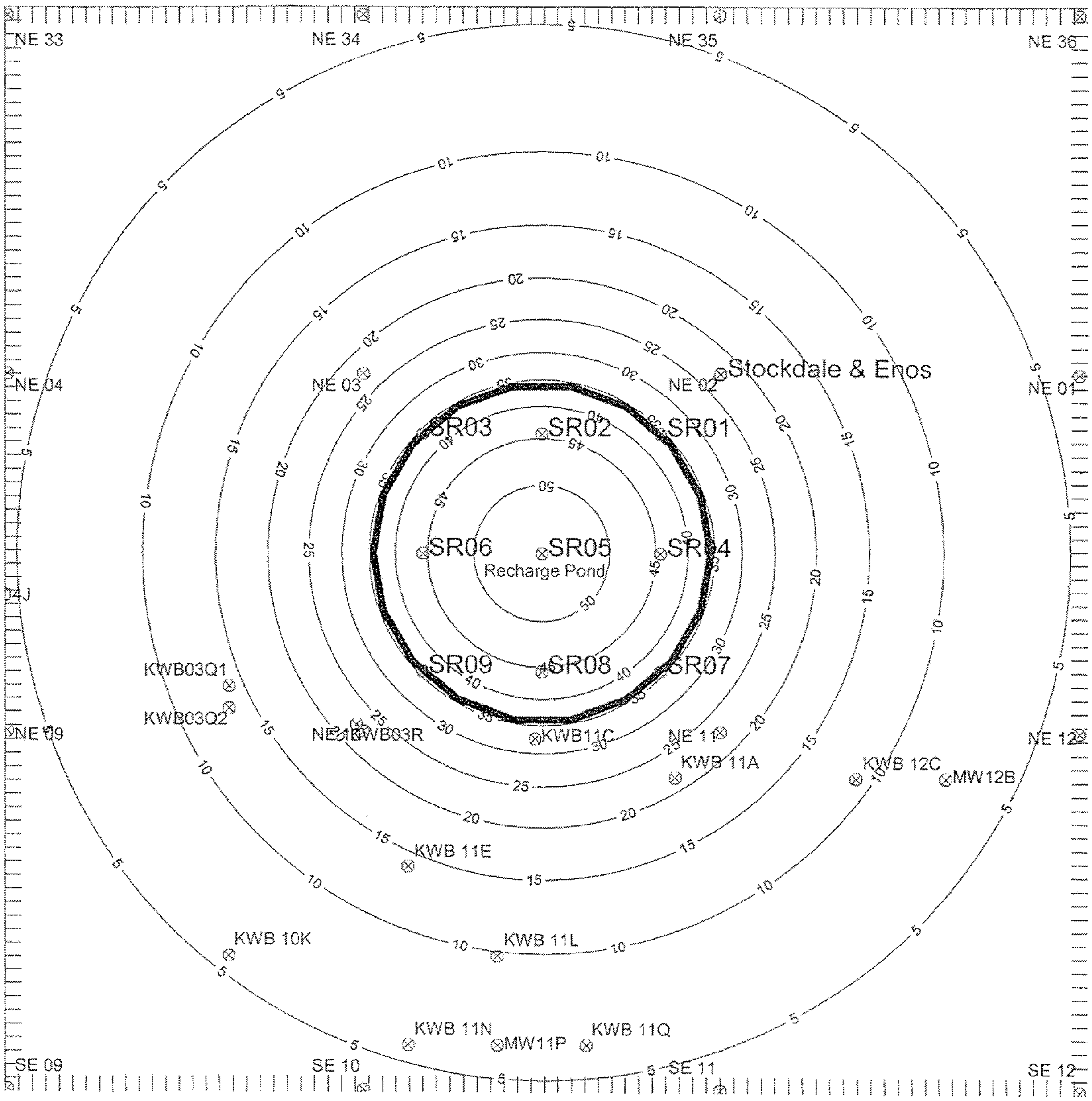
Figure 15
Water Level Rise Map,
Pond Recharge at IR = 0.25,
Base Case Aquifer Parameters



SOURCE: Sierra Scientific Services, 2007

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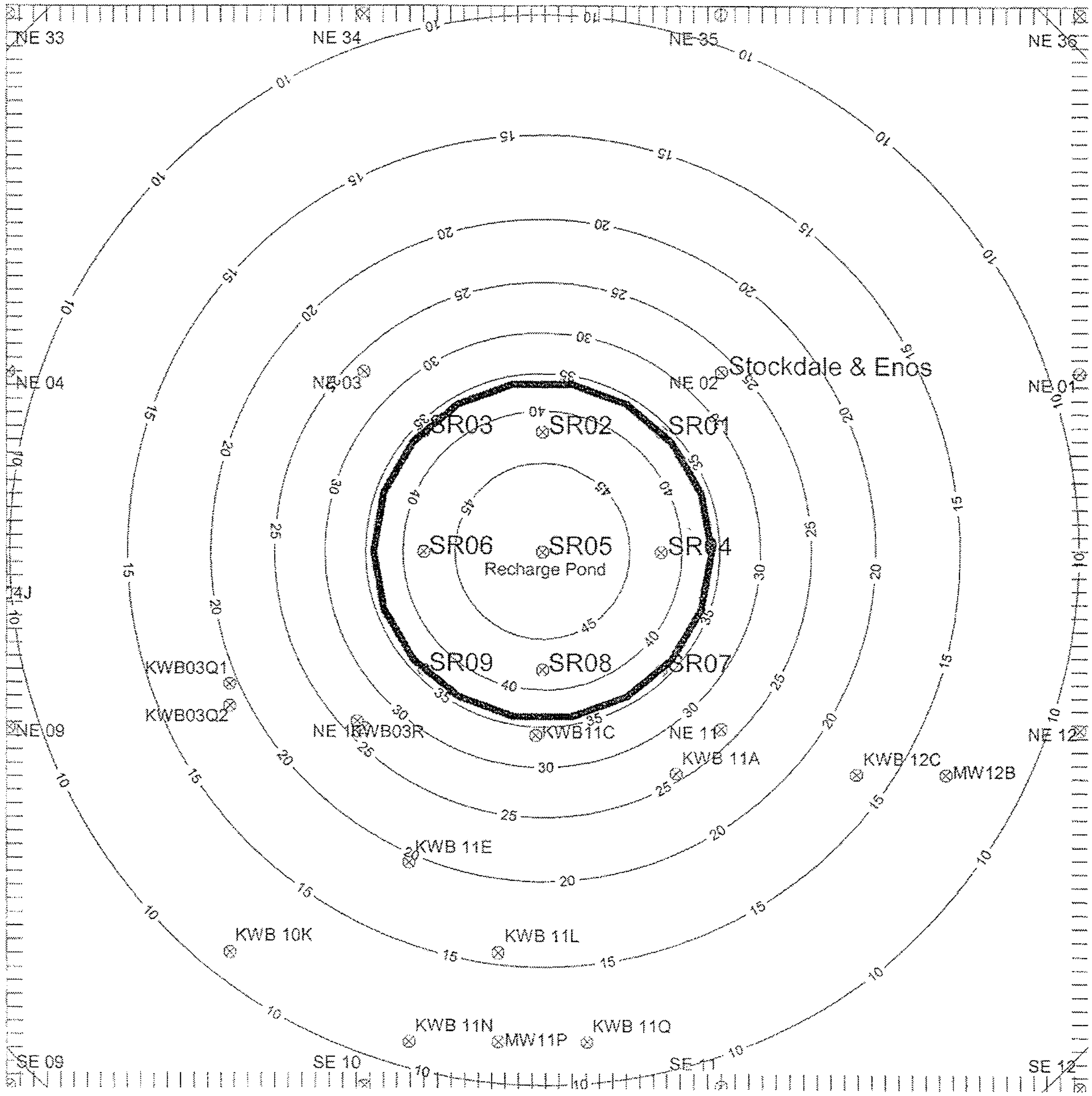
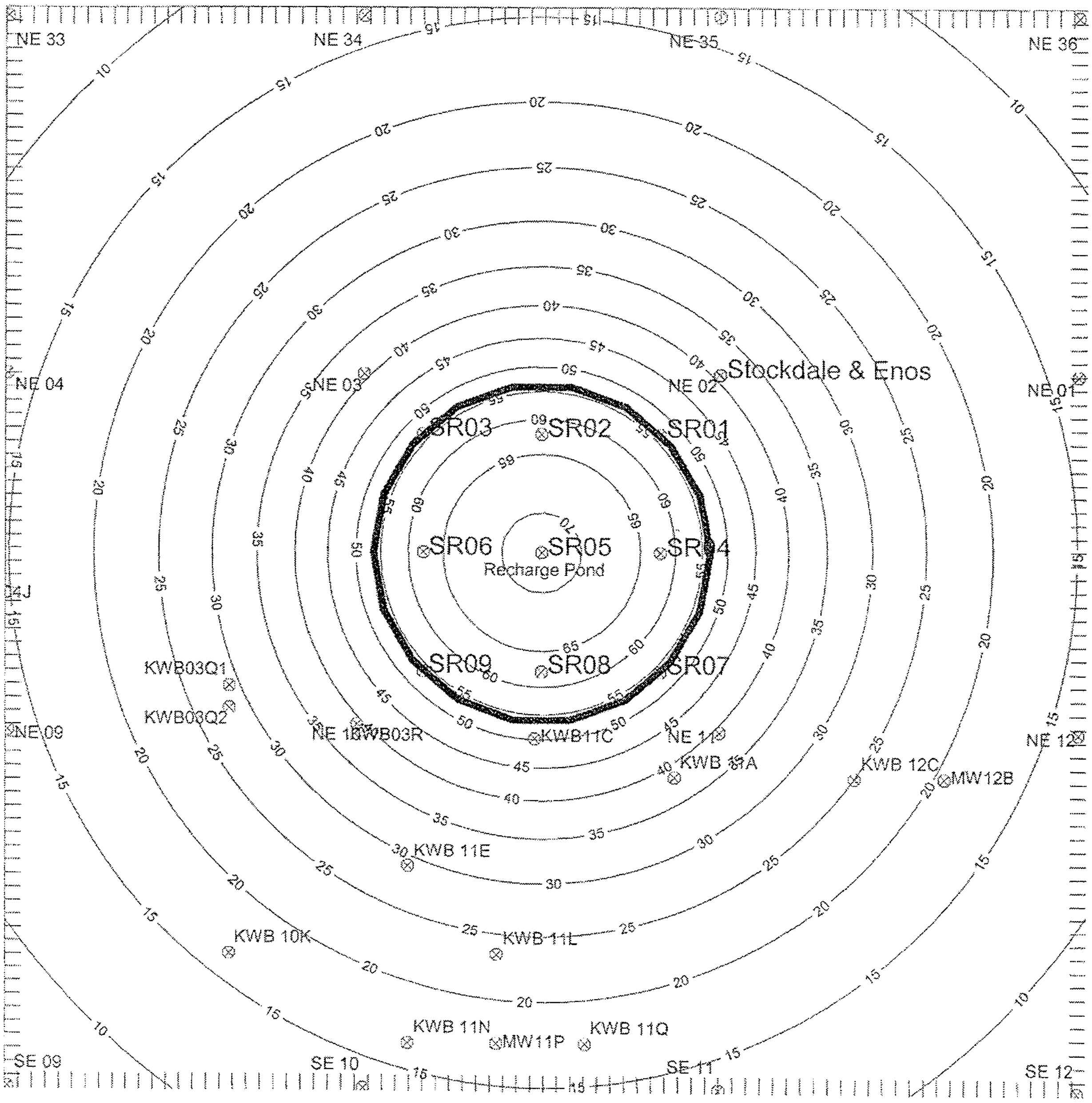
Figure 16
Water Level Rise Map,
Pond Recharge at IR = 0.30,
Base Case Aquifer Parameters



SOURCE: Sierra Scientific Services, 2007

Irvine Ranch Water District . 205426

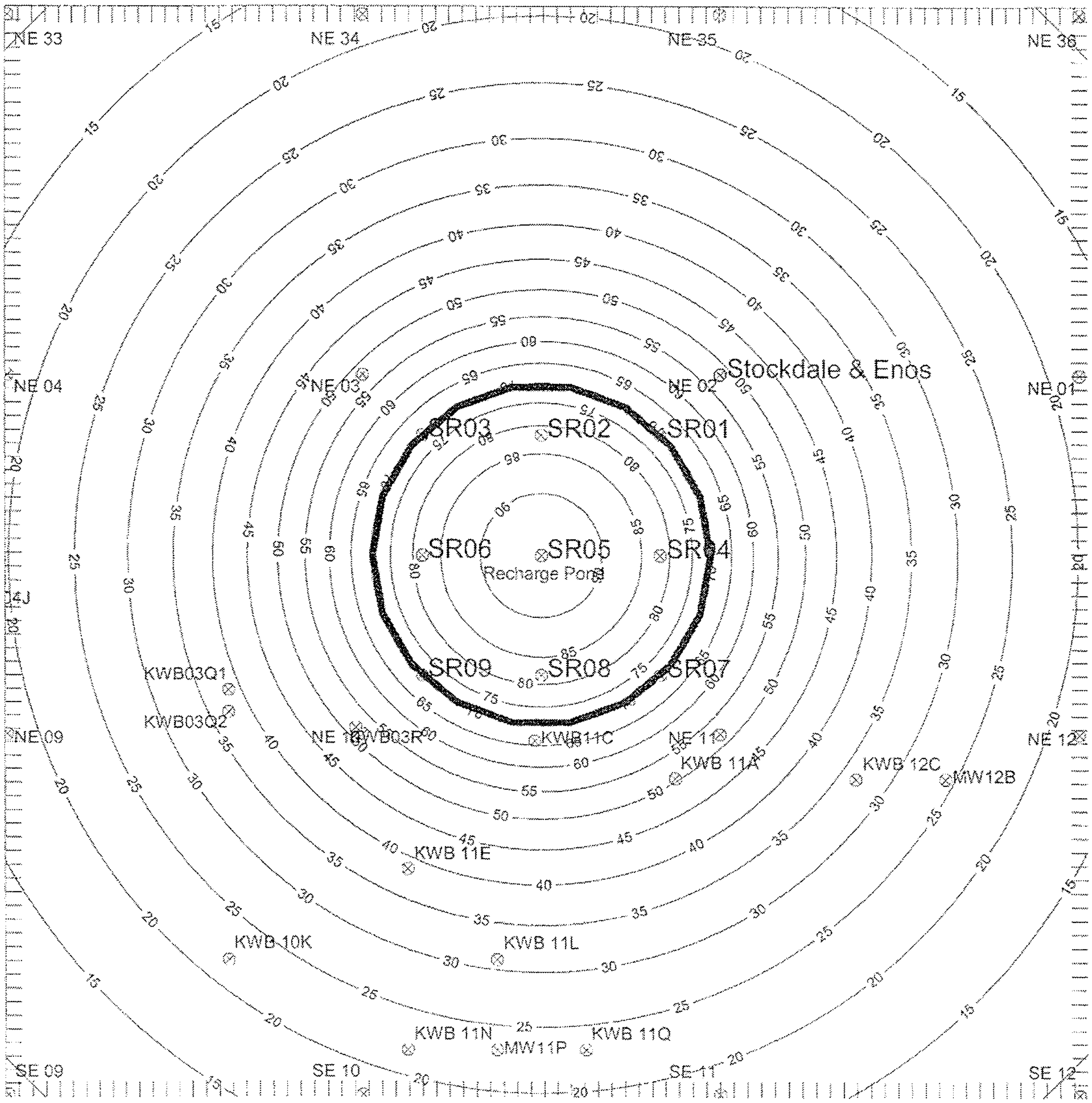
Figure 17
Water Level Rise Map,
Maximum Recharge at IR = 0.20,
Base Case Aquifer Parameters



SOURCE: Sierra Scientific Services, 2007

Irvine Ranch Water District . 205426

Figure 18
Water Level Rise Map,
Maximum Recharge at IR = 0.30,
Base Case Aquifer Parameters



SOURCE: Sierra Scientific Services, 2007

Irvine Ranch Water District . 205426

Figure 19

Water Level Rise Map,
Maximum Recharge at IR = 0.40,
Base Case Aquifer Parameters

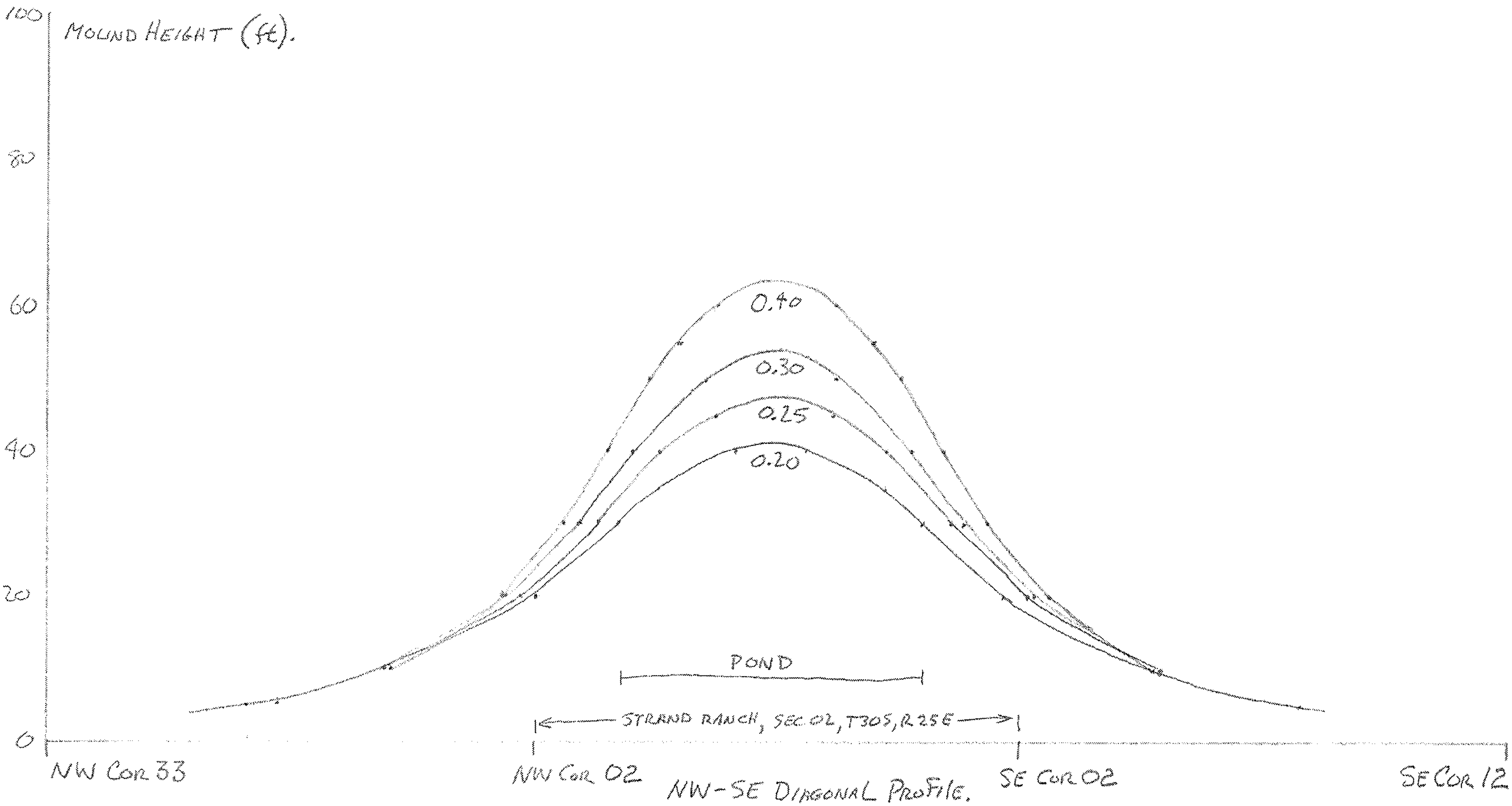


FIGURE 20. WATER LEVEL PROFILES, POND RECHARGE AT IR = 0.20, 0.25, 0.30, 0.40 ft/d; TOTAL VOLUME = 17,500 af, ALL CASES.

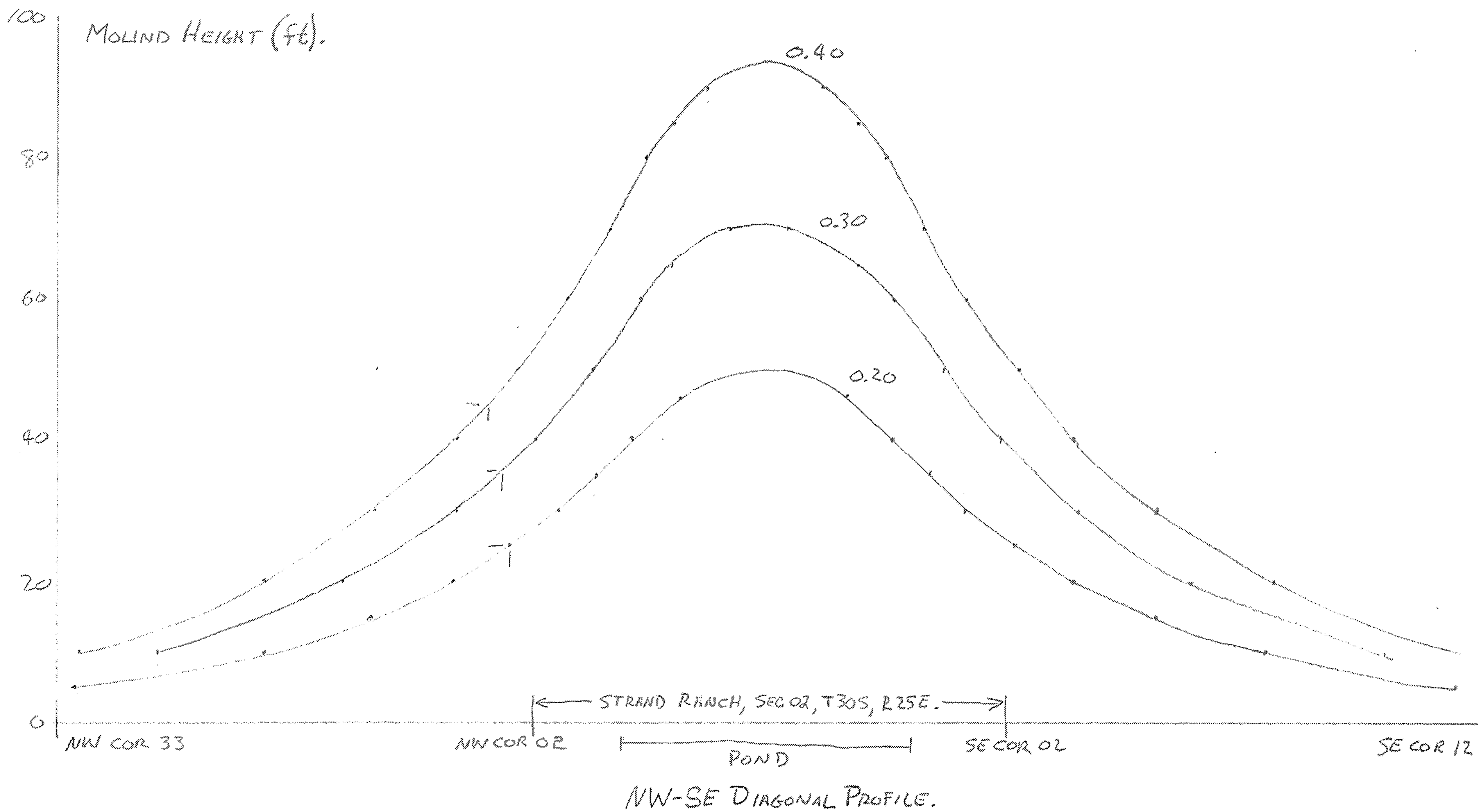


FIGURE 21. WATER LEVEL PROFILES, POND RECHARGE AT IR = 0.20, 0.30, 0.40 ft/d; TOTAL TIME = 365 days, ALL CASES.

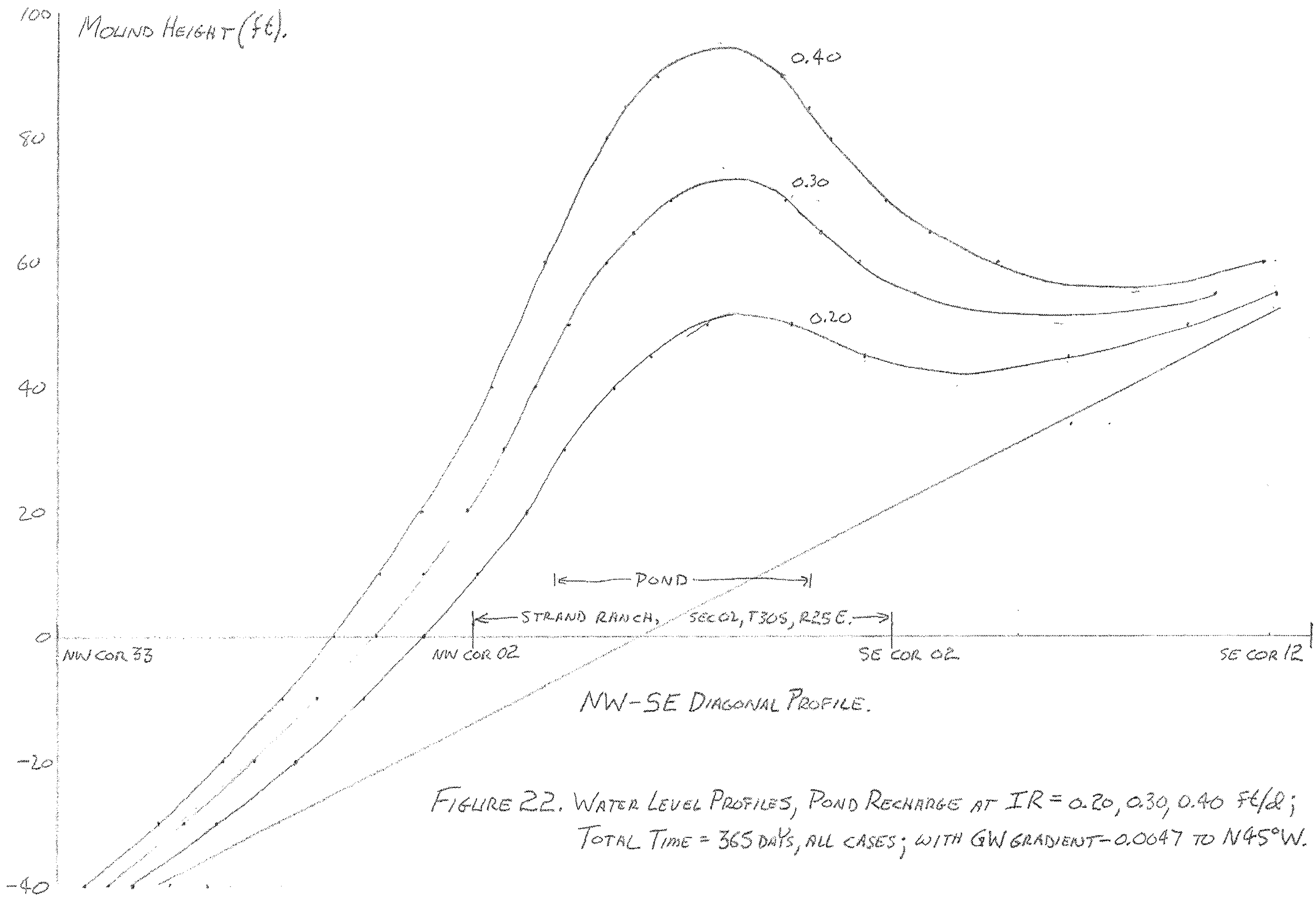


Figure 22. Water Level Profiles, Pond Recharge at IR = 0.20, 0.30, 0.40 ft/d; Total Time = 365 days, all cases; with GW gradient – 0.0047 to N45°W.

Tables.

Table 1. IRWD Strand Ranch Drawdown Model Parameters.

Property	Sym.	Value	Units
Aquifer Parameters			
Aquifer Hy. Conductivity (Hor)	K(h)	57	ft/d
Aquifer Hy. Conductivity (Vert)	K(v)	n/d	ft/d
Aquifer Thickness	H	300	ft
Aquifer Transmissivity	T	17100	ft^2/d
Aquifer Specific Yield	Sy	0.15	v/v
Aquifer Specific Storage	Ss	0.000067	ft^-1
Aquifer Storativity	S	0.02	v/v
Aquifer Porosity	phi	0.3	v/v
Aquitard Hy. Conductivity (Vert)	Kv'	0.0475	ft/d
Aquitard Thickness	H'	100	ft
Aquitard Leakance	L'	0.000475	d^-1
Hantush Factor	B	6000	ft
GW gradient	G	0.0048	N 45 W
SR Well Recovery Rate	Q	432000	cf/d

Well Parameters (X, Y) coordinates in feet wrt local origin (0,0) at NE cor Sec 02, T30s, R25e.

Well	Q (cfs)	Q (cf/d)	Q (af/d)	X (ft)	Y (ft)
SR 01	5	432000	9.9	-880	-880
SR 02	5	432000	9.9	-2640	-880
SR 03	5	432000	9.9	-4400	-880
SR 04	5	432000	9.9	-880	-2640
SR 05	5	432000	9.9	-2640	-2640
SR 06	5	432000	9.9	-4400	-2640
SR 07	5	432000	9.9	-880	-4400
SR 08	5	432000	9.9	-2640	-4400
SR 09	5	432000	9.9	-4400	-4400
Nikkel (RRB)	3.3	285120	6.5	-3300	3300
Nikkerl Shop (RRB)	3.3	285120	6.5	1980	4620
Brimhall (RRB)	3.4	293760	6.7	3300	5940
KWB 03Q1	6.3	544320	12.5	-7260	-4620
KWB 03Q2	7.0	604800	13.9	-7260	-4950
KWB 03R	7.1	613440	14.1	-5940	-4620
KWB 10K	6.6	570240	13.1	-7260	-8580
KWB 11A	4.7	406080	9.3	-660	-5940
KWB 11C	5.3	457920	10.5	-3300	-5940
KWB 11E	5.4	466560	10.7	-4620	-7260
KWB 11L	3.7	319680	7.3	-3300	-8580
KWB 11N	3.7	319680	7.3	-4620	-9900
KWB 11Q	7.2	622080	14.3	-1980	-9900
KWB 12C	4.5	388800	8.9	1980	-5940

Note: KWB includes all 11 listed wells, each centered on their respective 40-acre designations.
Note: KWB well flow rates (Q, cfs) taken from KWBA production data; Jan - Apr, 2003, 4-mo avg flow rate.
Note: RRB irrigation wells centered on their 40-acre designations.
Note: SR well flow rates assumed to be 5 cfs, according to proposed project design specification.

Table 2. Strand Ranch Calculated Water Level Drawdown Summary.

3x3-mi Project Study Area centered on Sec 02, T30s, R25e.

9-well Scenario, Wells 1-9.
Average Drawdown per Section (ft).

12	20	12
20	43	20
12	20	12

9-well Scenario, Wells 1-9.
Range of Drawdowns per Section (ft).

5 to 28	9 to 36	5 to 28
9 to 36	29 to 55	9 to 36
5 to 28	9 to 36	5 to 28

7-well Scenario, Wells 1-7.
Average Drawdown per Section (ft).

9	21	10
14	34	17
8	13	9

7-well Scenario, Wells 1-7.
Range of Drawdowns per Section (ft).

3 to 23	8 to 31	3 to 24
8 to 29	17 to 45	8 to 30
7 to 18	7 to 25	3 to 23

5-well Scenario, Wells 13579.
Average Drawdown per Section (ft).

7	11	7
11	24	11
7	11	7

5-well Scenario, Wells 13579.
Range of Drawdowns per Section (ft).

2 to 16	6 to 19	2 to 16
6 to 19	17 to 30	6 to 19
2 to 16	6 to 19	2 to 16

Table 3. Strand Ranch Calculated Water Level Drawdowns at Selected Locations.

WELL GROUP:	9 wells	7 wells	5 wells-A	5 wells-B	4 wells
Well numbers:	SR 1-9	SR 1-7	SR 13579	SR 12345	SR 2468
see map =	F2	F3	F4	F5	B20
Total Drawdown at:	(ft)	(ft)	(ft)	(ft)	(ft)
well SR 01	-45	-40	-25	-30	-17
well SR 02	-50	-40	-22	-35	-25
well SR 03	-45	-40	-25	-35	-17
well SR 04	-50	-40	-22	-22	-25
well SR 05	-55	-45	-30	-35	-20
well SR 06	-50	-40	-22	-35	-25
well SR 07	-45	-35	-25	-16	-17
well SR 08	-50	-29	-22	-19	-25
well SR 09	-45	-24	-25	-18	-17
well Nikkel (RRB)	17	14	9	12	8
well Nikkel Shop (RRB)	9	8	5	7	4
well Brimhall (RRB)	7	6	3	4	2
well KWB 03Q1	-20	-14	-12	-11	-9
well KWB 03Q2	-19	-14	-11	-10	-9
well KWB 03R	-27	-18	-15	-14	-12
well KWB 10K	-12	-8	-7	-5	-5
well KWB 11A	-28	-20	-15	-12	-12
well KWB 11C	-30	-20	-16	-13	-15
well KWB 11E	-20	-13	-12	-9	-9
well KWB 11L	-16	-11	-8	-7	-8
well KWB 11N	-11	-7	-6	-5	-5
well KWB 11Q	-12	-8	-7	-5	-5
well KWB 12C	-17	-13	-10	-8	-8
NE cor study area (NE sec 36)	5	4	2	3	1
SE cor study area (SE sec 12)	5	3	2	2	1
SW cor study area (SW sec 10)	5	2	2	2	1
NW cor study area (NW sec 34)	5	3	2	3	1
Center, north side study area	10	8	6	7	4
Center, east side study area	10	8	6	7	4
Center, south side study area	10	5	6	4	4
Center, west side study area	10	7	6	5	4

Table 4. Strand Ranch Water Level Drawdown Sensitivity Analysis.

Table 4a. Base case Drawdowns with Variations in Aquifer Model.
(base case in **bold**.)

Aquifer Model =	**Semi-confined**	Confined	Unconfined
see Map =	**B0**	B11	B12 (only wells 13579)
Drawdown at:	**(ft)**	(ft)	(ft)
within the SR well field	**-40 to -55**	-85 to -100	-100 to -115
within the SR property (sec 02)	**-30 to -55**	-70 to -100	-87 to -115
within 1 mile of SR (adj. sections)	**-10 to -30**	-40 to -70	-65 to -87
beyond 1 mile from SR	**0 to -10**	0 to -40	0 to -65

Table 4b. Base case Drawdowns with Variations in degree of Confinement.
(base case in **bold**.)

confinement:	less	**base case**	more
Variation in confinement: B = ft	3200	**6000**	10000
see Map =	B1	**B0**	B2
Drawdown at:	(ft)	**(ft)**	(ft)
within the SR property (sec 02)	-15 to -35	**-30 to -55**	-45 to -70
within 1 mile of SR (adj. sections)	0 to -10	**-10 to -30**	-20 to -45
beyond 1 mile from SR	0	**0 to -10**	0 to -20

Table 4c. Base case Drawdowns with Variations in Aquifer Permeability.
(base case in **bold**.)

permeability:	more	more	**base case**	less	less
Variation in conductivity: K = ft/d	100	80	**57**	50	40
see Map =	B3	B4	**B0**	B5	B6
Drawdown at:	(ft)	(ft)	**(ft)**	(ft)	(ft)
within the SR property (sec 02)	-15 to -30	-20 to -40	**-30 to -55**	-35 to -60	-45 to -75
within 1 mile of SR (adj. sections)	-5 to -15	-7 to -20	**-10 to -30**	-12 to -35	-15 to -45
beyond 1 mile from SR	0 to -5	0 to -7	**0 to -10**	0 to -12	0 to -15

Table 4d. Base case Drawdowns with Variations in Pumping Duration.
(base case in **bold**.)

duration:	less	less	less	**base case**	more
Pumping Duration, t = days	10	30	100	**300**	1000
see Map =	B7	B8	B9	**B0**	B10
Drawdown at:	(ft)	(ft)	(ft)	**(ft)**	(ft)
within the SR property (sec 02)	-15 to -35	-25 to -50	-30 to -55	**-30 to -55**	-30 to -55
within 1 mile of SR (adj. sections)	-1 to -15	-5 to -25	-10 to -30	**-10 to -30**	-10 to -30
beyond 1 mile from SR	0 to -1	0 to -5	0 to -10	**0 to -10**	0 to -10

Table 5. Strand Ranch Calculated Water Level Mounding Summary.
3x3-mi Project Study Area centered on Sec 02, T30s, R25e.

Recharge 17,500 af in 194 days (IR=0.20)
Average WL Rise per Section (ft).

6	13	6
13	32	13
6	13	6

Recharge 17,500 af in 194 days (IR=0.20)
Range of WL Rise per Section (ft).

1 to 18	5 to 27	1 to 18
5 to 27	20 to 43	5 to 27
1 to 18	5 to 27	1 to 18

Recharge 17,500 af in 155 days (IR=0.25)
Average WL Rise per Section (ft).

6	13	6
13	36	13
6	13	6

Recharge 17,500 af in 155 days (IR=0.25)
Range of WL Rise per Section (ft).

1 to 21	4 to 30	1 to 21
4 to 30	22 to 48	4 to 30
1 to 21	4 to 30	1 to 21

Recharge 17,500 af in 129 days (IR=0.30)
Average WL Rise per Section (ft).

6	14	6
14	40	14
6	14	6

Recharge 17,500 af in 129 days (IR=0.30)
Range of WL Rise per Section (ft).

1 to 22	4 to 33	1 to 22
4 to 33	23 to 53	4 to 33
1 to 22	4 to 33	1 to 22

Table 6. Strand Ranch Calculated Water Level Mounding Rise at Selected Locations.

Recharge Case	base	alt 1	alt 2
recharge rate (ft/d) =	0.20	0.25	0.30
recharge duration (d) =	194	155	129
recharge volume (af) =	17489	17467	17444
Total Water Level Rise at:	(ft)	(ft)	(ft)
well SR 01	28	32	35
well SR 02	35	40	44
well SR 03	28	32	35
well SR 04	35	40	44
well SR 05	43	48	53
well SR 06	35	40	44
well SR 07	28	32	35
well SR 08	35	40	44
well SR 09	28	32	35
well Nikkel (RRB)	12	12	12
well Nikkel Shop (RRB)	3	3	3
well Brimhall (RRB)	2	2	2
well KWB 03Q1	13	14	14
well KWB 03Q2	13	13	13
well KWB 03R	19	21	22
well KWB 10K	6	6	6
well KWB 11A	18	20	22
well KWB 11C	27	30	33
well KWB 11E	13	14	14
well KWB 11L	9	10	10
well KWB 11N	6	6	6
well KWB 11Q	7	7	7
well KWB 12C	11	11	11
NE cor study area (NE sec 36)	1	1	1
SE cor study area (SE sec 12)	1	1	1
SW cor study area (SW sec 10)	1	1	1
NW cor study area (NW sec 34)	1	1	1
Center, north side study area	5	5	5
Center, east side study area	5	5	5
Center, south side study area	5	5	5
Center, west side study area	5	5	5

Table 7. Strand Ranch Calculated Net Water Level Impact Summary.
3x3-mi Project Study Area centered on Sec 02, T30s, R25e.

Recharge: 90 af/d x 194 d.
Recovery: 9-wells @ 90 af/d.
Avg Net Impact per Section (ft).

-6	-7	-6
-7	-11	-7
-6	-7	-6

Recharge: 90 af/d x 194 d.
Recovery: 7-wells @ 70 af/d (1-7).
Avg Net Impact per Section (ft).

-3	-8	-4
-1	2	-4
-2	0	-3

Recharge: 90 af/d x 194 d.
Recovery: 5-wells @ 50 af/d (13579).
Avg Net Impact per Section (ft).

-1	3	-1
3	16	3
-1	3	-1

Table 8. Strand Ranch Calculated Net Water Level Impact at Selected Locations.

Recharge Case	base	base	base	= 194 d @ 90 af/d.
Recovery Case	9-well	7-well	5-well	= #wells @10 af/d/w.
Nominal Rcharge/Recovery Volume	17500	17500	17500 af	
Net Water Level Impact at:	(ft)	(ft)	(ft)	
well SR 01	-17	-12	3	
well SR 02	-15	-5	13	
well SR 03	-17	-12	3	
well SR 04	-15	-5	13	
well SR 05	-12	-2	13	
well SR 06	-15	-5	13	
well SR 07	-17	-7	3	
well SR 08	-15	6	13	
well SR 09	-17	4	3	
well Nikkel (RRB)	29	26	21	
well Nikkel Shop (RRB)	12	11	8	
well Brimhall (RRB)	9	8	5	
well KWB 03Q1	-7	-1	1	
well KWB 03Q2	-6	-1	2	
well KWB 03R	-8	1	4	
well KWB 10K	-6	-2	-1	
well KWB 11A	-10	-2	3	
well KWB 11C	-3	7	11	
well KWB 11E	-7	0	1	
well KWB 11L	-7	-2	1	
well KWB 11N	-5	-1	0	
well KWB 11Q	-5	-1	0	
well KWB 12C	-6	-2	1	
NE cor study area (NE sec 36)	6	5	3	
SE cor study area (SE sec 12)	6	4	3	
SW cor study area (SW sec 10)	6	3	3	
NW cor study area (NW sec 34)	6	4	3	
Center, north side study area	15	13	11	
Center, east side study area	15	13	11	
Center, south side study area	15	10	11	
Center, west side study area	15	12	11	

Table 9. Strand Ranch Maximum Water Level Mounding Summary.
3x3-mi Project Study Area centered on Sec 02, T30s, R25e.

Recharge 32,850 af in 365 days (IR=0.20)
Average WL Rise per Section (ft).

12	19	11
19	39	19
11	19	12

Extra Recharge = 15,350 af.
Extra Rise from 194 to 365 days (IR=0.20)
Average WL Rise per Section = 5 - 6 ft.

6 to 12	13 to 19	6 to 11
13 to 19	32 to 39	13 to 19
6 to 11	13 to 19	6 to 12

Recharge 49,275 af in 365 days (IR=0.30)
Average WL Rise per Section (ft).

18	28	18
28	58	28
18	28	18

Extra Recharge = 31,775 af.
Extra Rise from 129 to 365 days (IR=0.30)
Average WL Rise per Section = 12 - 14 ft.

6 to 18	14 to 28	6 to 18
14 to 28	40 to 58	14 to 28
6 to 18	14 to 28	6 to 18

Recharge 65,700 af in 365 days (IR=0.40)
Average WL Rise per Section (ft).

23	36	23
36	76	36
23	36	23

Extra Recharge = 48,200 af.
Extra Rise from 97 to 365 days (IR=0.40)
Average WL Rise per Section = 16 - 20 ft.

7 to 23	16 to 36	7 to 23
16 to 36	40 to 76	16 to 36
7 to 23	16 to 36	7 to 23

Table 10. Strand Ranch Maximum Water Level Mounding Rise at Selected Locations.

365-day Recharge Case	IR = 0.20	IR = 0.30	IR = 0.40
pond acreage (ac) =	450	450	450
recharge rate (ft/d) =	0.20	0.30	0.40
recharge duration (d) =	365	365	365
recharge volume (af) =	32850	49275	65700
Total Water Level Rise at:	(ft)	(ft)	(ft)
well SR 01	36	54	70
well SR 02	42	62	82
well SR 03	36	54	70
well SR 04	42	62	82
well SR 05	48	71	93
well SR 06	42	62	82
well SR 07	36	54	70
well SR 08	42	62	82
well SR 09	36	54	70
well Nikkel (RRB)	19	27	36
well Nikkel Shop (RRB)	7	10	13
well Brimhall (RRB)	6	9	12
well KWB 03Q1	19	29	38
well KWB 03Q2	18	28	37
well KWB 03R	26	39	52
well KWB 10K	11	17	22
well KWB 11A	26	38	50
well KWB 11C	34	50	66
well KWB 11E	19	29	38
well KWB 11L	16	23	31
well KWB 11N	11	17	22
well KWB 11Q	12	18	23
well KWB 12C	17	19	26
NE cor study area (NE sec 36)	4	6	9
SE cor study area (SE sec 12)	4	6	9
SW cor study area (SW sec 10)	4	6	9
NW cor study area (NW sec 34)	4	6	9
Center, north side study area	10	15	20
Center, east side study area	10	15	20
Center, south side study area	10	15	20
Center, west side study area	10	15	20

Exhibits.

Exhibit 1.

Mathematical Aquifer Models.

Exhibit 1.
Mathematical Aquifer Models.

Aquifer behavior.

An aquifer is a porous medium consisting of one or more layers of rock or sediment which can store and transmit water in useful quantities. In the simplest terms, ground water aquifers function in two ways: an aquifer functions as a reservoir to store water and an aquifer functions as a pathway for ground water flow. Changes in aquifer storage or aquifer flow are caused by either gains or losses of water from the aquifer due to any of several natural or manmade actions. These changes are always manifested as changes in the elevation, orientation, and/or gradient of the potentiometric surface (i.e, water levels) in the aquifer.

In the case of aquifer storage, hydrologists evaluate ground water storage with a map of the water level elevation which basically represents how "full" the aquifer is at any particular location and time. If a hydrologist wants to determine the hypothetical impacts of gaining or losing water from the aquifer due to, for example, recharge ponds or pumping wells, then the impacts would be represented by changes in the configuration of the water table as presented in one or more maps or cross sections. All estimates of the change in aquifer storage use the area-weighted vertical changes in this water surface to calculate the volumetric change in storage.

In the case of aquifer flow, hydrologists evaluate ground water flow in the aquifer by determining the flow paths (which we call particle trajectories) and flow rates (particle velocities) that describe the movement of water molecules in the aquifer. If a hydrologist wants to determine the hypothetical impacts of changing the aquifer dynamics due to, for example, recharge ponds or pumping wells, then the impacts would be represented by changes in the lengths and directions of the flow paths as presented in one or more maps or cross sections.

Computer Modeling.

Hydrologists use mathematical aquifer models (sets of equations including sets of conditions and parameters) to calculate the hypothetical water level elevation maps and the ground water flow velocities and flow path maps which are predicted to result from the aquifer dynamics related to recharge ponds, pumping wells, streams, springs, and/or any other natural inflow/outflow or manmade action of interest. Since many aquifers and types of aquifer dynamics have been thoroughly studied and modeled, many computer models exist which can be used to model many classes of aquifer behaviors. Many such aquifer behaviors may be easily, quickly, and reliably studied with the right choices of model and parameters.

Modeling is an exercise in cause-and-effect. In modeling, we consider the natural or manmade flows of water into and out of an aquifer to be "causes" and the resulting water level behaviors observable in the aquifer to be "effects". Causes are the inputs to a model and the effects are the intended output of the model. The model itself is our mathematical representation of the real aquifer and we will consider a model to be a good model if a set of model inputs and outputs satisfactorily resembles a set of known cause-and-effect flows and water level behaviors actually observed in the aquifer.

Water Level Drawdown Analysis.

Let us consider the special case of potential water table drawdown and inward radial flow of ground water due to installing and then pumping a new water well. Hydrologists often refer to this type of evaluation as a drawdown analysis or impact analysis. Our desired output is a map which shows the hypothetical water table drawdown and ground water flow paths within the capture zone surrounding one or more wells. We can calculate a predicted aquifer behavior for one or as many wells as we are interested in, since the mathematics of modeling provides for an unlimited number of causes and effects, depending only on computer memory and processing speed.

There are many computation methods for predicting drawdown from a pumping well in space and time and every method requires that the user select the equations which are most appropriate for the user's preferred model of the aquifer. In essence, the user must try to select the set of mathematical expressions which best represents the user's physical model of the aquifer. The hydrologist's physical model of the aquifer includes knowledge of the geology and hydrology including the layering, structure, depths, dimensions and physical properties of the aquifer as well as the locations and flow rates of all sources of inflow and outflow to the aquifer such as wells, streams, ponds, etc.

The calculated result, if done correctly, always represents the workings of the mathematical equations but only represents the behavior of the real aquifer to the extent that the parameters, simplifications and assumptions of the mathematical model reflect the true workings of nature. The selection of the mathematical model, the equations, the accuracy of the parameter values, and the representativeness of the calculated output all reflect the experience, expertise, correctness of- and uncertainty in- the judgments of the hydrologist. These judgments cannot be made by the computer and the two main judgments include the choice of mathematical model and the choice of a set of aquifer parameters.

There is no such thing as a simple calculation. A good impact analysis rests at least as much on a hydrologist's competence in understanding equations, validity tests, boundary conditions, and model parameterization as it does on the determination of aquifer properties. In our opinion, many hydrologists and engineers who use mathematical models to compute aquifer impacts would benefit from a better background and understanding of the proper use and pitfalls of such models because, from experience, we have observed the results of many aquifer modeling efforts which are unusable because they demonstrably fall into one or more of the obvious and avoidable pitfalls of the method.

Analytical Models.

For any scope of work, there are two basic choices of mathematical model. The first choice is to select a "canned" analytical computer model which best approximates the interpreted aquifer conditions and then supply the user's best estimates of the required aquifer parameter values. The great advantage to this alternative is that the models are fast, convergent, easy to customize and operate, and the models result in a *unique* set of solutions because the degrees of freedom in the model are the same as the number of available parameters. SSS selected an analytical model since it was very well suited to the aquifer characteristics for this particular project scope of work.

The general disadvantage of an analytic computer model is that the mathematical model may not represent all of the known or suspected complexities of the real aquifer and the user must evaluate the relevance and magnitude of the possible errors in the results due to the simplifications in the mathematical model. The analytical models which are frequently used today include the familiar equations attributed to Theis, Cooper - Jacob, Hantush, Hantush - Jacob, Neuman, Strack, etc., for all of the useful recharge and recovery interactions (wells, ponds, rivers, surface recharge, etc) for transient and steady- state conditions in unconfined, confined, and leaky aquifers. Analytical models are particularly well-suited to the prediction and simulation of water levels and flow trajectories related to recharge mounds and water level depressions due to the operations of aquifer storage and recovery (ASR) projects.

Numerical Models.

The second choice, which SSS did not choose for this project, is to design and program a numerical computer model which best approximates the interpreted aquifer conditions in all its 3-dimensional detail and then supply the user's best estimates of the required aquifer parameter values. The only advantage to this alternative is that the model may be designed to any degree of complexity in order to approximate the true aquifer structure and dynamic inflow/outflow elements.

The disadvantages of numerical modeling are numerous and punishing. The models are tedious and difficult to build and verify; the models require an impossibly vast knowledge of the aquifer properties because the user must define the value of every aquifer parameter at every depth at every location; the hundreds or thousands of degrees of freedom always outnumber the amount of real data which causes non-uniqueness[8] and equivalence[9] in the model outputs; and there is a significant likelihood that numerical complexity does nothing to improve the quality or accuracy of the output of the calculation compared to analytical models while giving a false sense of precision in the effort.

One of the most popular numerical models is actually a number of programs which are all referred to by the name *Modflow* (a trademark of the United States Geological Survey), which are based on a publicly- available computer code developed by the U.S.G.S. and commercialized in several proprietary forms by different scientific software companies. Sierra Scientific Services owns a complete set of Modflow simulators for groundwater flow, contaminant transport modeling, and parameter estimation but SSS favored the analytic model to be better suited to this particular project scope of work.

Model Calibration.

Modeling is commonly thought of as specifying a set of inflows and/or outflows to a parameterized aquifer model and then calculating the predicted water level fluctuations which are expected at various locations over time. The locations, magnitudes, and durations of the calculated water levels depend on the choices of the numerical values of the various aquifer

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[8] Uniqueness is a computational condition in which a given set of inputs can result in only a single, fully determined output. Non-uniqueness is a computational condition in which a given set of inputs can result in two or more different, fully- determined possible outputs.

[9] Equivalence is a computational condition in which two or more different set of inputs can result in exactly the same, fully determined output.

properties that govern such behavior. Calibration is commonly thought of as tweaking the model parameters until the predicted water levels match the actual, observed water levels for the case being simulated.

The study of the movement of water through permeable aquifers is referred to as ground water hydraulics and *"the principle method of analysis in ground water hydraulics is the application ... of equations derived for particular ... conditions."*[10] *"The flow of fluids through porous media ... can be described by differential equations."*[11] *"These mathematical ideas are among the most abstract that we will encounter in hydrogeology."*[12] Groundwater modeling, therefore, is a process which requires expertise in mathematics as well as expertise in hydrogeology.

The use of computers and computer models has vastly revolutionized groundwater hydraulics by speeding up calculations, by improving computational accuracy, and providing for models that would have been impossibly complex to calculate by non-computer methods. This level of automation has *not* reduced the need for human judgment; rather, it has *increased* the need for operator education and expertise to correctly match the computational systems to the real-earth counterparts. The fact that nearly every model run by nearly every consultant still needs to be "calibrated" suggests that the models and/or the operators have not yet succeeded in correctly matching the computational systems to the real-earth counterparts.

"Model calibration" is a popular catch phrase which implies that there exists some special method of post-processing which can be used to independently verify, improve, or optimize the computational results of a modeling effort after a computer model has been "run". Let us consider what workers commonly mean by calibration.

Groundwater modeling is an exercise in simulating the connection between cause-and-effect in a natural aquifer system. For example, we know that pumping a water well causes water levels in an aquifer to decline. We can select one of many available commercial computer models and "parameterize" it to represent the aquifer of interest. If we use this

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[10] Lohman, S.W., 1972, Ground-water Hydraulics, USGS Professional Paper 708, Washington, D.C., p. 1.

[11] Fetter, C.W., 1994, Applied Hydrogeology, 3rd Ed., Prentice-Hall, p. 146.

[12] Domenico, Patrick, A., and Schwartz, F. W., 1990, Physical and Chemical Hydrogeology, John Wiley & Sons, p. 104.

computer model to predict the water level declines for a certain water well and then measure the actual water level behavior for that well under the same conditions, and if the predicted and actual water level behaviors are the same to within some acceptably small margin of error, then we might say that the model is correctly parameterized.

If the predicted and actual water level behaviors do not agree, then we assume that one or more of the model parameters may be incorrect. The process of calibration serves to adjust the model parameterization and we "calibrate" the model by changing selected parameter values until the predicted and actual behaviors agree for a specified calibration event. We then say that the model has been calibrated and we are thereby implying that the model now is an accurate representation of the aquifer. We are also implying that if we model and then observe a different set of cause-and-effect conditions, then the new set of predicted and observed results would agree since the model had been correctly parameterized through the process of calibration. We are further implying that, if we choose to model another set of cause-and-effect conditions which we are unable to verify by direct experiment or observation, we can place high confidence in the accuracy of the calculated results since the model has been calibrated. The real importance is not whether a model has been "calibrated" but whether some set of measures has been used to support an acceptable level of confidence in the accuracy of the predicted results.

In this study we used a computer model to calculate the hypothetical water level declines under the area of interest that would accompany a proposed project water well pumping scenario involving multiple operating wells. We cannot calibrate our computer model at this time with predicted and actual drawdowns because the well field doesn't actually exist so we have no actual cause-and-effect scenario.

Instead, we have used another set of measures to support an acceptable level of confidence in the accuracy of the predicted results. The actual area of interest is small enough that, based on experience and theoretical considerations, we expect each aquifer parameter to be constant across the entire "model space". Therefore, by eliminating spatial heterogeneity as a model factor, we have reduced the potential uncertainties to just a few degrees of freedom. Those degrees of freedom are the few aquifer parameter values which we need to perform our water level calculations.

We put a large effort into determining good values for the required aquifer parameters. We only have one aquifer parameter value which was measured within the actual area of interest but we can assign each of the other parameters to its own limited range of possible values based on our study of reported parameter data from similar geology in the surrounding area. We selected a single set of parameter values from these ranges of values to be used as a base case scenario and we analyzed the sensitivity of the calculated water level drawdowns to variations in each of the parameters. Since we conclude that it is very unlikely that any actual parameter value lies outside its specified range of possible values, we can calculate a limited range of possible water level drawdowns such that the true, but unobserved, drawdowns will most likely be within that range.

For the purpose of this study, we are primarily interested in whether or not the predicted water level drawdowns will be acceptable or mitigate-able according to some set of criteria. It may not be so important to accurately know the exact water level drawdowns if we can determine that the entire range of calculated water level impacts are acceptable by the relevant criteria.

Exhibit 2.

Aquifer Parameters and Parameter Values.

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Aquifer Parameters and Parameter Values.

The aquifer parameters of interest for mathematical modeling include those *intrinsic* physical properties of the porous media which determine the volume- specific storage and unit flow properties of the aquifer. These intrinsic properties are then combined with the physical dimensions (depths, thicknesses, boundaries, inflows, outflows, and gradients) of the aquifer media to determine the full- aquifer behavior. The storage properties include the specific storage (S_s) and specific yield (S_y) of each of the porous media. The required flow properties include the hydraulic conductivity (K), porosity (φ), and dispersivity (α) of each of the porous media. The hydraulic conductivity is required for volumetric flux and flow rate in directions of interest (K_h for horizontal flow and K_v for vertical flow), the porosity is required for particle tracking, and dispersivity (both longitudinal α_L and transverse α_T) is required for contaminant transport.

These properties are normally determined either by physical properties measurements on actual rock or sediment samples or by special types of pumping tests on water wells which have been completed across the thickness of the aquifer. Some of these properties vary by several orders of magnitude for common aquifer rock- and sediment- types, so for aquifer materials which have not been measured or tested, there is little likelihood that a best- guess "textbook" value which is based on rock type or another index property will be very close to the actual value. We recommend that the careful determination of the relevant physical properties be an essential and early part of any groundwater program.

It is important to emphasize that the values of these physical properties are all constants for each of the respective aquifer media and that they do not vary with changes in either the water table, or in the pump rate or completion interval of a well, or with any other observed variable, apart from the natural variability of the property within the porous medium itself. It is good practice to measure these properties as many times as possible to determine the average value and range of natural variability for each. And since hydrologists recognize that the natural variability of these parameters may be large, it is best to obtain measured values which are representative of the aquifer under the entire area of interest for which impact analyses are desired, and measured in ways which minimize the unassociated variance in the determination. It is also important to emphasize that few of these properties can be determined directly from well tests and must instead be derived indirectly from well test data by also using other information. The ability to do this is governed by cost, access to wells, and the expertise of the hydrologist to perform the right test and to make the necessary corrections for factors and interferences which otherwise cause errors in the values.

Aquifer storage properties.

Water is stored in an aquifer by occupying the intergranular void spaces of the porous aquifer material. The physical amount of water which can be stored in and recovered from a porous medium is the sum of two components; the fillable void space remaining in a rock or sediment which is at residual saturation, and a very much smaller component which is a result of the minute elastic dilation of this void space when the water in the aquifer is under pressure combined with the slight compression of the water itself.

When water is released or recovered from an aquifer, the first water recovered is always that which is released due to the elastic rebound of the pore space and the water. The last water recovered is always that which drains from the pore space and dewaters the aquifer. When water is stored in the aquifer, the reverse actions occur, i.e., water first fills the void spaces and then dilates the void space as the fluid pressure increases.

<u>Specific yield.</u> The first component is termed the *specific yield* (S_y) and is the amount of water produced by "de-watering" the aquifer void space as the water table falls within the aquifer. This term effectively determines the amount of water which is gained or lost under the project area or some specific area due to the rising or falling water table. The values for well sorted sandy sediments[13], such as in the area of interest may range from $0.10 \leq S_y \leq 0.35$. The formula for calculating the volume of water released by dewatering is $V_w = A \cdot S_y \cdot$_h for a drop in water table of _h. The aquifer thickness is not a term in this calculation.

[13] Fetter, C. W.. 1994. Applied Hydrogeology. 3rd ed., Prentice - Hall, Inc.. Table 4.4. p.91.

Specific storage and Storativity. The second component is termed the *specific storage (S_s)* and is the much smaller amount of water produced by contraction of the dilated pore space and expansion of the water as the pressure drops within the aquifer. The values for loose- to well-packed silty or sandy sediments[14], such as in the area of interest may range from $0.00017 \leq S_s \leq 0.0032$ ft^{-1}. This property is related to the in situ bulk compressibility of the aquifer media and the water itself. The compressibility of water is known and we can measure the compressibility of sediment samples, as SSS has done for RRBWSD on another project.

The formula for calculating the volume of water released from the aquifer by de-pressuring is $V_w = A \cdot H \cdot S_s \cdot$ _h for a drop in head of _h in an aquifer of thickness H. The product of aquifer thickness and specific storage in this equation is defined as *storativity*, $S = H \cdot S_s$, and it is obvious that if the thickness of an aquifer changes, then the value of S will change, even though the intrinsic property of the porous medium, i.e., the specific storage, remains constant. It should also be noted that if only a portion of the full thickness of an aquifer is relevant to a particular problem, then the appropriate value of S to be used in any calculation is the value for the interval of interest.

The specific storage term is also an essential term in the flow equations which describe transient, i.e. non steady- state, aquifer flow. The ratio of hydraulic conductivity to specific storage is defined as the hydraulic diffusivity and this ratio explicitly occurs in all non steady-state equations of flow. Therefore, while it is tempting to dismiss the need for an accurate value of S_s because it is negligible for the calculation of aquifer storage, it is important to obtain as good a value as is possible because it occurs directly in the flow equations along with conductivity. For example, the 20-fold difference between low and high values of S_s will make only a negligible difference in the calculated storage capacity of the aquifer, but will significantly alter the calculated results of the flow equations.

Available storage capacity (SC). The available storage capacity, which is not relevant to this particular scope of work, is defined as the volume of water that could be stored in the unsaturated zone above the water table within the boundaries of the project area up to within a few feet of the ground surface. This working definition is usually used to calculate a change in aquifer storage due to a rise or fall of the water table over some time period, and is not an important or even relevant part of many types of aquifer modeling. In practice, the specific

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[14] Domenico, P.A. and Schwatrz, F.W., 1990. Physical and Chemical Hydrogeology. John Wiley, Inc. Table 4.1, p.111.

storage (S_s) is negligible compared to the specific yield (S_y) ($0.0005 < S_s/S_y < 0.00005$) so, unless an aquifer is very thick, we do not consider the specific storage in the calculation of storage capacity and just use the specific yield formula.

Layered- aquifer storage properties. For aquifers which are either heterogeneous or layered, we must determine the storage properties of each type of sediment within the aquifer and the proportions of each, and perhaps even the sequence in which they are successively filled and/or dewatered. For a layered aquifer, the volumetric storage capacity under an area (A) is defined as being equal to the volumetric integral: $SC = \int^A \int \varphi(1 - S_r)dAdh$, which simplifies to a summation which looks like: $SC = A\Sigma(h_i \cdot Sy_i)$, that is, the total Project area times the sum of products of the individual layer thicknesses and specific yields which, finally, is often more-conventionally written as: $SC = A \cdot H \cdot Sy_{eq}$, the product of total Project area area times total aquifer thickness times the "average" or equivalent specific yield. We must always remember that the correct values for determining an actual change in storage must be those values of $h_i \cdot Sy_i$ which represent the actual interval being filled or dewatered, and not the "full- aquifer" average value. Any modeling effort which simplifies the aquifer stratigraphy by reducing the number of layers must address the issue of determining the equivalent parameters of each layer model relative to the actual parameters of the actual stratigraphy.

The same additive property is true of storativity (S) for a sequence of layers in an aquifer. The value of storativity is a summation which looks like: $S = \Sigma(h_i \cdot Ss_i) = \Sigma(S_i)$, that is, the storativity of any depth interval is the sum of the individual- layer storativities for all layers within the interval. This additive property is important to consider when interpreting well tests which are not completed across the full layered- aquifer thickness.

Aquifer flow properties.

Water flows down-gradient in an aquifer from higher to lower potential. Groundwater flow may be horizontal or vertical or have components of both. The externally applied forces which cause water to move come primarily from gravity and secondarily from manmade actions. In other words, left to itself, the groundwater in aquifers and in basins "seeks its own level" and always prefers the path of least resistance. Water will stop moving when there is no change in potential along a pathway. Otherwise, water is moving in one of two type of conditions, either steady- state flow or transient flow. In steady state flow, water passing any location continues to flow in the same direction at the same flow rate and at the same head without any change over time. In transient flow, water passing any location will not be steady in direction, flow rate, or head because of dis-equilibrium somewhere in the system. Transient flow may be non-Darcy flow and this is the condition of the aquifer in the project area most of the time.

The persistent re-equilibration of a groundwater system toward a no-flow condition takes time. Often the cycle of recharge to- and recovery of- water from the system is faster than the ability of the groundwater system to either re-balance or even achieve a steady- state. As in most cases, the groundwater system is always dynamic and in a transient state, even if it appears to respond slowly and steadily by human perception.

The groundwater flow behaviors of interest include flow direction and flow rate. Flow direction may be visualized as an arrow pointing in the down- direction of the potential gradient, since water moves in the direction of the applied force. Flow direction may also be visualized as a hypothetical flowline that a single water molecule would follow under steady-state. A contour map of the water table or piezometric surface is a map of the groundwater potential in the aquifer, and the direction of flow at any location will be perpendicular to the contours and pointing in the direction of lower potential.

Flow rate can be described as the average flow speed of a water molecule at a specified place and time or as the "instantaneous" volumetric flux of a volume of water through a specified cross sectional area (W·H) of the aquifer over a short period of time. Apart from the externally applied driving forces and the physical dimensions of the aquifer, these measures of ground water flow depend only on the hydraulic conductivity and porosity of the porous medium.

Hydraulic conductivity. The *hydraulic conductivity (K)* is a measure of the ease with which *water* flows through an aquifer. In general, the natural flow of a fluid through a porous medium depends on the density (ρ) and viscosity (μ) of the fluid, the intrinsic *permeability (k)* of the porous medium, and the driving force of gravity (g) which causes fluid to move. Since the value of gravity and the values of density and viscosity of water are nearly constant for the usual range of aquifer conditions, the only variable property which controls the fluid flow in an aquifer is the permeability. So, for mathematical convenience hydrologists have combined the value of gravity, the properties of water, and the measure of aquifer permeability into a single, new property which is defined as the hydraulic conductivity, where $K = k(\rho g)/\mu$. The units of this "aquifer" property are length per time, i.e., units of velocity such as ft/day.

This term effectively determines the flow rate or volumetric flux of water through the aquifer under whatever potential gradient exists at the time and place of interest. The K values for silty and sandy sediments, such as occur in the area of interest may range from $0.001 \leq K \leq 300$ ft/d, a range covering more than five orders of magnitude. The formula for calculating the steady- state volumetric flux of water (Q_w) in an aquifer is $Q_w = W \cdot H \cdot K \cdot G$ for a groundwater potential gradient G = _h/_x, through an aquifer cross sectional area of width W and thickness H. If the aquifer is not in steady- state, then the calculation represents only the "instantaneous" flow at that moment at that location under those conditions and the full equation of flow must instead be used to describe the transient flow behavior over time.

The steady- state flux equation applies to both horizontal and vertical groundwater flow with the condition that the values of K and G are the values of hydraulic conductivity and gradient in the direction of flow. Most aquifer materials, whether unconsolidated sediments or sedimentary rocks, are anisotropic and are commonly 5 - 20 times more permeable in flow directions parallel to the bedding planes than in flow directions perpendicular to the bedding planes. Thus, in order to quantify or model aquifer flow with both horizontal and vertical components, it is necessary to specify both the horizontal and vertical hydraulic conductivities of relevant aquifer materials.

Transmissivity. A term representing hydraulic conductivity occurs in all groundwater flow equations. This term also occurs in the solutions to many flow problems as the product of conductivity (K) times aquifer thickness (h) which we define as transmissivity, $T = Kh$. The significance to the hydrologist is that an aquifer pump test often results in providing a value for the thickness-conductivity product Kh, which we've defined as transmissivity T, but the aquifer test does not provide a means of separately determining the values of K or h alone. We normally measure the aquifer thickness (h) directly in a well, on an outcrop, or from geophysical data, and then obtain a calculated value of $K = T/h$ from the independently measured values of T and h.

We point out that aquifer transmissivity is not an intrinsic property of an aquifer or aquifer material since its value depends on the saturated vertical thickness of the aquifer, i.e., transmissivity will vary from place to place as the saturated aquifer thickness varies, even where the intrinsic permeability of the aquifer remains constant. We strongly prefer and recommend that it is better to specify the aquifer properties of K and h separately rather than specifying only a value of transmissivity.

Leakance. The *leakance (L')* is a property which determines the rate of downward vertical flow of water from a water table aquifer, through a somewhat-permeable aquitard, and into an underlying semi-confined aquifer due to head differences across the aquitard. Such head differences are common in many aquifer systems. The value of L′ is determined as the ratio of vertical hydraulic conductivity to the thickness of the aquitard, $L' = K_v'/h'$. (The prime (′) in the abbreviations symbolize that these are properties of the *aquitard* and not of the underlying aquifer). We refer to aquifers which show this type of recharge behavior as semi-confined or "leaky" aquifers and one flow equation which describes this type of flow behavior is the Hantush - Jacob equation, named after its authors.

The mathematics of leakage occurs in the flow equation in the form of what is referred to as the Hantush leakage factor (B) and B is related to known parameter values according to the formula $B = (T/L')^{1/2}$. In the project area, the high- permeability zones of the aquifer are sandy sediments and the low-permeability zones are silty sediments. These silty sediments are the aquitards which retard the vertical flow of water between the sandy layers of the aquifer. Based on our measurements and estimates of the relevant properties, we estimate that the value of B varies in the range of about $3200 \leq B \leq 10000$ and we have used a value of B = 6000 as our base case value.

Porosity. The *porosity* (φ) is the dimensionless ratio specifying the fraction of void space to total space in a unit volume of a porous medium. As a flow property, it determines the amount of intergranular flowpath within the porous medium that is available to the water. The formula for calculating the steady- state flow velocity of water (v_w) in an aquifer is $v_w = K \cdot G/\varphi$. If the aquifer is not in steady- state, then the calculation represents only the "instantaneous" flow speed at that moment at that location under those conditions and the full equation of flow must instead be used to describe the transient flow behavior over time. Well-sorted, unconsolidated,

sands and silts commonly have porosities ranging from 10 - 30%. Porosity decreases as the degree of sorting decreases, i.e., as the range of grain sizes increases in the stratum.
Layered- aquifer flow properties. For aquifers which are either heterogeneous or layered, we must determine the hydraulic conductivity and porosity of each type of sediment within the aquifer and the proportions of each. For a layered aquifer, the total average horizontal hydraulic conductivity of the full saturated aquifer thickness is defined as being equal to a summation which looks like: $K_{avg} = \Sigma(h_i \cdot K_i)/H$, that is, the sum of products of the individual layer thicknesses and hydraulic conductivities divided by the total aquifer thickness. Since the product of thickness and conductivity in this equation is defined as transmissivity (T), this is often more-conventionally written as: $T_{eq} = H \cdot K_{avg} = \Sigma(h_i \cdot K_i) = \Sigma(T_i)$, i.e., the equivalent aquifer transmissivity is the sum of the individual layer transmissivities.

The average conductivity and equivalent aquifer transmissivity refer to a hypothetical, homogenous aquifer which would deliver the same total volumetric flux as the specified layered aquifer. However, it must be remembered that the true flow behavior and volumetric fluxes are different in the individual layers of the actual aquifer than in the hypothetical equivalent- layer model and that the average or equivalent properties represent a mathematical fiction which is usable only in certain specific ways.

Aquifer Transport properties.

Transport in this context refers to the motion of constituents which are dissolved and/or suspended in ground water, especially the movement of unregulated contaminant releases which propagate as slugs or plumes within the aquifer. The important transport processes are advection, dispersion, retardation, and attenuation which might be defined as follows. Advection is the physical transport of a constituent by the flow of water within a porous medium. Retardation includes all processes which cause a plume or constituents to move slower than the ground water. Dispersion includes all processes which re-distribute constituents away, i.e., spreads them out, from the center of mass of a plume. Attenuation includes all processes which permanently remove constituent mass from a ground water plume.

These processes affect contaminant transport and plume behavior in specific ways. Mathematically, they may all be represented by terms in the transport equation which describes the location, speed, amount and distribution of contamination within a plume in space and time. Advection refers to groundwater flow which we have already discussed. Both retardation and attenuation may be thought of as properties related to the type of constituent rather than as properties of the aquifer. Dispersion is related to dispersivity which is strictly an aquifer property which can be measured with special types of well test or estimated from theoretical considerations. Since the treatment of transport is outside this project scope of work, we omit the discussion of these processes from this report. However, it is important to note that most contaminants travel at different flow speeds and different particle trajectories than the ground water and must be modeled in different ways.

Sources of data.

Sierra Scientific Services (SSS) used four sources of information for the aquifer properties within the area of interest (AOI) including:

1. SSS physical property data (S_y, S_s, φ, K, H, F_{sd}) measured on surface and borehole samples or determined from electric logs from locations within the Rosedale - rio Bravo Water Storage District,
2. ID4 December, 2001, well test data (T & S) from wells near the intersection of Stockdale Hwy and Allen Rd at the northeast end of the Kern Fan,
3. C.o.B. infiltration test data (Kv) for large test ponds also near the intersection of Stockdale Hwy and Allen Rd at the northeast end of the Kern Fan,
4. KCWA water table elevation maps covering the Kern Fan area of interest.

SSS carefully reviewed and chose not to use the data from two other sources including:

5. DWR aquifer model data (Sy, S, K & T) for the Kern Fan area,
6. KWBA and Pioneer Project pump test data from various reports by Kenneth Schmidt and Associates (KDSA) of Fresno, Ca.

SSS did not use the data from these two sources for several reasons, chief among them is that we obtained a minimum but sufficient amount of well- documented, actual measurements for the necessary parameters of interest from the first four sources. However, with all due respect, we also consider the data from both of these other two sources to be questionable because of a lack of data, poor documentation, questionable or incorrect calculation methodologies, lack of corroboration, supporting discussions which are inconsistent with basic principles of hydrology, and/or internal inconsistencies. We recommend that readers carefully evaluate the data from these sources against their own technical and theoretical criteria before they use them in their own analyses. We offer some of our observations regarding the data from these two sources below, for purposes of clarification since we consider the selection (or rejection) of parameter values to be an important, documentable, exercise of judgment in a modeling program.

The DWR parameter data[15]. In 1988, the California Department of Water Resources (DWR) purchased approximately 20,000 acres of land in Kern County for an aquifer storage and recovery (ASR) program. The area has since changed ownership and is now known as the Kern Water Bank. In the early 1990's, the DWR attempted to develop a numerical computer model to simulate the aquifer behavior and evaluate various aspects of their project. The modeling effort concluded in early 1996 with the publication of the footnoted DWR memorandum which summarized the work. The memorandum included a discussion and summary of all the aquifer parameter values that the DWR used, and these parameter values have been referenced and used by some workers in the local water community.

In the process of parameterizing their computer model of the Kern Fan area, the DWR never actually measured a single value of any parameter in preparation for what became a massive modeling effort. The DWR assigned "textbook" values of specific yield obtained from the general literature (but not specific to the study area) to each of 55 different types of drill cuttings reported in driller's reports. Then, after blundering through a simplistic and erroneous application of trend analysis in which they assigned book values of K_h, K_v and S to these same drill cuttings and then numerically correlated to the assigned textbook values of specific yield, they proceeded to put these values into their computer model.

For example, the DWR assigned values of Sy ranging from 12 - 27% to drill cuttings described as water gravel, dry gravel, heavy gravel, heaving gravel, hard gravel, dead gravel, and cemented gravel. The DWR assigned values of Sy ranging from 12 - 20% to drill cuttings described as hard sand, heaving sand, dirty pack sand, tight sand, and quick sand. The DWR assigned values of Sy ranging from 3 - 6% to drill cuttings described as sediment, soil, loam, hard clay, cemented clay, adobe, and muck.

The DWR then used driller's logs and electric logs to basically assign all of the Kern County geology to one of the 3 previously-described sediment groupings, i.e., gravel, sand, or

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[15] Swartz, Robert, 1995, Development and Calibration of the Kern Fan Ground Water Model, DWR San Joaquin District Report, July, 1995.

silt/clay and then proceeded to apply their fabricated numerical parameter values to their geological model.

Apart from the aquifer parameter values, the DWR approach to developing the basic computer model appears to be consistent with many of their model simplifications which were required in order to approximate the true physical aquifer behaviors within the constraints of the model. However, in our opinion, their treatment of aquifer parameters shows poor judgment perhaps stemming from an insufficient understanding of the physical properties and property interrelationships of porous media and geological materials and, in our opinion, their poor parameterization showed up in their modeling as poor results.

DWR reported that the model calibration results were unsatisfactory based on their initial parameter values so they arbitrarily changed the parameter values around their control points to improve the outcome. Unfortunately, the DWR computer model never provided good results, which we attribute to incorrect parameter values, poor assumptions and poor choices of free parameters in the "calibration" tests.

Since the initial parameter values were questionable on petrophysical and theoretical grounds, since their choices of driller's explanations of the geological materials are unrepresentative of the local stratigraphy, and since the model results were unsatisfactory, we conclude that there is very little credibility in the representativeness of any of the DWR parameter values except to the extent that they fall within the wide ranges of published values for generic geological materials. We therefore, place no credibility whatsoever in any of the initial or subsequent textbook parameter values that the DWR assigned to any aquifer layer at any location as have chosen to not use their data or modeling results.

Kern Water Bank and Pioneer Project well test data[16]. The operators of these two sites have conducted a number of pump tests on wells in these areas over the years, and the test data have been interpreted and reported by Kenneth Schmidt and Associates (KDSA) of Fresno, Ca

[16] Schmidt, Kenneth D., November 27, 1997, Hydrogeologic Conditions for Development of the Maximum Recovery Plan for the Kern Water Bank Authority, revised report, Kenneth D. Schmidt & Associates, Fresno, CA.

Schmidt, Kenneth D., September 22, 1998, Maximum Recovery Plan for the Pioneer Kern Fan Project, draft report, Kenneth D. Schmidt & Associates, Fresno, CA.

on behalf of and under contract to the Kern County Water Agency to provide estimates of the aquifer parameters T & S. Part of the issue with these well tests as a source of aquifer parameters is that the test operations and test data are only poorly documented in these reports. But based on our review of the scant information in these reports, we can make the following observations.

The pump tests appear to have been designed and operated by engineers in order to determine pump-parameter values rather than aquifer parameter values. Many of these tests had multiple wells pumping simultaneously and most tests lasted for only short durations (as little as 20 minutes or 1 - 2 hours), both of which make it difficult to determine aquifer properties. Moreover, all of the reported drawdowns were measured in the pumping wells and not in adjacent monitoring wells, so none of the data meet the standard validity criteria for aquifer analysis.

Our main objections to the findings of the two KDSA reports include: no presentation of test data or calculations, no discussion of where the data came from, no discussion of the assumptions or the methods of calculation of T or S, the acknowledged dependence on uncorrected discharge/drawdown ratios for a number of pumping wells to estimate values of T without providing calculations or making corrections for even the most basic and most obvious variations in well conditions, many explanatory statements that are inconsistent with fundamental principles of hydrology, a heavy reliance on the DWR parameter values which we have reviewed, criticized, and rejected (see previous section) and, finally, an unexpectedly large range of reported values for T which is inconsistent with our own independent data. We therefore give very little credibility to the KDSA parameter data for these reasons.

Aquifer Parameter Values used in this Study.

Aquifer Dimensions. The aquifer model includes a 300-ft thick shallow unconfined zone, a 50-ft thick middle aquitard zone, and a 300-ft thick deep semi-confined zone. All wells are assumed to be completed across the full aquifer thickness of the deep zone, i.e., a producing interval 300-ft long.

Porosity (φ). The source of porosity values for this scope of work is the field work that SSS[17] completed for the Rosedale - Rio Bravo Water Storage District (RRBWSD) and reported in 2003. RRBWSD contracted SSS to drill coreholes, collect sediment samples and obtain laboratory analyses for specific yield and a set of other useful physical properties. One suite of samples came from the RRBWSD recharge pond area less than 1 mile north of the Strand Ranch project site. Based on those samples, the measured average porosity of well sorted sandy sediments is 37% and the measured average porosity of the silty sediments is 34% and give a weighted average porosity for the aquifer media of 30% for this project.

Specific yield (S_y). Specific yield is a function of the porosity and grain surface area of porous media and is a property which varies over only a limited range of values for the few aquifer materials of interest. The source of specific yield values for this scope of work is also from the 2003 field work that SSS completed for the Rosedale - Rio Bravo WSD.

Based on the RRB study, the average specific yield of the sandy and silty sediments in the area of interest are 33% and 8.6%, respectively. Based on the relative fractions of each in the upper aquifer, the average specific yield of the interval is about 21%.

In contrast, KDSA (1998, p. 15) reported that:
"The average specific yield of Layer 1 is estimated to be about 17%, based on DWR groundwater modeling. The best specific yield value that can be used ... is 10%. This is thus considered to be an appropriate value to use to estimate future water level declines due to recovery pumpage..."

And in contradiction, KDSA (1997, p. 11) reported that:
"... long term tests in [the KWB] area in 1990 - 1991... generally indicated that [the] unconfined aquifer could be assumed with a storage coefficient of about 0.01 to 0.02 .."

Our measured values are considerably different than the fabricated DWR values and the KDSA values of unknown origin. We therefore, have rejected the DWR and KDSA values in favor of our own data. In the case of specific yield (Sy), this has no impact on the drawdown analysis since dewatering of the aquifer does not enter into the calculation and therefore the value of Sy is not used in the determination.

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[17] Crewdson, Robert A., 20 January, 2003, Determination of Aquifer Storage Capacity for the Rosedale - Rio Bravo Water Storage District. Bakersfield, California., Sierra Scientific Services, Bakersfield, Ca.

Specific storage (S_s) and Storativity (S). Specific storage is a function of the porosity and bulk compressibility of porous media and is a property which varies over only a limited range of values for the packed, unconsolidated sandy and silty media of interest. The source of specific storage values for this scope of work is from the 2003 field work that SSS completed for the Rosedale - Rio Bravo WSD. Based on compressive stress tests on samples of poorly sorted sand and silty sand, the bulk compressibilities of these samples range from 4.5 - 7.9 x 10^{-8} m^2/N from which we have derived the values for the dense, compacted equivalents of these sediments as 1 - 1.8 x 10^{-8} m^2/N which are in the expected range of compressibilities for dense sands. From these values we have calculated the corresponding values of S_s ranging from 0.000030 to 0.000053 ft^{-1} and averaging 0.000041 ft^{-1}. This range of S_s values is entirely consistent with the range of published values expected for dense sands and silts.

Based on these values of S_s, the equivalent values of storativity for a 300-ft thick aquifer range from 0.009 to 0.016 and if we add a factor for water released from storage in the overlying aquitard, the expected value of aquifer storativity is expected to be in the range from 0.012 to 0.021. Based on this analysis, we would have chosen to use an average value of S = 0.016 for our modeling but, as presented in the following discussion, we have used a value of S = 0.020 as our base case value of storativity.

We have reviewed the available published sources of parameter values and we consider the ID4 well test of December, 2002 to be the best available source of a verifiable T & S value from an actual aquifer pump test for the Kern Fan area of interest. KDSA[18] originally interpreted the data and reported a transmissivity T = 476,000 gpd/ft [equivalent to 63,600 ft^2/d] and a storage coefficient S = 0.0008. However, based on our own independent analysis, we found that the KDSA calculations were incorrect due to a failure to meet the validity criteria of the method and, after our own reformulation, the corrected aquifer test yielded values of T = 20,000 ft^2/d and a storage coefficient S = 0.00056. We also disagreed with the entire KDSA distance - drawdown interpretation presented in the same report because of an incorrect application of the Cooper - Jacob (single-well) method to a cluster of several pumping wells. As a result, we have chosen not to use the KDSA reported values of T & S, in favor of our own reinterpretation of the data.

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[18] Schmidt, Kenneth D., February 28, 2003, Supplement to the Groundwater Conditions and Potential Impacts of Pumping for the ID-4 Kern Parkway and Rosedale - Rio Bravo WSD Projects, aka Allen Road Well Field December 2002 Pump Test, Kenneth D. Schmidt & Associates, Fresno, CA.

Despite the calculation error, the original KDSA values and our recalculated values of T & S from the 2002 ID4 well test differ significantly from those values published in the KDSA report of 1997 (KDSA did not report values of storativity in their 1998 report). With respect to storativity, KDSA (1997, p. 20) reported:

> *"Past pumping in the COB 2,800-area and the Kern Water Bank area indicate a value for storage coefficient of 0.02, which is considered applicable for most of the existing recovery wells. With continued pumping, (i.e. greater than six months), the storage coefficient is expected to gradually increase, to about 0.05, and to possibly as high as 0.10."* (Curiously, KDSA does not report any S values in their 1998 study, stating that (p. 15) *"The storage coefficient can't be readily determined from the available pump tests, mainly because the tests could not be run for long enough periods in the absence of interference.."*)

On the one hand, we are prepared to accept a reported value of S = 0.02 as being close to our expected range of values (0.009 to 0.016) for the deep aquifer zone except that the KDSA value was intended to represent the entire aquifer across all three zones, so there is less agreement here than it appears. We would expect a deep zone value, based on the KDSA full-aquifer number, to be more in the range of 0.001 to 0.01. However, the value of S = 0.02 is completely uncorroborated since KDSA did not provide any data, calculations, or discussions so we are unable to place any credibility in the value. Moreover, their claim that the value of S will increase with time due to continued pumping is not only unsupported with any discussions or calculations, it is contrary to expectation and incorrect based on the most fundamental theoretical considerations. We therefore reject the credibility of the KDSA parameter values as being questionable or at least unverifiable.

Nevertheless, since the KDSA 1997 Report was written for and presented to the Kern Water Bank Authority, we assume that the KWBA is using these parameter data for their own modeling calculations. Lacking any corroborating data to improve the reliability in the parameter value, we have chosen to use the KDSA reported value of S = 0.02 anyway as our base case value for storativity because it was close to our expected range of values and it was also the value reported and used by the Kern Water Bank, the nearest neighbor to the Strand Ranch project Our use of the 1997 KWB storativity value of S = 0.02 is for attempted consistency with previous work for-, and for general acceptability to-, the Kern Water Bank and is neither intended to be construed as our acceptance nor our verification that these values represent the true values within the aquifer.

Transmissivity (T) and Conductivity (K). One T-value for this scope of work is based on our re-interpretation[19] of the ID4 well test of December, 2002. As previously mentioned, we reviewed the KDSA report, disagreed with the KDSA findings, and re-calculated the T & S values using the correct theoretical assumptions and validity conditions for the method.

Based on our re-analysis, the correctly determined value of transmissivity is T = 20,000 ft^2/d. The chief concern is that the test well covers a different completion interval and is about 6 miles from our current area of interest so that the T & S values may not be representative of the conditions near the Strand Ranch. Based on an unpublished, proprietary study by SSS, we have data which tentatively suggests that the average aquifer transmissivity under the Rosedale - Rio Bravo Water Storage District under the east half of township 29s/25e and the west half of 29s/25e is in the range of 18,000 - 24,000 ft^2/d. This large area is immediately north of the current project site and suggest that perhaps an aquifer transmissivity around 18,000 - 20,000 ft^2/d within ± 20% may be representative of the producing zone in the study area as well.

We also reviewed the 1997 KDSA Report and focused on the T and K data which they attributed specifically to the areas of the Kern Water Bank immediately adjacent to the Strand Ranch project site, i.e., KWB Area 3, Area E, and Area S. The reported K values for the three surrounding areas (1997, Table 1, p. 14) have an average value of K = 57 ft/d which is the same as the KDSA reported K-value for the shallow aquifer under Area E alone (1997, p. 13, HCvert = 430 gpd/ft). The values are reportedly calculated from the observed rise in water levels under recharge ponds in 1995 - 1996, using the 1978 Bouwer formula. Unfortunately, KDSA provided no data, formulas, or calculations so these findings are completely uncorroborated. Based on our familiarity with the Bouwer method (Bouwer, 1978, section 8.3.1, pp. 279-288) we observe that such a calculation would be very much more complex than the otherwise simplistic handling of data presented in the rest of the KDSA report. Nevertheless, if these findings were to be accepted as is, they would appear to be unique in that they represent a departure from using the DWR computer model data that is the basis for all of the other reported parameters (1997, p.12).

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[19] Crewdson, robert, A., 20 July, 2004, An Evaluation of Well Placements and Potential Impacts of the ID4 / Kern Tulare / Rosedale - Rio Bravo Aquifer Storage and Recovery Project, Bakersfield, California, Sierra Scientific Services, Bakersfield, Ca.

In our attempt to use aquifer parameter values that will be found acceptable by the Kern Water Bank Authority, we chose to use this reported value of K = 57 ft/d and have calculated an aquifer transmissivity for the 300 ft thickness of the producing zone of T = 17,100 ft^2/d. This value is close to, but less than our range of expected values of T for the same interval. Given the complete lack of verifiable data in the area, we have no basis to prefer one set of parameter values over another. If this T-value proves to be too low in subsequent testing, then the predicted hypothetical drawdowns will have been too large. For all T-values in the real aquifer that are larger than our assumed base case value of 17,100 ft^2/d, the actual drawdowns will be less than those we have calculated in this study. Since there is a body of other data, even though of questionable value in our opinion, which reports a wide range of possible and particularly much higher values of T, we have treated T as one of our free parameters which we vary in our modeling sensitivity analysis. The sensitivity analysis was based on a range of hydraulic conductivity values of $40 < K < 100$ ft/d.

Aquitard leakage factor (B). The mathematics of leakage occurs in the flow equation in the form of what is referred to as the Hantush leakage factor (B) and B is related to known parameter values according to the formula $B = (T/L')^{1/2}$. In the project area, the high-permeability zones of the aquifer are sandy sediments and the low-permeability zones are silty sediments. These silty sediments are the aquitards which retard the vertical flow of water between the sandy layers of the aquifer. Based on our measurements and estimates of the relevant properties, we estimate that the value of B varies in the range of about $3200 \leq B \leq 10{,}000$ and we have used a value of B = 6000 as our base case value.

Both Swartz (1995) and Schmidt (1997) quote generic values for vertical hydraulic conductivity (K_v)for the Kern Water Bank area (see Exhibit 2) ranging from .0004 - .0027 ft/d which are within the two orders of magnitude of typical textbook values for silty sediments. Swartz (1995, p.116) indicated that the selected DWR values were guessed at and did not work very well in their computer models and had to be changed to other, unreported values. Schmidt reported (1997, p.11) that their K_v values were determined from long- term well tests performed in the KWB area in 1990 - 1991 but we do not know how this might have been done, since Kv cannot normally be determined from a well test. Moreover, Schmidt did not present either the well locations, test methods, test data, or calculations so we cannot independently verify the reported values or their relevance to the project area. Except that these reported values fall within the range of expected textbook values for silty sediments, we place no particular credibility in the representativeness of these particular values of K_v. We do not know of any other reported pump test data which provide a determination of the vertical hydraulic conductivity of the local sediments.

There are several reported measured values of vertical hydraulic conductivity Kv_{sand} for both sand and silt samples collected in the area of interest. RRB (Crewdson, 2003) and the City of Bakersfield (COB, 2000) separately reported independent sediment permeability data which are based on laboratory core analyses of shallow unconsolidated sediments which have been retrieved from boreholes down to 120 ft deep. The RRB sand samples had a $Kv_{sand} = 18$ ft/d and the COB sand samples had a $Kv_{sand} = 112$ ft/d. The RRB silt samples had a $Kv_{silt} = 0.038$ ft/d and the COB silt samples had bimodally distributed values of $Kv_{silt} = 0.3$ and $Kv_{silt} = 0.03$ ft/d. Based on these core- sample data, we observe that the local silty sediments are about 500 - 1000 times less permeable than the local sandy sediments.

Based on the Kv/Kh ratio for these sediment analyses and the well-test value of K_{Hsand} = 80 ft/d, we estimate that the range of vertical hydraulic conductivity of the silty intervals is about $0.04 < K_{Vsilt} < 0.16$ ft/d with an average estimated value of $K_{Vsilt} = 0.08$ ft/d . Finally, we have estimated the aquitard thickness (b′) based on E-logs and dimensional considerations to be 50 - 100 ft thick and have calculated a range of values of leakance (L′) and Hantush leakage factor (B) accordingly. We have selected an average value of B = 6000 ft for base case drawdown calculations and a range of $3200 \leq B \leq 10{,}000$ for sensitivity analyses.

Water Levels and Groundwater Gradients. For the calculation of drawdown impacts, we have initially assumed that the regional gradient in the test area is zero so that all model impacts are superimposed on an initially flat water table. We set our reference elevation to be zero at the initial water table rather than at ground level or at mean sea level so that all calculated drawdowns are relative to the initial water table. This device allows us to easily observe just the predicted pumping- induced drawdown at any location without the complicating effects of the natural gradient.

However, in order to perform particle trajectory and capture zone analyses, we must superimpose the calculated pumping- induced drawdowns on a realistic approximation of the natural water table gradient. We based our approximations on observed historical water table behavior for wet and dry climatic conditions in which the unimpacted natural groundwater gradient is northwesterly at -10 to -30 ft/mile. The greater impact during dry conditions is the distortions in the water levels due to pumping of non-project wells in the immediate area so we have prepared one scenario in which the impacts of the local Kern Water Bank wells were included in the drawdown model. The pumping rates for the KWB wells were obtained from KWB published data.

Exhibit 3.

Limitations of the Analyses.

Exhibit 3.

Limitations of the Analyses.

SSS has evaluated several sets of base case and non- base case operating scenarios and aquifer conditions to determine the predicted impacts of a hypothetical Strand Ranch pumping program. The uncertainties in the calculated results are due to several factors which we briefly summarize in this Exhibit.

<u>Non - project wells.</u>

There are three issues related to the impact of non- project wells in the local area. The first issue is the effect of water table decline due to the pumping of these non- project wells which is in addition to, and superimposed upon, the drawdown caused by the project wells. We have not included any hypothetical scenarios which takes this into consideration.

The second issue is that these non- project wells are removing water from aquifer storage which is not included in the project water balance. Even though the project, by design, will remain in balance, the local area may still suffer a net shortage of recharge depending on the operations of other parties which may create a net decline in water levels, which will ultimately change the aquifer behavior from semi-confined to unconfined. We have already recognized this hypothetical condition in our general analysis, and it is important to recognize the potential for shallow aquifer dewatering by the pumping of non-project wells.

The third issue is that non- project wells create capture zones of their own which extend outward into surrounding areas which are outside of the capture zone limit of just the project well field alone. It is possible that these surrounding wells may draw contamination into the project area that would not have arrived here otherwise. Such a capture analysis is outside the scope of this analysis. While there are limits to the possible magnitude of this potential impact, the wells of greatest potential concern would be wells which are close to the project well field and those which are to the east or south of the well field.

<u>Changes in the groundwater gradient.</u>

The Strand Ranch ASR Project is near, but northwest of, the recharge axis of the Kern Fan recharge mound. Based on KCWA groundwater elevation maps for the area, we have observed historical changes in overall water levels and changes in the groundwater gradients as the climate swings from wet to dry conditions.

The depths to groundwater under the Project site fluctuate significantly due to the rise and fall of the Kern Fan recharge mound under the influence of the regional climatic wet/dry cycle. During consecutive dry years the groundwater may be 150 - 170 ft deep such as in 1990 - 1994, whereas during consecutive wet years the groundwater under the site may be 20 - 70 ft deep such as in 1995 - 1998. The unimpacted, natural groundwater gradient under the Project site in dry years trends northwesterly at -10 to -15 ft/mi WNW and in wet years trends northwesterly at -20 to -30 ft/mi NW.

The unimpacted, natural groundwater gradient under the Project site in wet years trends -20 to -30 ft/mi NW'ly (for example, see KCWA groundwater elevation map for Spring, 2001.) During a dry cycle, the absence of recharge in this stretch causes a shallower, more westerly -10 to -15 ft/mi WNW unimpacted, natural gradient to dominate. However, dry years are also characterized by heavy pumping in the Kern Fan banking projects. The groundwater pumping within the Kern Water Bank in the areas adjacent to the Strand Ranch project site has historically been observed to cause reversals, depressions, and/or other complexities in the groundwater gradient under the Strand Ranch project site (for example, see KCWA groundwater elevation maps for Spring, 1993 or Spring, 1994).

Similar large water level fluctuations in the future will create potential design and operating challenges for the placement and operation of downhole pumps in the Strand Ranch water recovery wells. The evaluation of such potential factors is entirely outside the scope of this work program.

We also recognize that such historical water level fluctuations and gradient changes have already affected the downgradient location of the observed shallow-aquifer brine plume which has migrated under the project site from an unspecified off-site, upgradient location. We expect that future gradient changes will continue to impact the known plume and may cause potential but as-yet unrecognized contaminant plumes located outside of, but close to, the long term project well-field capture zone limit to move into the capture zone. The reverse is not really possible, i.e., contaminant plumes leaving the capture zone, because even though particle trajectories say it is possible, actual contaminant migration invariably leaves in situ residues behind in its pathway which linger as continuing in situ sources of low- grade contamination for many years thereafter. We have not included the unknown future fluctuations in water levels or ground water gradient in our analysis.

Uncertainty in predictive modeling.

There are several causes of uncertainty in the outcome of a predictive forecast and it is useful to keep the relative importance of these causes in perspective.

Natural variability. The single most significant cause of uncertainty is natural variability, i.e., the complexity, heterogeneity, and randomness in the real world which are impossible to fully identify or evaluate at relevant scales of measure. In this project, we know that the aquifer is more complex in ways which we may or may not recognize but can't model because of insufficient data. For example, we know that the silty layers seen in the E-log of one well rarely correlate with the silty layers seen in adjacent wells. But we can't model all of these individual layers because we don't actually know where they start and end in the unobserved spaces between wells. The same is true for boundaries which are there but have not yet been detected by the existing investigations.

We must therefore try to represent the known or suspected complexity with a simpler component within our model which best approximates the expected behavior of the real earth by lumping the complex properties together in the form of a simpler analog. The practice of "lumped parameter" modeling is a simplification of choice as well as necessity. Even if it were possible to represent every sand grain and every pore space in the aquifer, the increase in microscopically detailed complexity may not contribute anything to improve the accuracy or reliability of the results. It is one of the hard-won skills of good modeling to know when and where a simpler approximation will be an effective and accurate representation of the real system.

A corollary effect of natural variability is that the true aquifer parameters will always be somewhat different than those in the model at some place or at some time. Even if we could precisely determine the true average value for every parameter, those local parts of the aquifer which are higher or lower than the average value and have observation wells located in them, will be observed to behave differently than predicted by the model. Since predictive modeling is often used *before* projects have begun, it is often true that a sufficient amount of good data doesn't even exist to estimate the average properties of the aquifer let alone map the full range of variability at all locations. Often a sufficiency of data doesn't exist until such a project has operated for many years. So, when comparing a predicted behavior to a subsequently observed behavior, it would be a mistake to treat point- by- point differences as a parameter error when those differences can be adequately explained as being caused by simple, undeterminable, natural variability about an average value.

Another effect of natural variability applies to the inability to predict future naturally-occurring or manmade events or behaviors, in addition to the variability in physical properties. For example, highly variable weather conditions can deviate significantly from average behavior without being considered anomalous, so that any *particular* predicted event has a significant chance of being different than the actual occurrence even though the prediction is a "correct" one. For these types of conditions, the correct prediction is actually a set of predictions covering the full range of possible values, with a probability of occurrence attached to each one. So in this project, we predict aquifer drawdowns due to pumping and our model stipulates that the actual future drawdown behavior will be controlled in part by the amount and timing of recharge which is controlled by the climatic weather cycle.

Judgment. The second significant cause of uncertainty is errors in judgment by the modeler, including such mistakes as selecting an inapplicable model or poor model parameters, doing the work incorrectly, or failing to recognize and correct "catchable" mistakes. These errors in judgment range from making an informed choice under difficult conditions or with very little data to blatant mistakes. There is probably little chance of a non- expert catching errors in judgment other than, perhaps, blatant mistakes.

In our opinion, there are three ways for a client to try to minimize judgment errors. The first is to use a modeler who clearly has the education, the background, and the experience to do the job correctly to begin with. The second is to get a thorough presentation of the work (model and results) and, if necessary, get second opinion from a qualified expert. The third is to take the time to learn enough basics to make a critical review of the work. After all, the accuracy of your own work may depend on these results. And then, require clear, complete, and verifiable documentation beyond simple numerical QA/QC with any modeling project and simply evaluate the work product for logic, consistency, clarity, and credibility.

Expectation. A third cause of uncertainty is errors of expectation on the part of an inexperienced modeler or the final user of the predictive output. Errors of expectation can include expecting too much and expecting too little. Unreasonably high expectations often come from a lack of understanding of the issues of natural variability. Examples of such errors of expectation include the assumption that there is only a single possible answer or that it is single- valued; that the answer is precise and accurate and, if correct, will be verified to a high degree by the actual observed outcomes; that the answer must be right because modeling is a numerical procedure and computational accuracy is mistaken as being the same as representational accuracy; or that the modeling procedure is wrong or useless or that mistakes must have been made if the predicted results and actual results disagree in some way.

Low expectations often come from a lack of understanding of how powerful and sophisticated predictive modeling can be in the hands of a competent expert. Many business people, policymakers, engineers, and consultants go about their particular business unaware that predictive modeling tools exist for almost every type of process or system including groundwater phenomena such as the flow behavior of rivers, water supply reliability, weather patterns, basin analysis, flow behaviors, and contaminant plume migration.

Unlike errors of judgment by a trained practitioner, errors of expectation are not a matter of right or wrong. Getting it wrong while learning what to expect is the normal process for all of us. The lesson is that if modeling is not part of one's expertise, then 1. hire an expert rather than trying to do it yourself, 2. talk to your expert about reasonable expectations, and 3. learn something about the required inputs, the process itself, and the form of the expected output so you can bring some critical review to the results.

Exhibit 4.

Drawdown Analysis of Proposed Wells Located Within the RRBWSD Service Area.

Exhibit 4.

Drawdown Analysis of Proposed Wells Located Within the RRBWSD Service Area.

One of the design objectives of the proposed Strand Ranch Aquifer Storage and Recovery Project is to provide all of the project benefits to the project participants while minimizing the potential, adverse, impacts on the environment, the project itself, and on adjacent entities. The adverse impacts of primary concern include well interference within the project well field and drawdown impacts to non-project wells in the surrounding area.

We have already discussed the proposed design practices for the Strand Ranch well field to minimize these impacts in the main text of the Report. The project also proposes to use an additional, available, alternate mitigation measure as necessary or as beneficial which is to reduce the rate and/or duration of pumping from the Strand Ranch onsite project wells which would otherwise be necessary by recovering water, by mutual agreement, from up to three wells located off the project site and within the adjacent Rosedale - Rio Bravo Water Storage District serv ice area.

As part of a pre-existing proposed well field program, RRBWSD agrees to provide a priority right of use to up to three wells located on or near the existing Paul Enns Recharge Ponds Facility (in Sec 34, T29s/R25e) or along the Goose Lake Slough upstream of the Enns Facility (on or near the north section lines of Sec 35 or 36, T29s/R25e).

We have modeled the predicted recovery-well drawdowns for four hypothetical well scenarios on the RRBWSD property. All scenarios assume that every well pumps at a nominal rate of 10 af/d (5 cfs). The four scenarios include: 1. five wells (5-spot pattern in a 160-acre area) in the Enns Recharge Pond Facility; 2. three wells (3 in-line at 1/3-mile spacing) just south of the north section line of Sec 35; 3. three wells (3 in-line at 1/3-mile spacing) just north of the north section line of Sec 36; or 4. All eleven wells operating simultaneously.

The drawdowns have been calculated and plotted on a rectangular base map covering a 2-mile N/S by 5-mile E/W area centered on the 11-well array (see, at the end of this text, Maps 4-1, 4-2, 4-3, & 4-4, for the pumping scenarios 1 - 4, respectively). This study area is bounded on the north side by Rosedale Highway and on the south side by Stockdale Highway. The main impact-areas-of-concern include the northernmost portions of the Kern Water Bank which lie to the south of the proposed RRBWSD well field. The northernmost boundary of the Kern Water Bank in Twp 25E runs E/W parallel to- and ½-mile south of- Stockdale Highway.

In all well-field pumping scenarios, the maximum predicted drawdown at or just south of Stockdale Highway is 5 ft and by easy extrapolation, the maximum predicted drawdown ½-mile south of Stockdale Highway is less than 2 ft (Maps A01, A14, A15, and A21, included in this Exhibit). The northernmost three KWB wells are all 3/4 to 1-mile south of Stockdale Highway where we predict that the maximum drawdown (from the 11-well scenario) would be less than 1 ft, and for any three-well scenario, the maximum predicted drawdown at the closest KWB wells is a fraction of 1 ft. We conclude that there will be no significant adverse impact to any non-project wells outside of the District due to the hypothetical case of pumping of all eleven wells in the proposed RRBWSD well field.

We also conclude that the expected impacts due to pumping of any three wells at any three locations within the proposed RRBWSD well field, whether clustered or separated, will have maximum drawdown impacts of less than 2 ft south of Stockdale Highway, and less than 1 ft at locations within the boundary of the Kern Water Bank.

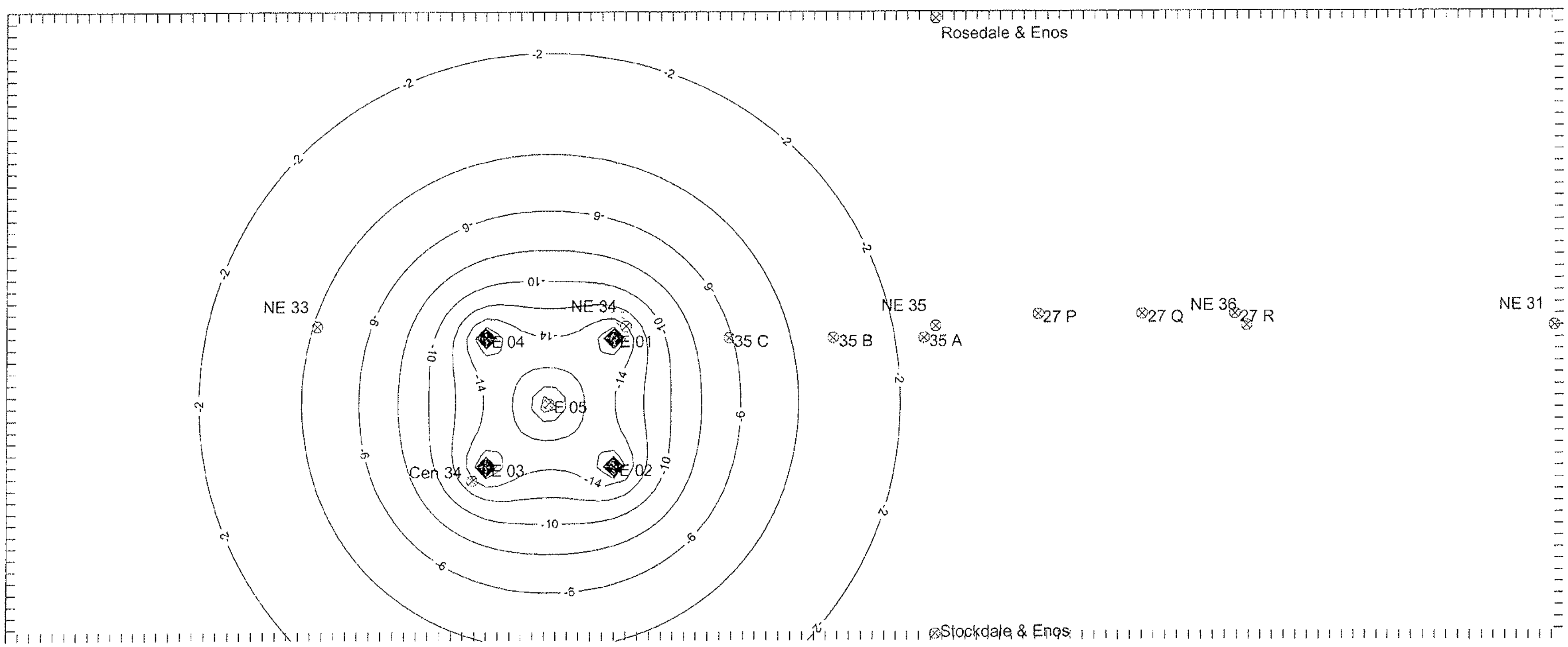

EXHIBIT 4. MAP 4-1.

A01

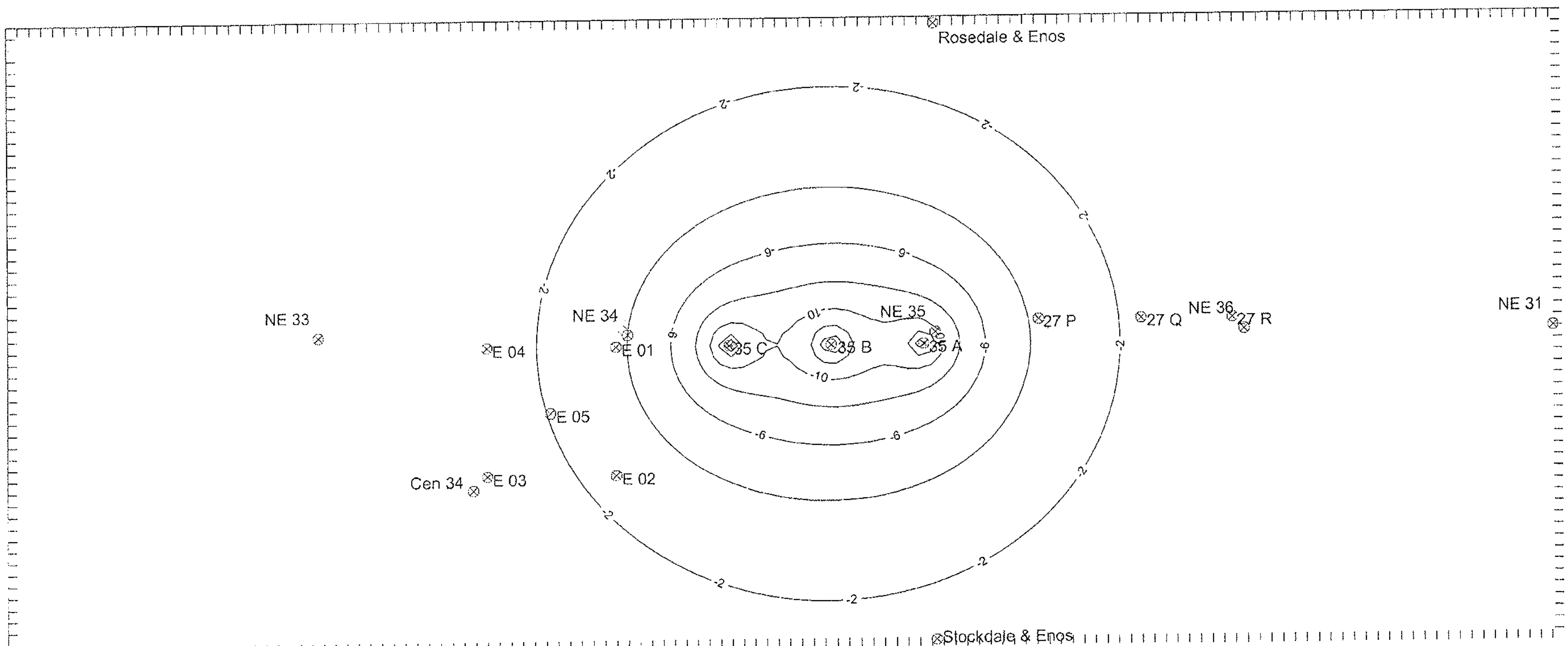

EXHIBIT 4. MAP 4-2.

A14

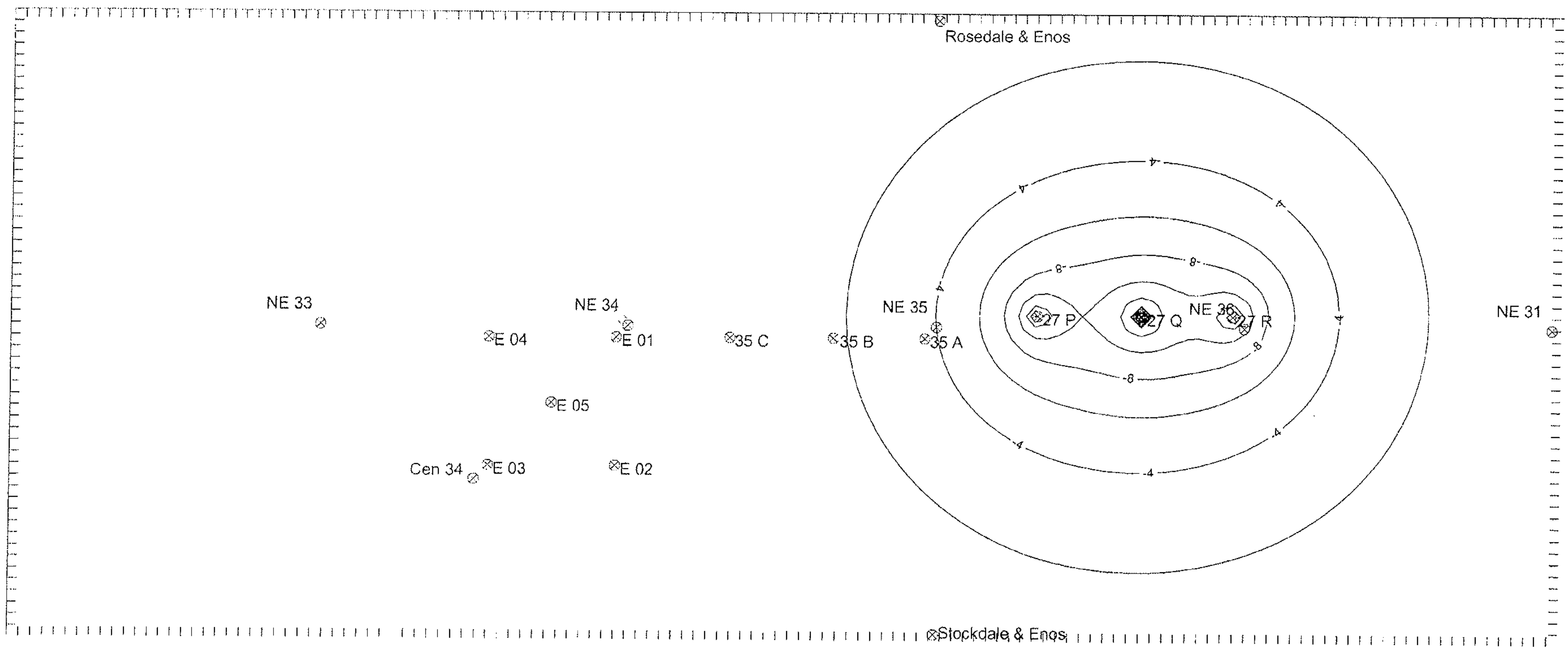

EXHIBIT 4. MAP 4-3

A15

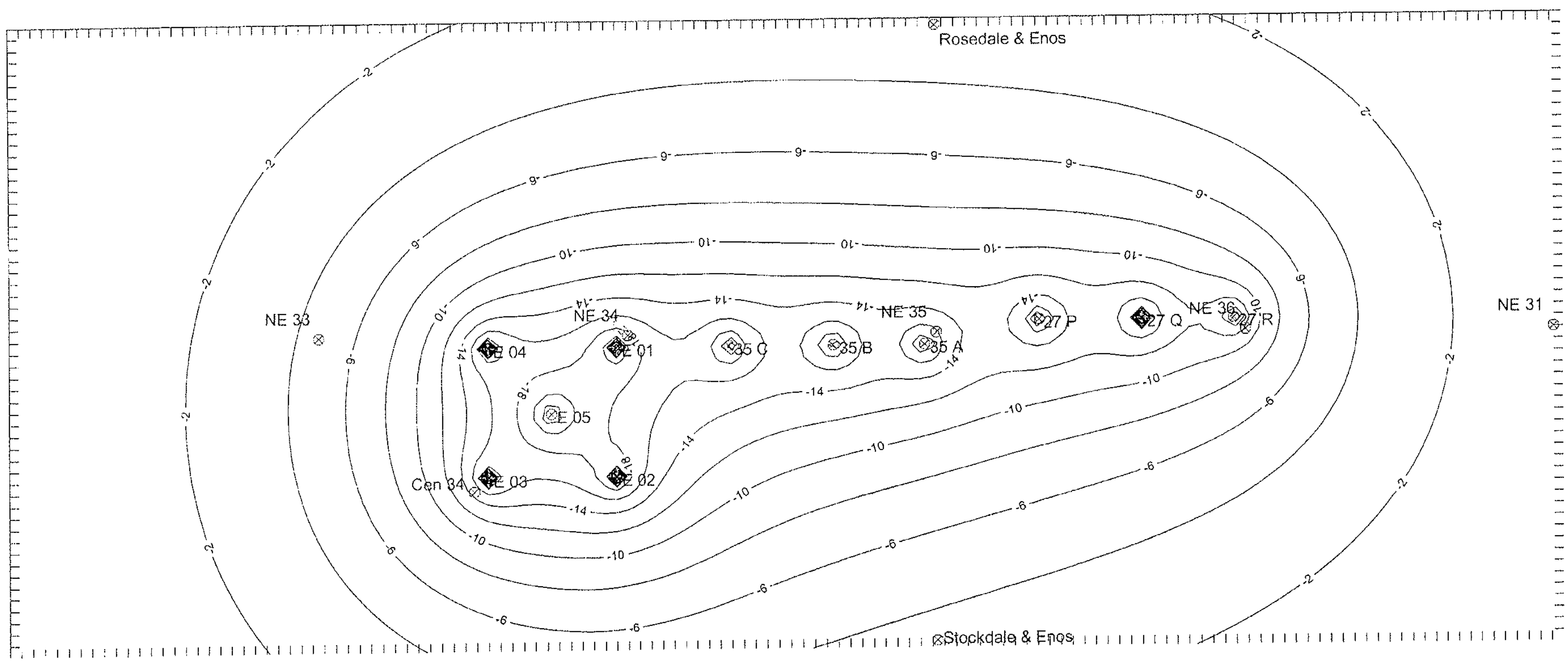

EXHIBIT 4. MAP 4-4.

A21

Exhibit 5.

Catalog of Drawdown and Mound Analyses.

Exhibit 5.

Catalog of Drawdown and Mound Analyses.

SSS evaluated several sets of base case and non- base case conditions to illustrate the calculated drawdowns for purposes of comparison and evaluation. The best way to compare variations is to look at the maps to observe the changes in drawdown at locations of interest with respect to the changes in the free parameters and remember that the parameter changes are intended to reflect hypothetical changes in the real aquifer properties which affect the groundwater behavior. All maps cover nine sections centered on sec 02, T30s, R25e at a scale of approximately 1inch = 2290 ft. The model space is an 80x80-cell grid which is marked on the map margins; each cell represents 200x200 ft in real space. All maps include reference markers at the NE, SE, SW, and NW corners of section 02.

We have compiled a set of introductory maps (Set 0) showing the well locations, groundwater gradient scenarios, and parameter sensitivity variations in the absence of project pumping. We have compiled the data sets into groups of drawdown analyses (Sets 1 - 3) with or without particle trajectories, and a group of other special-case analyses (Sets 4 - 7) which are illustrative of other issues but not necessary to the basic drawdown impact scope of work. From the drawdown analyses, we have tabulated the observed drawdowns within the Strand Ranch well field, within the overall Strand Ranch project site, within the surrounding eight sections which comprise the study area, and outside the study area perimeter.

We list the complete set of drawdown analyses in the catalog below.

Set 0. Basic model data.

- Map B40 - B43, well location maps.
- Map B0, B22, base case drawdown, w/o and w/ GW gradient.
- Map B39, GW gradient (GWG) only.

Set 1. Variations in aquifer model.

- Map B0 - B2; B = 3200, 6000, 10,000.
- Map B0, B3 - B6; K = 57, 100, 80, 50, 40 ft/d.
- Map B0, B7 - B10; t = 300, 10, 30, 100, 1000 days.
- Map B0, B11 - B12; leaky, confined, unconfined.

Set 2. A. Variations in well operation *without* GW gradient.

- Map B0, B14, B16, B18, B20, D1; wells 1-9, 12356, 4789, 13579, 2468, 1-7.

B. Variations in well operation *with* GW gradient.

- Map B22, B15, B17, B19, B21, D2; wells 1-9, 12356, 4789, 13579, 2468, 1-7.

Set 3. Variations in particle tracking.

- Map B23 - B25; steady-state 10 & 5-yr, transient 10-yr.

Set 4. Special cases comparing 1760-ft and 1320-ft Strand Ranch well spacing.

- Map B26, B38; WL diff between SR 1-9 (1760-ft) and SR 11-19 (1320-ft).
- Map B27 - B28; wells SR 11 - 19, 1320-ft spacing, w/o and with GW gradient.

Set 5. Special cases comparing Strand Ranch drawdowns with Kern Water Bank drawdowns.

- Map C1-C3; SR only, SR & KWB1, KWB1 only,
- Map C4 - C6; KWB1 w/GWG, SR & KWB1 w/GWG, SR only w/GWG
- Map B29 - B31; KWB1 no GWG, ref change, KWB1 w/GWG
- note: KWB1 - 03R and 11C at setback locations.

Set 6. Special cases comparing Strand Ranch drawdowns with Kern Water Bank drawdowns.

- Map B33; KWB2 drawdown. (KWB2 - 03R & 11C on property boundary).
- Map B34 - B35; diff calc shows net areas of SR or KWB drawdowns.
- Map B36 - B37; SR & KWB2 total drawdown, with & w/o GWG.

Set 7. Drawdown impacts on Strand Ranch related to KWB wells 11C and 03R.

- Map E1 - E2; old locations, setback locations.
- Map E3 - E4; net diff calc, transient & steady-state.
- Map E5 - E6; same except for 11C only.

Set 8. Re-run of key models.

- Map F1 - F15; 9-,7-, & 5-well cases w/wo GWG & particle trajectories.

Appendix G

Strand Ranch Water Quality Report

Sierra Scientific Services

A Water Quality Evaluation of the Strand Ranch Aquifer Storage and Recovery Project, Kern County, Ca.

19 December, 2007

prepared for:

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Table of Contents

Figures.

Tables.

Exhibits.

Sierra Scientific Services

A Water Quality Evaluation of the Strand Ranch Aquifer Storage and Recovery Project, Kern County, Ca.

1. Summary of Findings

The proposed Strand Ranch Aquifer Storage and Recovery Project is designed to receive surface waters from the State Water Project, the Federal Central Valley Project, and the Kern River and store these waters in the available dewatered storage space of the underlying unconfined aquifer. At some later time, the Project will use high-flow water wells to recover a like volume of groundwater from the underlying aquifer.

All three surface waters are considered to be low-TDS, high-quality water which is acceptable for all uses in Kern County with little or no pre-treatment. The existing groundwater banking projects in the area have been storing these same three surface waters in the aquifer since about 1980. Since these three surface waters have lower TDS concentrations and lower constituent-of-concern concentrations than the groundwaters in the aquifer zones under the Project site, the historical data record shows that all recharge-then-recovery operations in all such projects have a beneficial salt balance impact and a beneficial COC balance impact on the basin.

Based on calculated hypothetical stoichiometry on the proposed Project recharge and recovery (predicted -118 mg/l net loss of salt from the basin), and based on the observed positive impacts from existing projects, we conclude that the water quality impacts from this Project will be significantly positive for the basin as well.

We have observed in the groundwater data that there is a shallow-aquifer brine plume which is migrating under the Project site from an unspecified, upgradient, off-site, source or sources, which is causing a ± 400 mg/l rise in TDS under the site relative to the unimpacted adjacent aquifer water. The suspected sources of the plume are oilfield wastewater disposal ponds which have not been active for more than 30 years, as qualified in this Report.

The plume has been degrading due to natural dispersion and active removal by local water wells. The residual concentrations at all locations in the plume have been declining and are expected to continue to do so, subject to verification of actual conditions over time. The project recharge and recovery operations will both have the immediate, beneficial impacts of remediating the plume in two ways: 1. the addition of lower-TDS surface water to the shallow aquifer during recharge will decrease the in-situ TDS by dilution and 2. the recovery operations will decrease the plume volume by permanently extracting plume water from the aquifer. The basin will benefit from the direct remediation of this plume as an incidental positive impact of Project recharge and recovery operations.

However, as long as the elevated-TDS plume exists and is not fully mitigated, the plume will have an impact on the Project by making it somewhat more difficult for the Project to meet the pump-in criteria for the Cross Valley Canal and the California Aqueduct when they need to recover and return water to end-users. The KWB continues to operate nearby plume-impacted water wells by blending the recovered plume water with other, lower-TDS recovered waters as necessary for their purposes and the same operational mitigation is available to the Strand Ranch Project as well.

We conclude that:

1. The conversion of agricultural land to an aquifer storage and recovery project eliminates the potential future use of Ag chemicals on the property which has been generally recognized in Kern County as a potential source of shallow-aquifer degradation;

2. The surface water sources available to the Project are free of constituents of concern (COCs) and are of lower total dissolved solids (TDS) content than the existing groundwater directly underneath the project site;

3. The recharge cycle will add lower-TDS surface water to the shallow aquifer where it will have the beneficial effect of diluting down the higher-TDS, plume-impacted groundwater;

4. The recovery cycle will remove groundwater which has a higher TDS and COC content than was originally put into the aquifer during recharge;

5. The positive water quality benefits of a full recharge/recovery cycle include a net removal of salt from the basin under the unimpacted natural water quality conditions of the aquifer, as well as an additional net reduction in COCs, and an ongoing dilution and extraction of the migrating brine plume as long as it continues to exist.

A Water Quality Evaluation of the
Strand Ranch Aquifer Storage and Recovery Project,
Kern County, Ca.

2. Introduction

Section I - Purpose.

The purpose of this Report is to describe the water quality interactions and impacts which are expected to occur as a result of the operation of the Strand Ranch Aquifer Storage and Recovery Project.

An operational objective of the Strand Ranch ASR Project is to protect and preserve the water quality of the underlying groundwater aquifer while meeting the applicable regulatory and contractual standards of ASR operation. These standards may include the "pump-in criteria" for transporting project water in the Cross Valley Canal and California Aqueduct, the terms of the Memorandums of Understanding (MOUs) with adjacent entities, terms established by contract or other agreement, or the concepts of sustainable groundwater management.

The initial findings of this study may be used as a baseline to begin a voluntary water quality monitoring and reporting program (MRP) for future ongoing water quality evaluations. The purpose of this study and the MRP is to provide a permanent water quality database related to the Project operations which can be used for demonstrating and verifying compliance with the water quality objectives.

Section II - Project Scope - Aquifer Storage and Recovery.

Aquifer storage and recovery (ASR) is the generic term which describes the practice of deliberately putting surface water into a groundwater aquifer through infiltration basins with the intention of recovering a like volume of water from the aquifer at a later date. Such a practice presents a great opportunity to increase the local and statewide capacity to store water. ASR projects help regulate the water supply and demand over time by storing excess water when it is available in wet years for future recovery when water is needed in dry years.

In Kern County, California, there are 3 main components to every ASR facility: recharge basins, water wells, and a conveyance system. The recharge basins are ponds which are constructed to allow ponded water to infiltrate into the groundwater basin. The water wells are conventional high-flow water wells used to pump water out of the underlying aquifer. The project conveyance system consists of one or more canals, ditches, or pipelines used to deliver water to or from the ASR facility by connecting it with the local and regional water conveyance infrastructure.

The Kern County water community generally refers to ASR projects as "banking" projects. According the Kern County Water Agency, "These banking programs are essential to Kern County's water management and future growth[1]" and this is broadly true of the entire State of California water infrastructure. As used in Kern County, the term "banking" is loosely used to describe the act of physically putting water into the underlying aquifer and crediting the owner with the right to remove a like volume of water from the aquifer at a later date. This credit allows the owner to show such a volume of banked water as part of its current water supply. If such water has been "banked" on behalf of another party, then it is considered to be real water held in trust for that party who has an absolute right of recovery.

Section III - Background.

The Irvine Ranch Water District (IRWD) is currently in the process of developing a ±600 acre parcel in Kern County, California, as an Aquifer Storage and Recovery (ASR) Project (Figure 1). The parcel of interest is located in Section 2, Township 30s, Range 25e, MDBM, located at the southwest corner of Stockdale Highway and Enos Lane, several miles west of the City of Bakersfield. The ±600-acre Strand Ranch ASR project will be the latest among several existing ASR projects in the area which currently cover approximately 20,000+ acres and include more than 120 wells. The project site is surrounded in all four compass directions by existing ASR facilities belonging to the Kern Water Bank Authority or to the

[1] Lloyd Fryer. 2005. Kern County Groundwater Banking Projects. KCWA brochure.

Rosedale - Rio Bravo Water Storage District. The parcel has been known historically as the Strand Ranch, so- named for the sand fairways crossing the property, so the project is informally referred to as the Strand Ranch ASR project.

The proposed project is designed to include 450+ acres of recharge ponds and 6 to 8 water recovery wells. The project site currently has approximately 120 ac of existing recharge ponds which were operated in 2006 on a pilot-study basis. The Cross Valley Canal runs through the Strand Ranch parcel which provides potential conveyance capacity to move surface water to and from the Project site. The site currently contains five or more irrigation wells which were installed by the previous owners of the Strand Ranch and are capable of recovering groundwater at this time. The project operator proposes to recondition or replace existing wells, and/or install recovery wells, as necessary or as beneficial, to meet their proposed operating parameters.

The site is flat at an elevation of about 320 ft above msl. The site overlies the prolific aquifers which comprise the so-called Kern Fan which, geologically speaking, is a thick pile of interbedded, fine- to coarse- grained, fluvial/alluvial sediments. The shallow aquifer is recharged by natural and manmade percolation of (mostly) Kern River water. Recharge occurs in the river bottom and nearby recharge ponds which form a 15-mile long, linear recharge axis starting in the city limits of Bakersfield and trending southwest across the southern San Joaquin Valley. When we refer to the Kern Fan in this Report we will generally be referring to the ±12-mile wide elongate area which straddles the recharge axis and includes the river channel, ASR project sites, and related surface infrastructures.

The Strand Ranch ASR Project is near, but northwest of, the recharge axis of the Kern Fan recharge mound. The depths to groundwater under the Project site fluctuate significantly due to the rise and fall of the Kern Fan recharge mound under the influence of the regional climatic wet/dry cycle. During consecutive dry years the groundwater may be 150 - 180 ft deep such as in 1990 - 1995, whereas during consecutive wet years the groundwater under the site may be 20 - 80 ft deep such as in 1995 - 1998. The unimpacted natural groundwater gradients under the Project site consistently trend northwesterly at -10 to -20 ft/mi WNW in dry years and -20 to -30 ft/mi NW in wet years.

The three potential sources of surface water which might be brought to the property include water from the Kern River, water from the Federal Central Valley Project (CVP) via the Friant- Kern Canal, and/or water from the California State Water Project (SWP) via the California Aqueduct. The source of both the Kern River water and CVP water is runoff from the winter snowpack from the highlands of the southern Sierra Nevada mountain range. The primary water source for the SWP is runoff from the greater volcanic highlands surrounding Mt Shasta in northern California. The waters from all three sources are very good quality when they reach their intended points of use within Kern County.

The water chemistries[2] of the surface waters differ somewhat from each other and they differ from the water chemistry of the groundwater. When surface water is stored in the aquifer and commingles with groundwater, the volume of water in the aquifer increases and the water chemistry of the augmented, commingled groundwater changes. The water chemistry of the commingled groundwater is intermediate between the water chemistries of the recharged water and the pre-existing groundwater in the zone of commingling. When groundwater is removed (recovered) from the aquifer, the water chemistry of the recovered water is the intermediate chemistry of the commingled water. For this study, the waters of interest include the following: the shallow, intermediate, and deep groundwaters; the three potential surface-water sources; and a brine plume flowing in the shallow aquifer under the site.

Section IV - Work Program.

Some of the data and findings in this Report have been excerpted and modified from another ongoing water quality study being prepared for the Rosedale - Rio Bravo Water Study District, with their permission. That study is a baseline water quality (BWQ) analysis of the groundwater aquifer in the RRBWSD area of interest, which happens to include the Strand Ranch Project area because of proximity. The RRBWSD baseline water quality analysis will be completed and presented in report form in the Fall, 2007.

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[2] By "water chemistry" we mean all of the individual constituent concentrations of the various dissolved solids, whether natural or manmade, which are of interest for the intended uses of the water.

The ongoing BWQ work program includes groundwater data collection, basic data analysis, and preliminary interpretation. The sources of data include: the Kern County Water Agency water quality database (courtesy of Tom Haslebacher, KCWA Senior Hydrogeologist), Vaughan Water Company water well analyses (courtesy of Mike Huhn, manager, VWC), and the Rosedale - Rio Bravo Water Storage District (courtesy of Robert Coffee, RRBWSD operations manager). Sierra Scientific Services specified the data screening criteria and the methods of data analysis according to accepted standards and practices.

For this study, we have added water sample analyses provided by IRWD collected from the accessible irrigation wells on the Strand Ranch property and analyses obtained by IRWD for other wells located on adjacent property.

Section V - Personnel.

Dr. Robert A. Crewdson is a Bakersfield, California consultant doing business as Sierra Scientific Services (SSS). SSS specializes in quantitative ground water hydrology, applied potential theory and time series analysis, quantitative ground water flow analysis, water quality geochemistry, well testing and monitoring, contaminant transport modeling, and aquifer properties testing. Dr. Crewdson is a research associate and adjunct professor at California State University Bakersfield where he has taught hydrology, contaminant transport, geochemistry and geophysics in upper division and graduate level courses.

Section VI - Methodology.

The primary task of this study was to collect the available data and determine the observed, historical water quality trends in the surface waters and groundwaters which flow into and out of the Kern Fan aquifer system as it relates to the Strand Ranch Project. The complete methodology will be presented in the forthcoming RRBWSD Baseline Water Quality report, but we present a summary in Exhibit 1. We present a tabulation of the surface water and ground water geochemical analyses in Exhibit 2.

Section VII - Water Quality.

There is no single, universal standard for *"water quality"*. But for the purposes of this study, we only need to establish the criteria which are relevant to the Strand Ranch Project. For our purposes, when we refer to "water quality" we really mean "water chemistry", since we are not so much applying criteria of acceptability (good for irrigation, residential, etc) as we are simply referring to the numerical values of the measured constituents. The constituents which we consider sufficient to be broadly representative of the water chemistry in the project area include: total dissolved solids content (TDS), hardness (Hd), hydrogen ion concentration (pH), arsenic concentration (As), alpha-emission radioactivity (α), and nitrate concentration (NO3).

In general, fresh water with a TDS content of 500 mg/l or less is considered to be good or excellent for domestic use and considered to be unacceptable over 1,200 - 1,500 mg/l, depending of course on the specific constituents. Water with a hardness less than 60 mg/l is considered to be "soft" and more than 120 mg/l is considered to be "hard" (120 - 180 mg/l) or "very hard" (>180 mg/l). Hardness is generally considered to be objectionable if it exceeds 100 mg/l. Water with a pH in the range from 5 to 9.0 is considered to be in the acceptable range for a public water supply.

Two naturally-occurring constituents of concern, arsenic and alpha radioactivity, exist in most natural waters at or above trace concentrations. The current federal regulatory maximum concentration limit (MCL) in water for each is 10 ug/l and 15pCi/l, respectively. These standards are set to achieve the following hypothetical objective: that if every person in a community were to drink 2 liters of water with these MCL concentrations daily for 30 years, there would be no more than one additional cancer death from arsenic poisoning and no more than one from alpha radiation poisoning per 10,000 people, on average, than would otherwise be expected in the community population.

The third constituent of concern, nitrate, is manmade in the sense that it occurs significantly in surface water and groundwater only because of manmade activities, i.e., it comes from agricultural use of fertilizers, from wastewater treatment plant effluent, and from stockyards. The federal MCL for nitrate is 10 mg/l.

In the Discussion section of this Report, we present the water chemistry of the surface waters, the ground waters, and the interactions and impacts related to the Strand Ranch Aquifer Storage and Recovery Project.

A Water Quality Evaluation of the
Strand Ranch Aquifer Storage and Recovery Project,
Kern County, Ca.

3. Discussion

The expected water quality interactions and impacts related to the Strand Ranch Project come from the developments and operations which are common to all aquifer storage and recovery (i.e. water banking) projects as designed and operated in Kern County, California. The following discussion includes the relevant surface water and ground water data and parameters which are specific to the Strand Ranch ASR Project.

Section I - Basic Project Development and Operation.

The Strand Ranch ASR Project development involves: 1. converting agricultural land which previously supported almond trees and row crops into infiltration ponds for the purpose of percolating surface water into the underlying aquifer, 2. Maintaining existing water wells and/or installing new water wells for the purpose removing water from the underlying aquifer, 3. installing ditches and/or pipelines to convey water between the Project facilities and the local conveyance infrastructure which, for the Strand Ranch Project, is the Cross Valley Canal, and 4. Installing monitoring wells for the purpose of monitoring water levels and water chemistry in the underlying aquifers.

The Strand Ranch ASR Project physical operation involves: 1. diverting a quantity of water from the local conveyance infrastructure into the Project recharge ponds, 2. maintaining the water depth in the active recharge ponds for maximum infiltration, 3. maintaining the empty and unused ponds when recharge is not occurring, 4. operating the recovery wells and delivering this water back to the local conveyance infrastructure. The maximum rates at which water can be diverted and recharged or recovered and re-conveyed are limited by the maximum physical operating capacities of the particular facilities which are in use. The actual rates and the actual scheduling of these water inflows or outflows may also depend on operating preferences, 3rd party requirements, contractual limits, uncontrollable circumstances, availability of water, and/or limitations due to capacities or priorities in the Cross Valley Canal.

For our purposes, we will assume that any expected interactions or impacts will be maximum when the recharge inflows or the recovery outflows are also at a maximum. This "maximum" scenario is defined by the maximum physical operating capacities of the hypothetical future facilities under consideration. This "maximum' scenario is not necessarily the most- likely scenario, nor should it be assumed that it is a "best-or-worst-case" scenario. The future Project operation currently under consideration in this water quality evaluation is based on hypothetical maximum recharge rates of 80 - 240 af/d (± 400 ac of ponds w/ IR = 0.2 - 0.6 ft/d) and maximum recovery rates of up to 45 cfs (90 af/d).

Section II - Water Chemistry of the Kern County Surface Waters.

All of the existing ASR (banking) projects on the Kern Fan have received their surface waters since 1995 from one of three sources: the Kern River (KR), the Federal Central Valley Project (CVP) via the Friant - Kern canal (FK), and the California State Water Project (SWP) via the California Aqueduct (AQ). The Strand Ranch ASR Project will receive all of its surface water from one or more of these same three sources. We have chosen to report the baseline water quality of each of these surface water sources according to the analyses reported by the KCWA Improvement District No. 4 (ID4) at the inlet to their water treatment plant (data obtained from the KCWA water quality database). We present all analyses from all sources in Exhibit 2.

The Kern River brings an average 772,800[3] af/yr of Sierran snowmelt runoff water into Kern County. Kern River water has an average TDS = 88 mg/l, an average Hd = 39 mg/l, and an average pH = 7.9. The three COCs (As = 5.9ug/l, α = 3.2 pCi/l, NO3 = 1.0 mg/l) are all present at low levels and less than their respective MCL concentrations.

[3]Source of inflow volumes: KCWA, August 27, 2001, Initial Water Management Plan, Public Review Draft, p. ES-13.

The Friant-Kern Canal brings an average 395,000 af/yr of Sierran snowmelt runoff water from the Federal CVP into Kern County. FK water has an average TDS = 41 mg/l, an average Hd = 22 mg/l, and an average pH = 7.5. The three COCs (As = 2.9ug/l, α = 2.9 pCi/l, NO3 = 1.4 mg/l) are all present at low levels and less than their respective MCL concentrations.

The California Aqueduct brings an average 807,500 af/yr of Northern California snowmelt runoff water from the State SWP into Kern County. SWP water has an average TDS = 334 mg/l, an average Hd = 115 mg/l, and an average pH = 8.3. The three COCs (As = 7.0 ug/l, α = 1.9 pCi/l, NO3 = 2.4 mg/l) are all present at low levels and less than their respective MCL concentrations.

The water chemistry of the SWP water which arrives in Kern County via the aqueduct varies significantly but predictably (Table 1). During climatic dry cycles such as the years 1991 - 1995, the average annual TDS (344 mg/l) is approximately 170% higher than the TDS during climatic wet cycles (208 mg/l) such as the years 1996 - 2000 (Table 1). Within any given year, the average monthly TDS in the winter months is consistently 150% - 190% higher than the TDS in the summer months (Table 1). We do not see a comparable variability in the FK or KR waters. The seasonal and climatic variability of the SWP water chemistry is significant enough that, to the extent possible, the Project can benefit from scheduling its water deliveries to minimize the salt-load impacts on the aquifer and scheduling its returns to maximize the Project's ability to qualify for Tier-1 pump-in to the Aqueduct.

By these measures, the overall Kern County surface water supply is very good quality, even during periods of elevated TDS in the aqueduct. The total dissolved solids contents are quite low, the physical properties are acceptable, suspended solids, if present, can be eliminated by settling or filtration, and the trace occurrences of constituents of concern (COCs) are below MCLs and, so far, of minor concern. As a result, there is a general consensus in the local water community that a source of Kern County surface water and/or ground water is most likely OK as long as does not contain any of the few recognized constituents that locally make the water *unacceptable* for its intended use.

Section III - Water Chemistry of the Kern Fan Aquifer Waters.

The project site overlies a prolific fresh water aquifer which is a 700-ft thick, stratified sequence of interbedded, unconsolidated, sandy and silty alluvial and fluvial sediments. Most groundwater in the basin today originated as Kern River water which infiltrated into the aquifers from areas of natural recharge through a number of different pathways in times past. Today, we recognize that the groundwater is of poorer water quality than the Kern River water from which it comes. Part of the difference comes from a simple increase in the total amount of dissolved solids in the groundwater as a result of passing through the soils and sediments along the groundwater flowpath. Much of this increased "mineralization" of the water is of no consequence for its consumptive use, but some of this mineralization may include naturally-occurring constituents of concern. The main naturally- occurring constituents of concern in the project area have been elevated but non-toxic levels of naturally- occurring arsenic and radioactivity. Both constituents are commonly associated with sediments which have been derived from the erosion of granitic-type rocks, as is the case in the study area. The process of mineralization of percolating water is considered to be a natural and inevitable process and there is currently no known way to prevent this process of mineralization from occurring. The standard measure of this effect is to calculate a "salt balance" for storing and recovering a unit volume of water of known water chemistry in the aquifer.

In the project area, as on adjacent lands and elsewhere, the potential for an additional decrease in aquifer water quality includes the introduction of non-native constituents due to manmade activities and practices. The recognized, potential sources of manmade COCs in and around the Project site may include agriculture, oilfield operations, accidental spills on the nearby highways, and groundwater inflows of COCs from up-gradient sources. The main manmade constituents of concern include nitrates, pesticides, fertilizers, and common mineral salts.

The water chemistry in the groundwater aquifer varies with location and with depth. The total saturated thickness of the commonly-used part of the aquifer is approximately 500 - 700 ft (dry or wet conditions, respectively) and is often described as consisting of shallow, intermediate, and deep producing zones. These three zones cannot be clearly defined based on stratigraphy alone but can be differentiated based on both water chemistry and hydraulic behavior.

Shallow aquifer water chemistry. The shallow aquifer zone (approx. 0 - 300ft deep) contains a vadose (unsaturated) zone overlying an unconfined water table which varies in depth from 10 - 200 ft below ground level depending on the climatic wet/dry cycle. In the project area which is, more specifically, part of the Kern Fan recharge area, the shallow aquifer contains groundwater which comes primarily from downward vertical recharge from overlying surficial sources. Since the source of most of this recharge water is the Kern River through natural and manmade recharge, the water chemistry of the shallow aquifer resembles that of the Kern River except modified by processes of dissolution and reaction accompanying the percolation of this water through the vadose zone. The water chemistry of the unimpacted shallow groundwater zone may be summarized as having moderate TDS (229 mg/l), moderately hard Hd (122 mg/l), somewhat basic pH (7.8), low As (0.7 ug/l), elevated alpha (5.5 pCi/l), and elevated NO3 (9.9 mg/l). These data are presented in Tables 2 & 3 and on maps in Figures 2 - 7.

Brine plume. The shallow aquifer zone in the project area is being impacted by a brine plume which appears to be migrating from an unidentified, off-property, source or sources which are upgradient of- and unrelated to- the Stand Ranch Project site. The source[4] is upgradient to the southeast of the project site, perhaps in section 12 and/or somewhat farther to

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[4] One possible plume source is the so-called Rio Bravo Pump Station which is located in the central-southern portion of Sec 12, T30s/R25e, approximately one mile SE of the SE corner of the project site. The following entry was printed in the Kern Water Bank Authority Monthly Status Report of August 15, 2007: The following item occurs under the heading "Third Parties and Environmental Cleanup" and under the sub-heading "Chevron": *"Rio Bravo Pump Station: Historic use of this facility resulted in the pollution of groundwater with salts. TDS in recent samples have been as high as 1500 mg/l. In correspondence dated November 28, 2006, the RWQCB requested that a groundwater monitoring program be implemented."*

Mr. Jon Parker, KWB Operations Manager, reports that the suspected source of the brine plume is a system of oilfield-wastewater disposal ponds in section 12 that are no longer active. The original plume reportedly never came under regulatory control because the groundwater impact was not considered to be serious enough. The KWB groundwater pumping operations since 1995 have removed a large volume of groundwater with elevated TDS content from within the plume zone of impact, resulting in an improvement to the local water quality of the shallow aquifer. (verbal comm. December, 2007) the southeast. The water chemistry of the shallow groundwater brine plume may be summarized as having elevated levels of most or all constituents relative to the unimpacted shallow groundwater, with moderate to very high TDS (385 - 2380 mg/l), hard to very hard hardness (163 - 991 mg/l), near-neutral, slightly basic pH (7.2 - 7.9), undetermined levels of As and alpha, and elevated NO3 (19 - 28 mg/l). These data are presented in Tables 2 & 3.

The brine plume at MW 12B, the monitoring well closest to the source area, has a TDS content which is approximately 11 times higher than the surrounding shallow aquifer water (2380 mg/l vs. 225 mg/l) and has a clear "fingerprint" indicated by a chloride (Cl) content that is 44 times greater than the chloride content of the surrounding shallow aquifer water. The chloride ion is useful because we can map the presence of excess chloride ion in the aquifer as an indicator of the migrating plume. We have also used the presence of excess calcium to independently map the plume location with similar results (see maps in Figures 8 - 10). Based on this analysis, the brine source appears to be located at or sufficiently close to the axis of recharge that it is actually causing plumes to migrate downgradient into both flanks of the recharge mound. A plume of elevated TDS is migrating to the northwest under the Strand Ranch project site (Figure 10) and a plume of elevated TDS is also migrating southeast away from the same source area. Based on the data in both plume-flow directions, the source(s) of the twin plumes must be located in or near sec 12, T30s/R25e and/or sec 07, T30s, R26e.

In our opinion, based on our own analyses and on credible local sources, the present plume has been in existence for more than 30 years. At an estimated average flow velocity of 1 ft/d, this plume has propagated more than 2 miles downgradient from the source location. However, the oilfield wastewater disposal ponds which were the suspected original sources of the groundwater brine plume are no longer active[5]. Based on theoretical considerations, we conclude that the plume has reached its maximum concentration at all points within its existing perimeter and these concentrations are actively decreasing. We expect that the natural processes of advection and dispersion will cause the perimeter of the remaining residual plume to steadily lengthen and widen and the TDS constituent concentrations to steadily decrease through dilution. The existing KWB operations and the proposed Strand Ranch operations will

[5] Mr. Royce Fast, a long-time local resident farmer, reports that these oilfield wastewater disposal ponds have been inactive for as long as he can remember, and specifically, that he has no recollection of the ponds being active at least as far back as the early 1970s and perhaps earlier. (verbal comm. December, 2007)

continue to remediate the plume with accelerated dilution through surface water recharge and accelerated TDS content removal by groundwater recovery within the plume zone of influence.

It is possible and likely, in our opinion and subject to verification, that low-grade, residual, in-situ salt deposits might still exist within the sediments of the vadose zone underlying the locations of the former disposal ponds. Such a residual, in-situ, source of salts may explain why the tail of the plume has not "disconnected" and migrated downgradient from the source area during the time since the pond use was discontinued, why elevated TDS concentrations still exist in monitoring wells close to the suspected source area, and why the plume has not been completely remediated by local groundwater extraction over the last 30+ years. Nevertheless, the ongoing processes of dilution and extraction will continue to remediate this pre-existing, residual, shallow-aquifer, brine plume.

Deep aquifer water chemistry. The deep zone (approx. 400 - 800 ft deep) contains a semi-confined aquifer which shows hydraulic connection with the overlying zones but with delayed pressure response and little inter-zonal flow in the unimpacted areas with few water wells. In the project area, the unimpacted deep aquifer contains groundwater which comes primarily from lateral recharge from sources of deep infiltration near the upgradient limits of the Kern Fan far to the east, rather than from downward vertical recharge. Since the deep groundwater has traveled a long flowpath with a long subsurface residence time, the water chemistry of the deep aquifer is different than the shallow water as we would expect from geochemical considerations. The water chemistry of the unimpacted deep groundwater may be summarized as having low TDS (119 mg/l), very soft Hd (6 mg/l), basic, elevated pH (9.4), elevated As (10 - 139 ug/l), low alpha (0.8), and low NO3 (± 0.8 mg/l). These data are presented in Tables 2 & 3 and on maps in Figures 11 - 16. According to available data, the brine plume does not currently extend into the deep zone of the aquifer.

Middle aquifer water chemistry. The middle zone (approx. 300 - 500 ft deep) is transitional between the shallow and deep zones in both hydraulic behavior and water chemistry and varies depending on location. The middle zone has a water chemistry which appears to be a stoichiometric blend of the shallow and deep waters. The water chemistry of the upper middle zone looks somewhat more like that of the shallow aquifer water and the water chemistry of the deeper middle zone looks somewhat more like that of the deeper aquifer water. We are limited by the spatial distribution of data points but the middle zone appears to be a thin, unimpacted, transitional zone between the shallow and deep aquifers on the northwest and southeast margins of the Kern Fan whereas the middle zone appears to be a thick zone of manmade blending underneath a contiguous area centered on the fan which includes the Pioneer North Project and the central portion of the Kern Water Bank which is north of the Kern River channel and east of Bussell Road.

Section IV - Water Chemistry of Local Water Wells.

According to public records, there have been eleven (11) water wells drilled or re-drilled between 1950 and 1976 on the Strand Ranch property. The wells were either irrigation wells or shallow domestic water wells which were completed across the shallow zone (5 wells) or both shallow and intermediate aquifer zones (6 wells). None of these wells were completed in the deep zone of the aquifer. IRWD sampled the five currently-existing, accessible wells (W1, W2, W3, W4, and W6) in December, 2003 (Figure 10). As we would expect, the water chemistries in each of the five wells is a plume-impacted blend of shallow and intermediate zone water chemistries (Exhibit 2).

All five wells clearly show the impacts of the brine plume migrating under the Strand Ranch project site. The waters in all five wells have elevated TDS ranging from 410 - 800 mg/l (avg 618 mg/l) and elevated shallow-zone COCs (alpha = 11 pCi/l and NO3 = 24 mg/l) relative to the unimpacted shallow aquifer (TDS = 229 mg/l) which we have mapped in the study area. Based on a simple blending calculation, the waters from these five wells are about two-thirds plume water and one-third non-plume aquifer water. In our opinion, these well-water analyses are representative of the plume-impacted waters in the shallow and upper-intermediate aquifer zones under the Project site.

The water wells in the surrounding sections to the north include 3 irrigation wells in the Rosedale - Rio Bravo Water Storage District (Figure 10), all of which are downgradient from the Project site, approximately ½ - 1 mile NNW of the north Project boundary. We do not know the depth intervals of these three wells (Enns-N, Enns-S, and Nikkel) but all three wells have water chemistries which are typical of a somewhat plume-impacted shallow aquifer: elevated TDS (312 - 448 mg/l), slightly basic pH (7.5 - 7.8), hard to very hard Hd (174 - 236 mg/l), low As (<1 ug/l), elevated alpha (>10 pCi/l), and moderate NO3 (6-7 mg/l). In our opinion, these three well analyses are representative of the plume-impacted shallow aquifer in this area (Exhibit 2).

The water wells in the surrounding sections to the south and west include banking project recovery wells which belong to the Kern Water Bank (Figure 10). The four wells for which we have data are all within ½ -mile of the south or west Strand Ranch property line. Wells 11A and 11C are upgradient from the Project site and wells 03Q and 03R are lateral to the Project site. We do not know the depth intervals of these four KWB wells but based on the reported water chemistries, well 11A appears to produce water from the deep aquifer zone (low TDS, high pH, elevated As, low alpha, and low NO3) and wells 11C, 03Q, and 03R all produce water from the plume-impacted shallow or shallow and intermediate zones (moderate TDS, lower pH, low As; unreported alpha and nitrate). Although well 11A is located substantially inside the recognized plume perimeter, it shows no constituent evidence of plume impacts and therefore, we conclude that it must be completed in a depth interval which is below the depth of recognizable plume impact. The TDS values at the other three locations are elevated with respect to the unimpacted shallow aquifer and therefore are useful in mapping the lateral and downgradient extents of the migrating brine plume. These data have been combined with the monitoring well data and the data from the Strand Ranch and Rosedale irrigation wells and are included in the shallow- aquifer TDS contour map shown in Figure 10.

The KCWA Improvement District No. 4 water treatment plant has historically received inlet water from recovery wells on the Kern Water Bank. The KWB source water (11 analyses over several years) came from unspecified wells but we assume that it was a blend from conveniently-located wells with "acceptable" water quality. This KWB water at the inlet to the ID4 treatment plant had a water chemistry which was consistent with a blend of 17% shallow aquifer water and 83% deep aquifer water: avg TDS (143 mg/l), slightly basic pH (7.6), very hard Hd (445 mg/l), elevated As (9.9 ug/l), low alpha (3.7 pCi/l), and low NO3 (2.7 mg/l). We consider this to be consistent with the KWB preference for deep wells in their project area.

<u>Aqueduct and Cross Valley Canal Pump-in Criteria.</u>

The California Department of Water Resources (DWR) requires that all waters which enter the California Aqueduct must meet their water quality criteria, i.e., that the water is of "consistent, predictable, and acceptable quality"[6]. The Kern County Water Agency has incorporated those same standards for all waters which enter the Cross Valley Canal which serves several member districts within Kern County and connects to the Aqueduct. The DWR water quality criteria establish two levels of acceptable water quality as follows: Tier 2 water is of lesser quality with respect to the DWR standards[7] such that water from a specific source can only be pumped into the aqueduct after the *DWR facilitation group* has reviewed the water quality and approved it on a specific case-by-case basis; Tier 1 water is of better quality with respect to the DWR standards and water *"meeting Tier 1 water quality standards shall be approved* [for delivery into the Aqueduct] *by DWR without further review..."*.

It is very desirable for a water source to have a Tier 1 designation because it creates tremendous flexibility in conveyance scheduling which is not subject to review, delay, or perhaps disapproval by the facilitation group. Kern River water meets Tier 1 criteria and Kern Fan groundwater, perhaps with minor blending, can meet Tier 1 criteria as well.

Some of the plume-impacted, shallow aquifer water under the Strand Ranch Project site exceeds the DWR constituent concentration limits and would not meet the Tier 1 water quality criteria unless it was blended with "better quality" water to dilute the objectionable constituents down to acceptable levels. The unimpacted shallow groundwater adjacent to the site is at or near-Tier 1 water quality, so at such time as the brine plume has been fully remediated by natural and/or project operations, the shallow aquifer under the Project will be at or near Tier 1 water quality, all else equal.

Section V - Water Chemistry Interactions and Impacts.

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[6]Interim Department of Water Resources Water Quality Criteria for Acceptance of Non-Project Water into the State Water Project. March 1, 2001.

[7]The March 1, 2001 Interim DWR water quality standards are presented on pp. D-4 through D-7 of the KCWA 2001 Kern Fan Operations and Monitoring Report. Examples of Kern County pump-in water quality from seven different sources is presented on p. E-6 of the same Report.

Land Conversion Impact. The potential water quality impacts from converting the site from agricultural use to an ASR site has two recognized elements. The first element is that by eliminating the Ag use of the land, the site has been eliminated as a potential source of allowable, but potentially undesirable low-grade, agriculture-related, shallow-aquifer degradation. We have no data on what agricultural products may or may not have been used on the property in the past. If such products had been used, then the conversion to project operations represents a cessation of such product use. And the conversion to an ASR project eliminates the potential future use of pesticides, fertilizers, sulfur compounds, and other Ag products from potential use. In our opinion, this element of site conversion is a neutral or positive impact on the aquifer.

The second element is that the future, initial episode of large-volume recharge which will occur as each new recharge pond is put into operation may be the first re-saturation of the underlying sedimentary column from the ground surface to the water table in several years, depending on the climate. Such a re-saturation may result in a short-term flushing of accumulated salts from the shallow strata which will enter the shallow aquifer. We are not aware of any data or any estimates of such impacts for any other ponds in any other projects in Kern County that such impacts exist or have been observed. In our opinion, we do not expect that such re-wetting events will have any significant, long-term impacts.

Moreover, the area experienced two consecutive years of major recharge since 2003 which raised the shallow water table on the entire Kern Fan and to within 5 ft of the ground surface within much of the Strand Ranch site. This major rise in the shallow water table was subsequently followed by the current drought and water levels have since dropped by 100 ft. The point is that this water table fluctuation has thoroughly purged the shallow strata of soluble salts in the recent past, so we conclude that there will be no significant future buildup of shallow salts between now and the start of the project since most of the acreage has already been fallowed.

Recharge and Recovery Salt Balance Impact.

Based on reported historical data, every existing ASR banking project on the Kern Fan (Pioneer, Berrenda Mesa, 2800 acres, and Kern Water Bank) has a positive impact on the basin by removing more dissolved salts in their recovery water than is put into the basin in their stored surface water (Table 4). This is true on a volume-for-volume basis because the average

TDS concentration is lower in the stored surface water and higher in the recovered water. For example, for the 2001 operating year, the reported average TDS of surface waters stored in the basin was 121 mg/l and the average TDS of ground waters removed from the basin was 218 mg/l, and therefore there was an average decrease in basin salt load of -97 mg for every liter of water. That is equivalent to a net removal of 264 lb of salt for every acre-foot of stored-then-recovered water (data from KCWA 2001 Kern Fan Monitoring Report, Figure 5D-1).

Based on the same source of reported historical data (KCWA 2001 KFMR, Tables 5D- to 5D-8), the incoming salt load varies significantly depending on the source of surface water which is stored in the projects. For example, for the reporting period from 1995 through 2001, 29% of all stored water came from the SWP via the Aqueduct, 28% came from the CVP via the FK canal, and 43% came from the Kern River. However, 57% of the total salt load came from the SWP water, only 11% came from the CVP water, and 32% came from the Kern River. Despite the nearly equal surface water volumes coming from the SWP and CVP, the salt load from the SWP was five times higher than that from the CVP because of the 5-fold difference in average TDS contents (227 mg/l vs 43 mg/l) of the respective waters over this time period. The salt load from the imported SWP water for the period was 180% greater than that of the Kern River even though the volume of SWP water was only 67% of the volume of KR water because of the difference in respective TDS contents. It is clear that SWP surface water is the least desirable source of surface water from a TDS salt balance perspective because it brings in the highest concentration of dissolved salts of the three potential sources.

For the Strand Ranch Project, the basic hypothetical salt balance data are as follows. The historical average TDS contents of the three potential sources of surface water are SWP TDS = 227 mg/l, KR TDS = 88 mg/l, and FK TDS = 41 mg/l. The average TDS contents of the local aquifer waters in the study area are: unimpacted shallow TDS = 229 mg/l, plume-impacted area-weighted shallow TDS = 559 mg/l, and unimpacted deep TDS = 119 mg/l.

Based on these data, all of the surface waters have TDS concentrations which are less than the plume-impacted shallow aquifer waters near and under the Project site and both the KR and FK have TDS contents that are less than that in any part of the underlying aquifer. If we look at the historical SWP data for the project operating period from 1995 - 2001, it is clear that the SWP water actually delivered to Kern County with an average TDS = 227 mg/l is much less than the unweighted, long-term, historical average of 334 mg/l (measured at the inlet to the ID4 water treatment plant) so it is possible to obtain large volumes of SWP surface water for banking programs at much less than the historical average TDS.

We have calculated a number of recharge/recovery salt balances for the project and for the wide range of all realistic assumptions, the hypothetical Project salt balances are all positive, i.e., there is a net loss of salt from the groundwater basin because of project recharge and recovery. The calculations yield a base case salt load balance of -118 mg/l (net loss of salt from the basin, equivalent to a loss of -332 lb per acre-foot).

We note that the predicted Strand Ranch Project positive impact (-118 mg/l salt loss) is in the same range as the 2001 reported project impacts from the existing Kern Fan banking projects which ranged from -72 mg/l at the Berrenda Mesa project to -129 mg/l at the Pioneer project. The 2001 Kern Water Bank salt balance was -99 mg/l. And we also point out that since the Strand Ranch Project has the elevated-TDS brine plume to deal with, the predicted Strand Ranch salt balance beneficial impact may be greater depending on the fraction of shallow-aquifer water which is captured in total recovery volume.

The salt balance calculations are included in tables 3.1 - 3.3 of Exhibit 3. Table 3.1 presents the hypothetical long-term average recharge TDS based on various relative mixes of SWP, KR, and FK source waters. Hypothetical inflow blends 11-16 and 21-26 are for assumed SWP TDS conditions of 334 and 227 mg/l, respectively as previously described. We have assumed In-Blend 26 to be our hypothetical base case and an long-term average inflow TDS of 111 mg/l.

Table 3.2 presents the hypothetical long-term average recovery TDS based on various relative mixes of shallow and deep aquifer waters. Hypothetical outflow blends 31-38 and 41-48 are for assumed shallow aquifer TDSD conditions of 559 and 237 mg/l, respectively for brine-plume and non-plume conditions. We have assumed Out-Blend 36 to be our hypothetical base case and a long-term average outflow TDS of 229 mg/l.

Table 3.3 presents a matrix of hypothetical long-term net aquifer salt balance outcomes for the various in-flow conditions listed across the top of the table and the various outflow conditions listed down the left side of the table. The base case conditions (in bold) assume long-term average inflows at +111 mg/l TDS and long-term average outflows at -229 mg/l TDS resulting in a net loss of salt from the basin at a rate of -118 mg/l. The base case assumes that the long-term average surface water inflow to the project is 20% SWP, 70% KR, and 10% FK at TDS contents of 227, 88, and 41 mg/l, respectively. The base case assumes that the long-term average recovered water outflow from the project is 25% shallow aquifer and 75% deep aquifer at TDS contents of 559 and 119 mg/l, respectively. Other possible scenarios may be read directly from the table.

Recharge and Recovery Constituent-of-Concern (COC) Impact.

Based on reported geochemical data, all COC concentrations in the three potential sources of surface water are significantly below the respective MCLs and are at lower concentrations than in the ground waters in the study area. Therefore, we conclude that the COC balance for all species of interest is favorable to the basin, without the need to perform the calculations to demonstrate this.

Figures

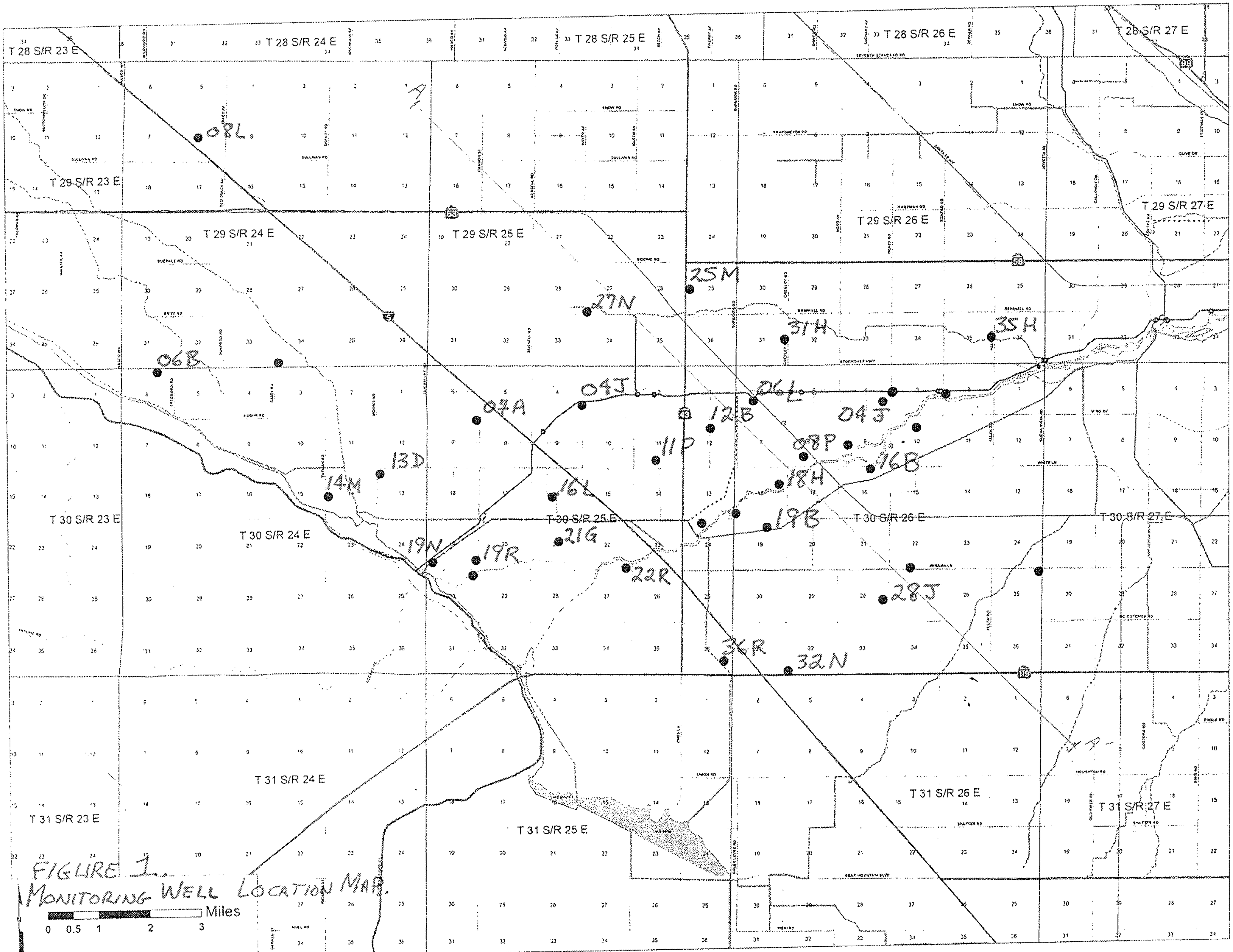


FIGURE 1.
MONITORING WELL LOCATION MAP.

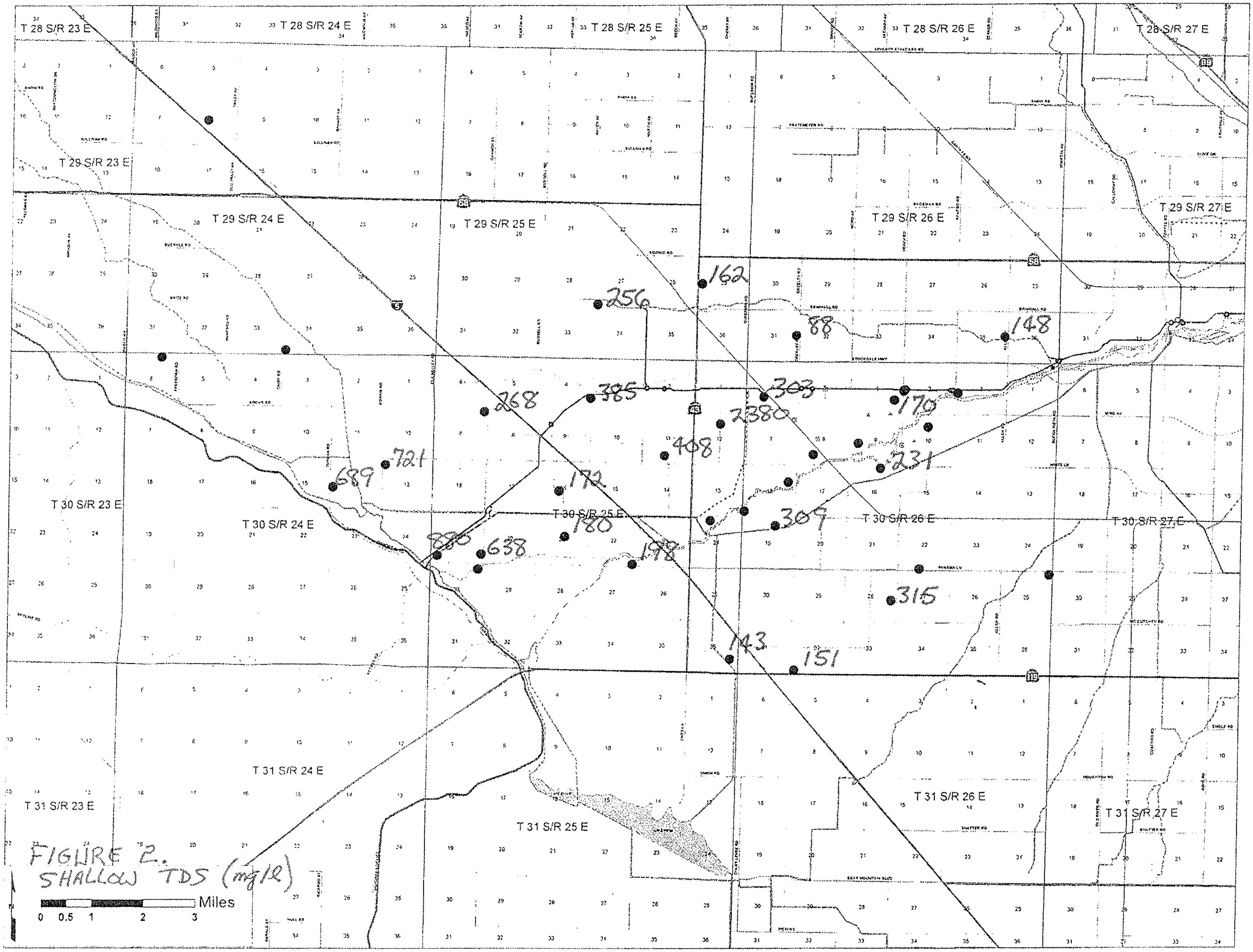


FIGURE 2.
SHALLOW TDS (mg/l)

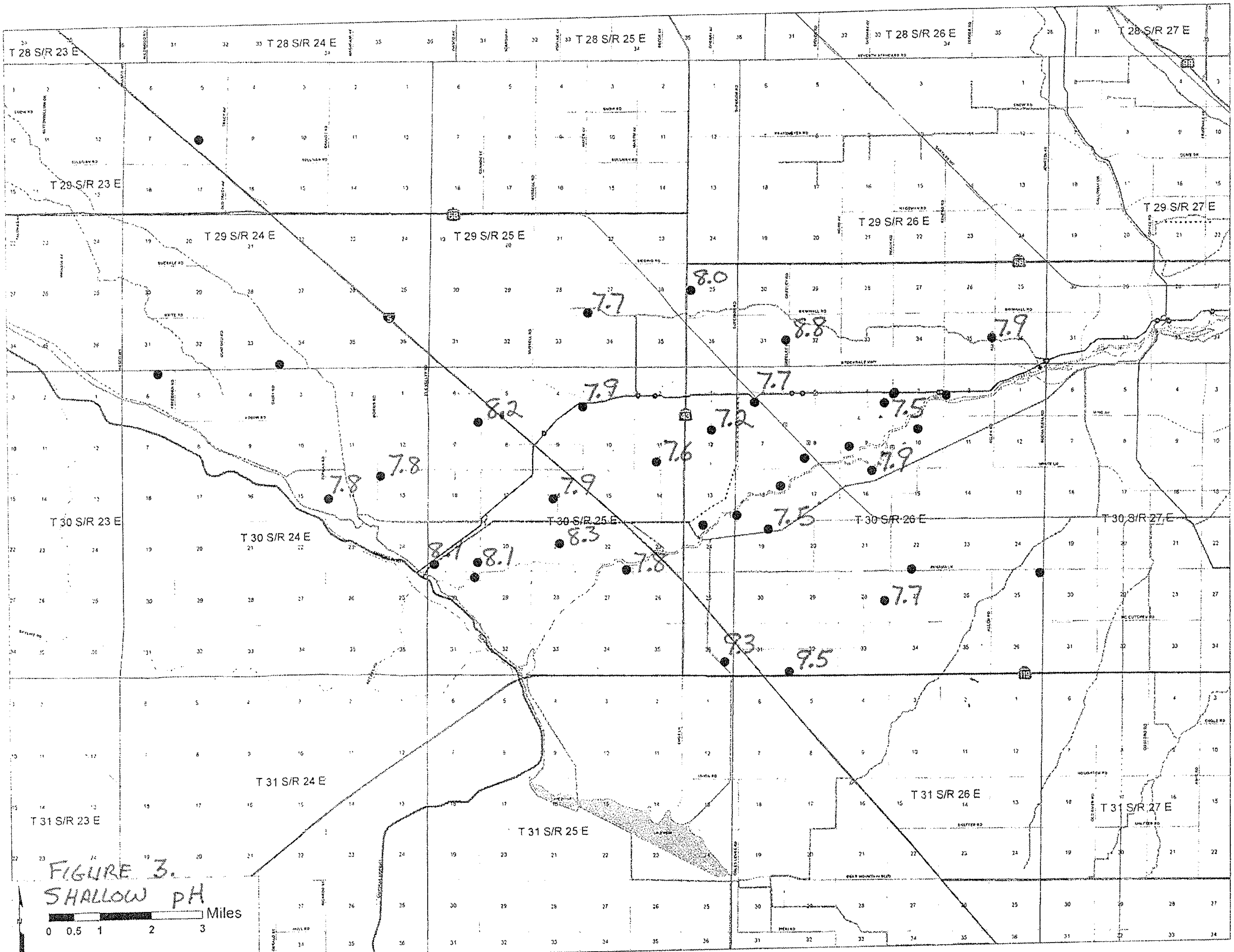


FIGURE 3.
SHALLOW pH

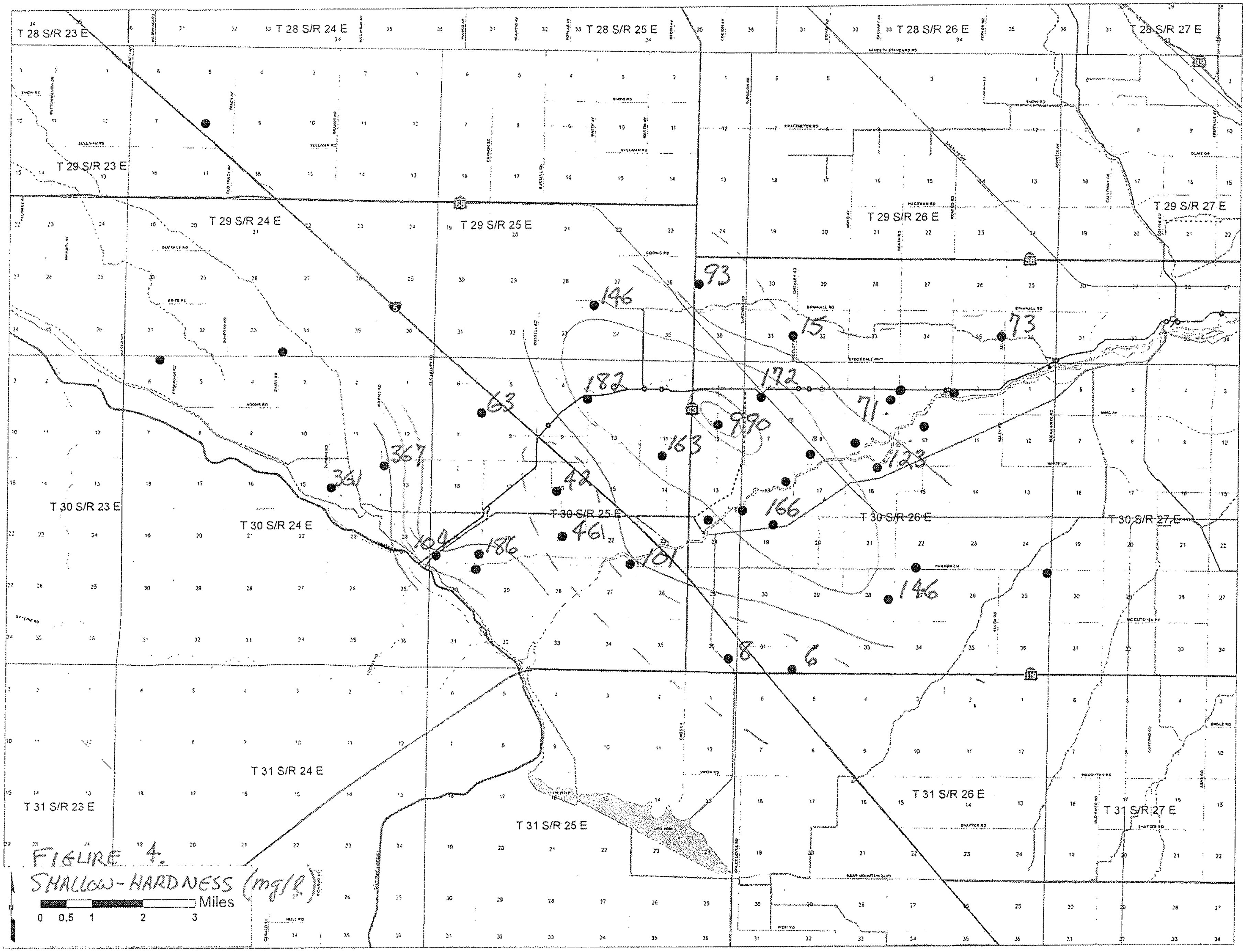


FIGURE 4.
SHALLOW-HARDNESS (mg/l)

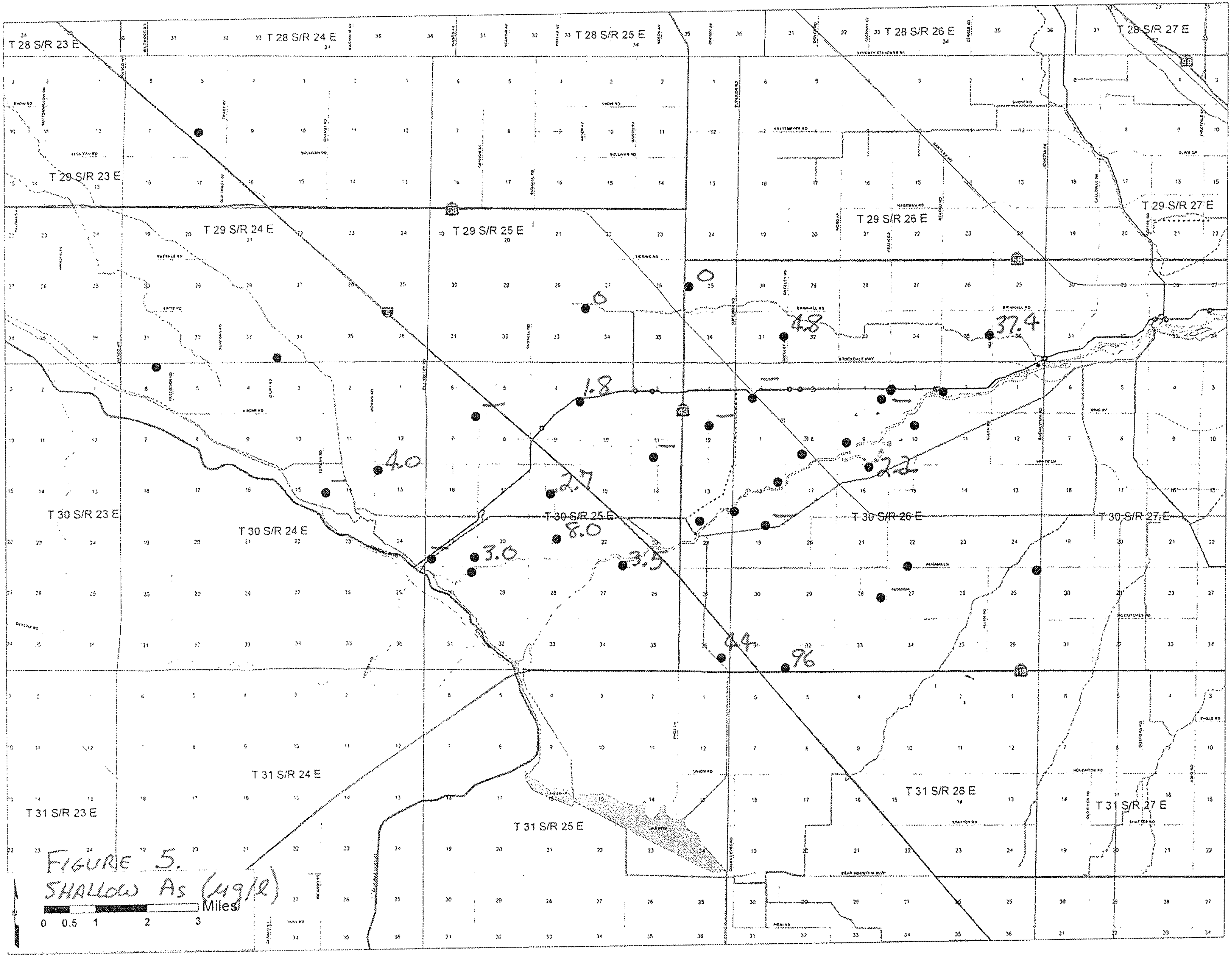


FIGURE 5.
SHALLOW As (µg/l)

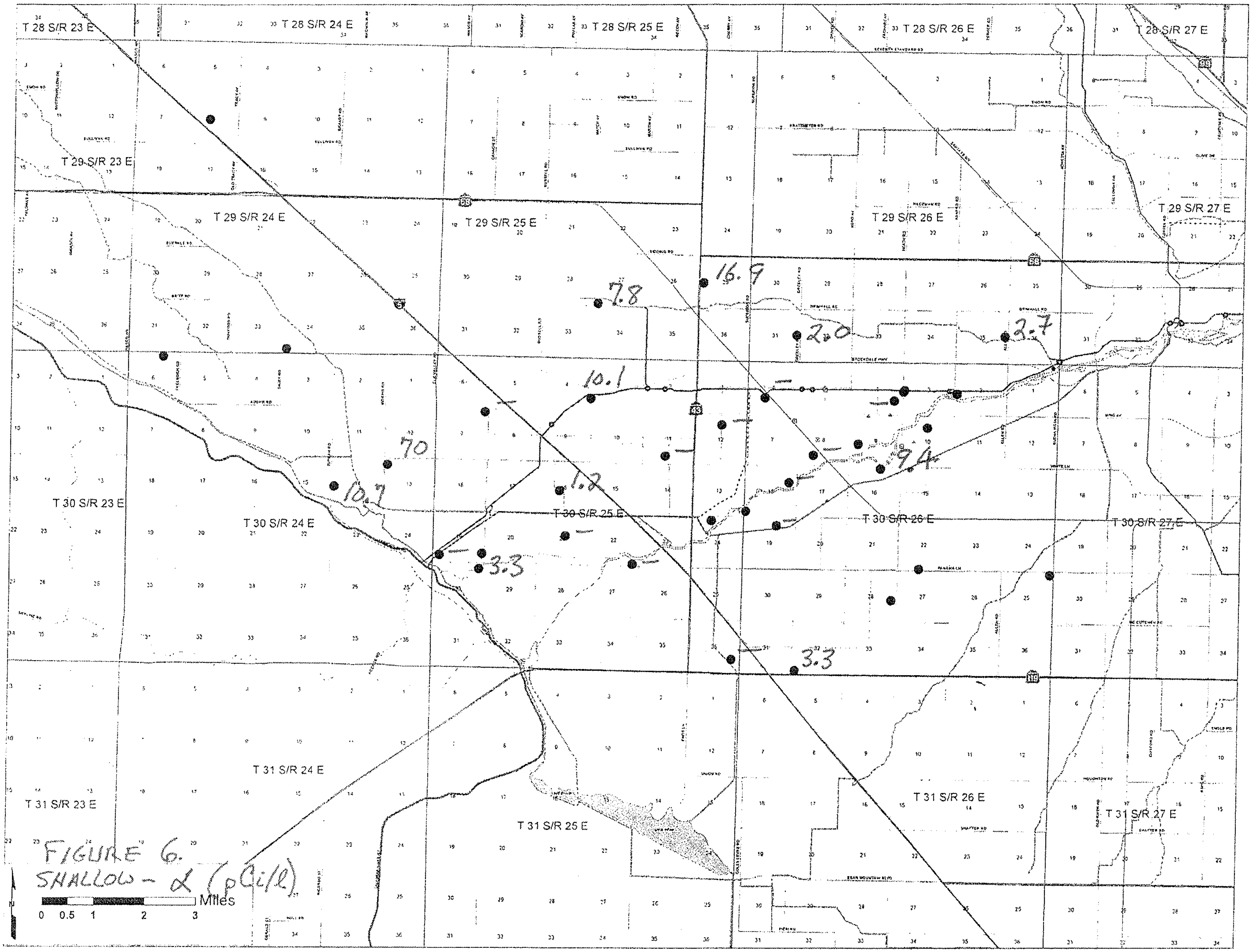


FIGURE 6.
SHALLOW - α (pCi/l)

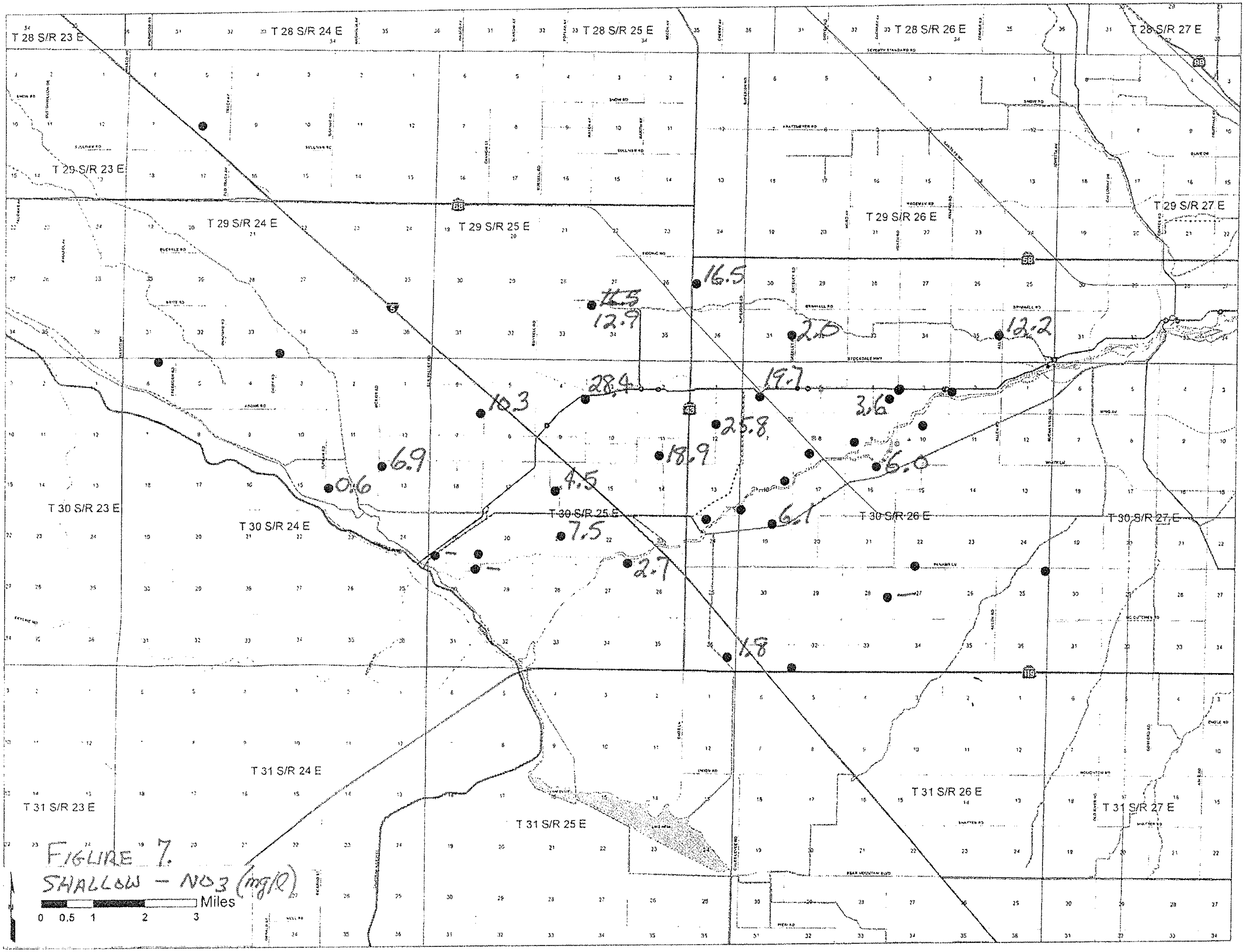


FIGURE 7.
SHALLOW – NO3 (mg/l)

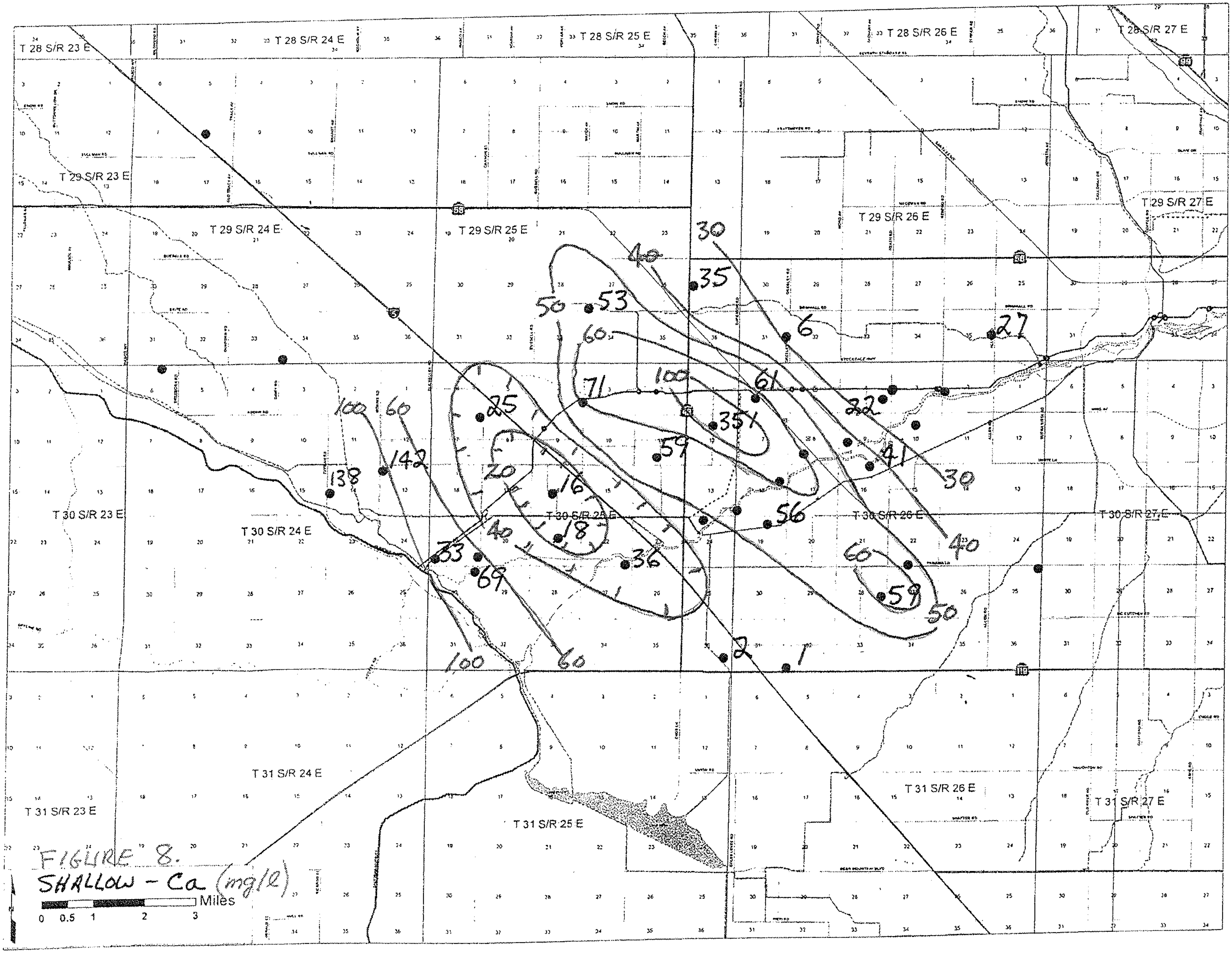


FIGURE 8.
SHALLOW - Ca (mg/l)

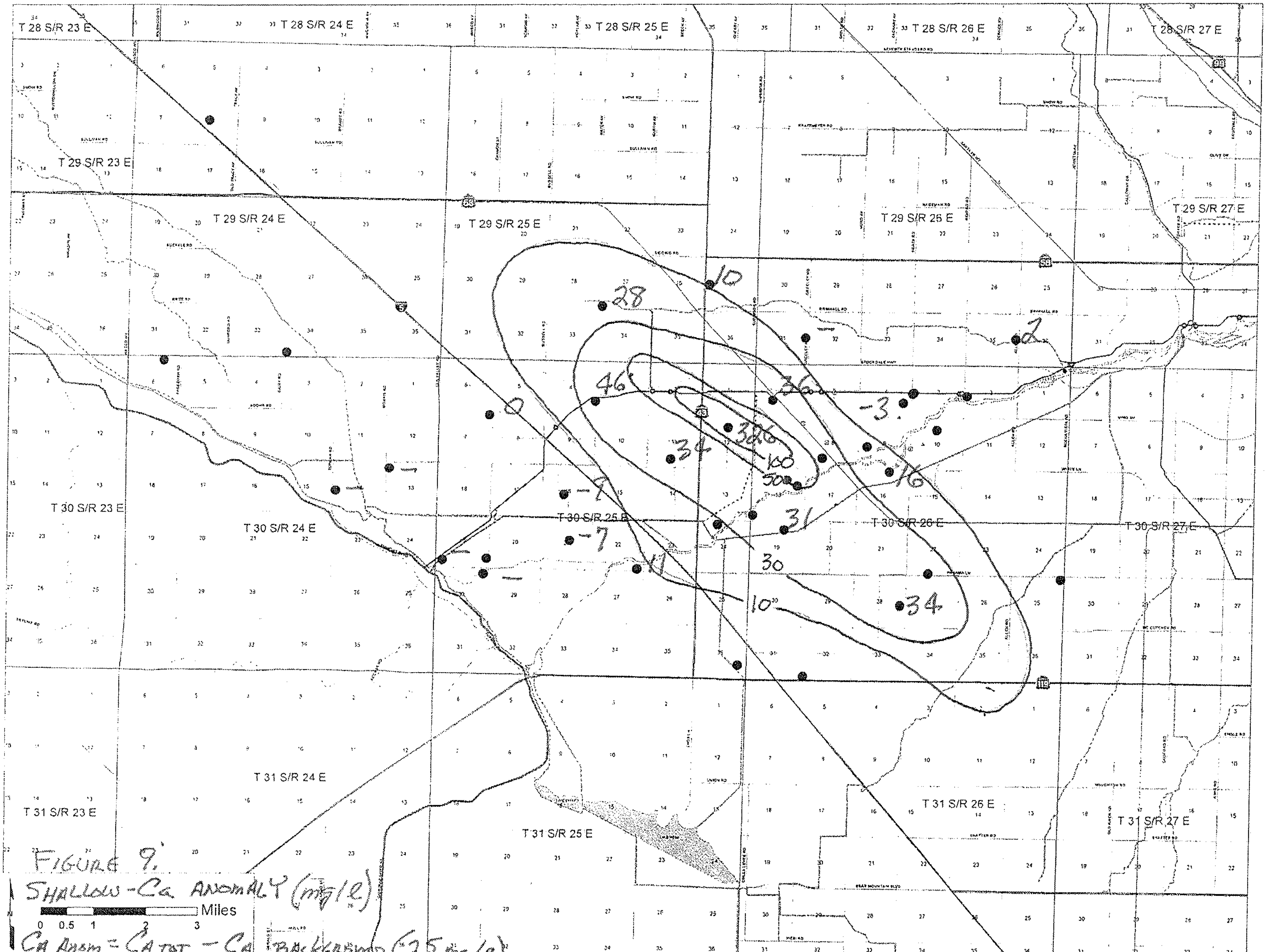
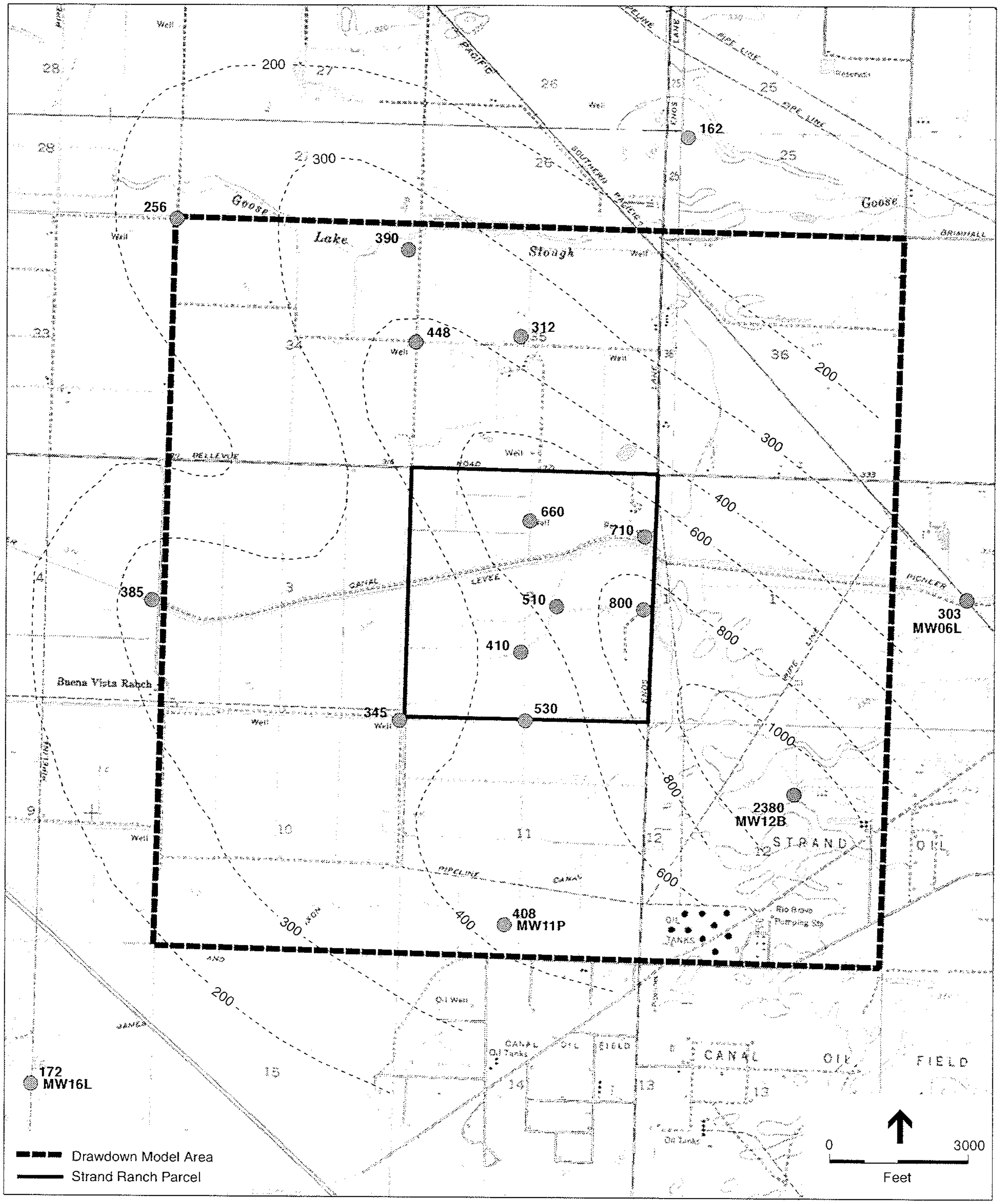


Figure 9.
Shallow-Ca anomaly (mg/l)
Ca Anom = Ca tot - Ca background (25 mg/l)



SOURCE: USGS; Sierra Scientific Services, 2007; ESA, 2007.

Irvine Ranch Water District . 205426

Figure 10
Contour Map of Shallow Aquifer
TDS Content (mg/l)
Showing Plume Impact

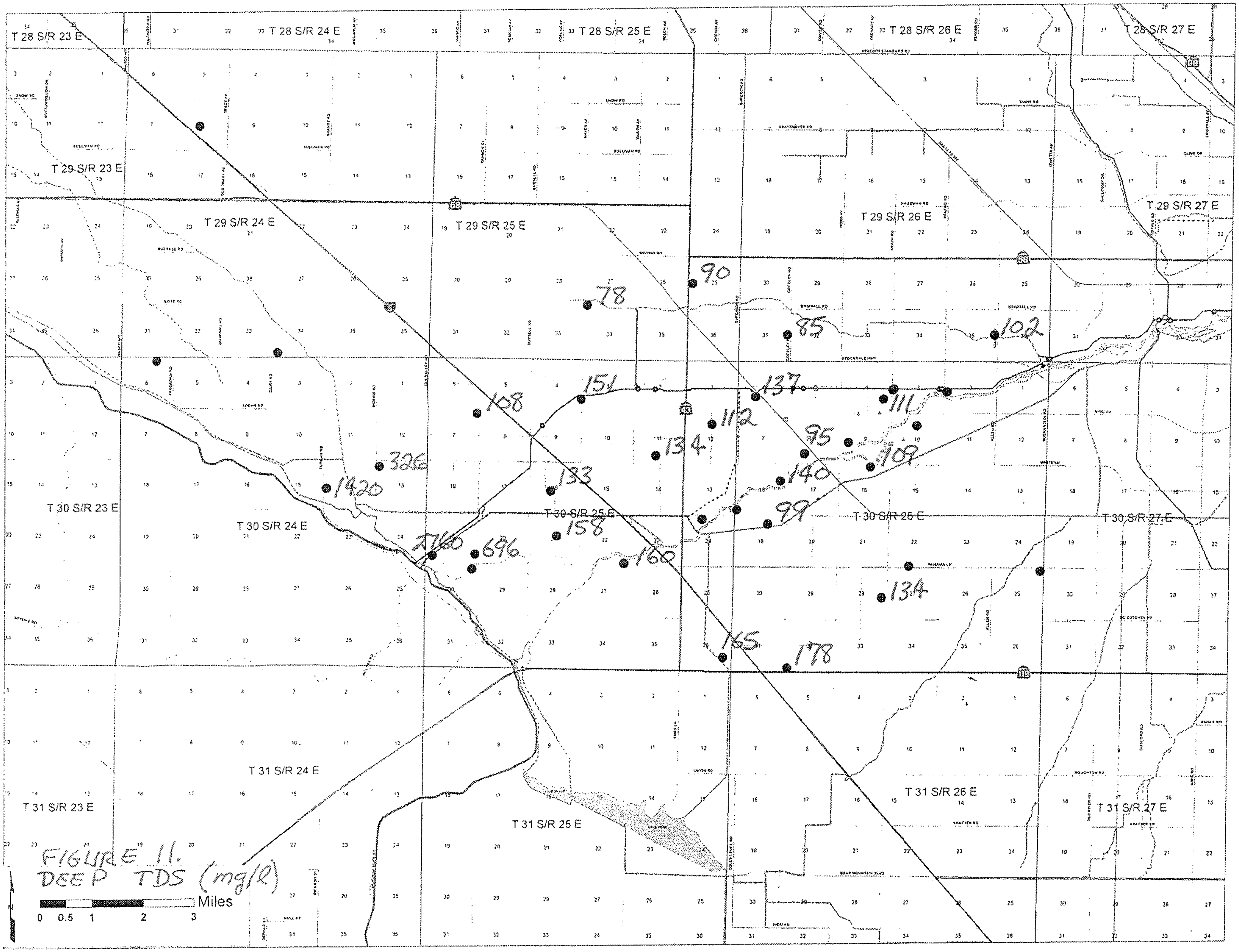


FIGURE 11.
DEEP TDS (mg/l)

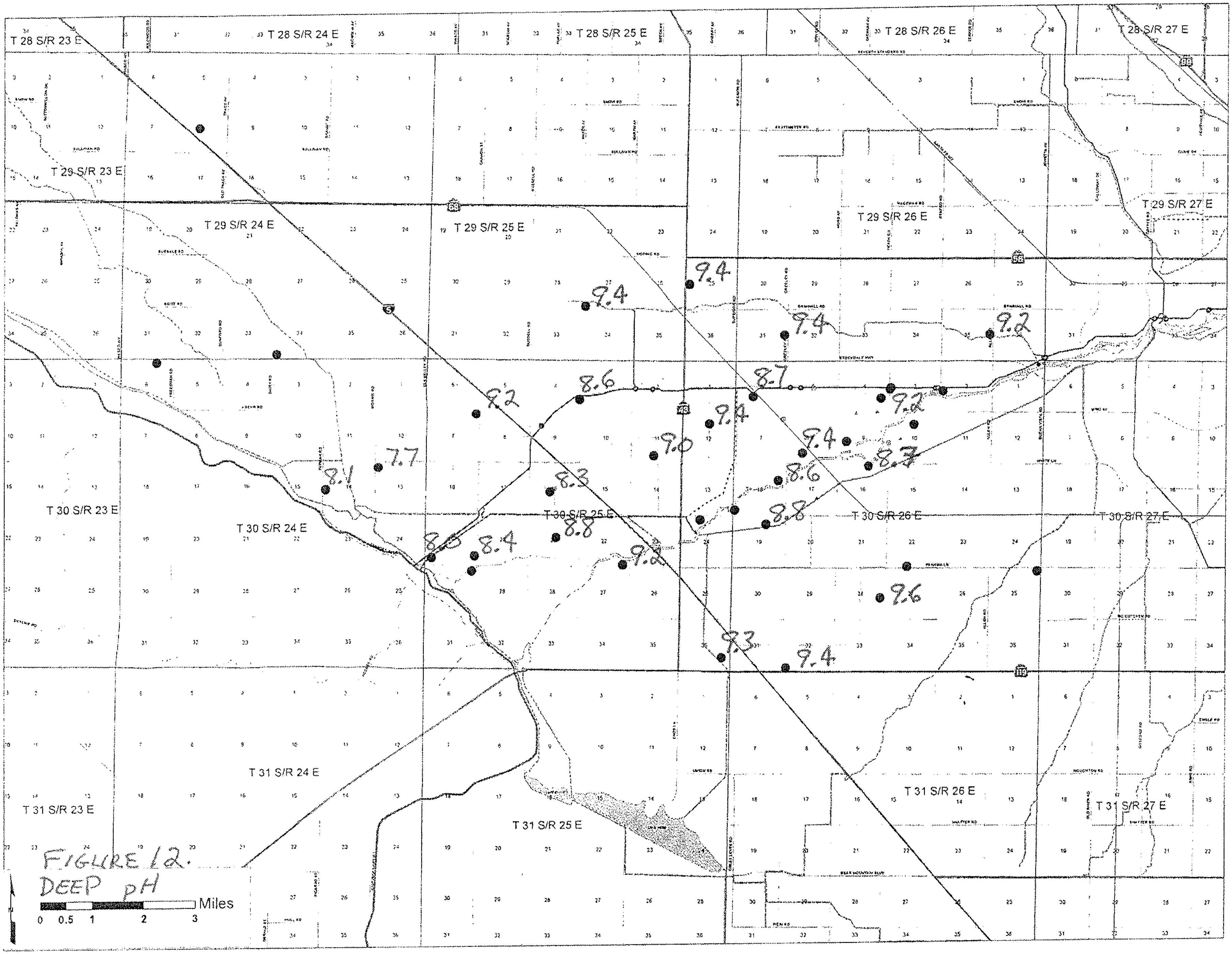


FIGURE 12.
DEEP pH

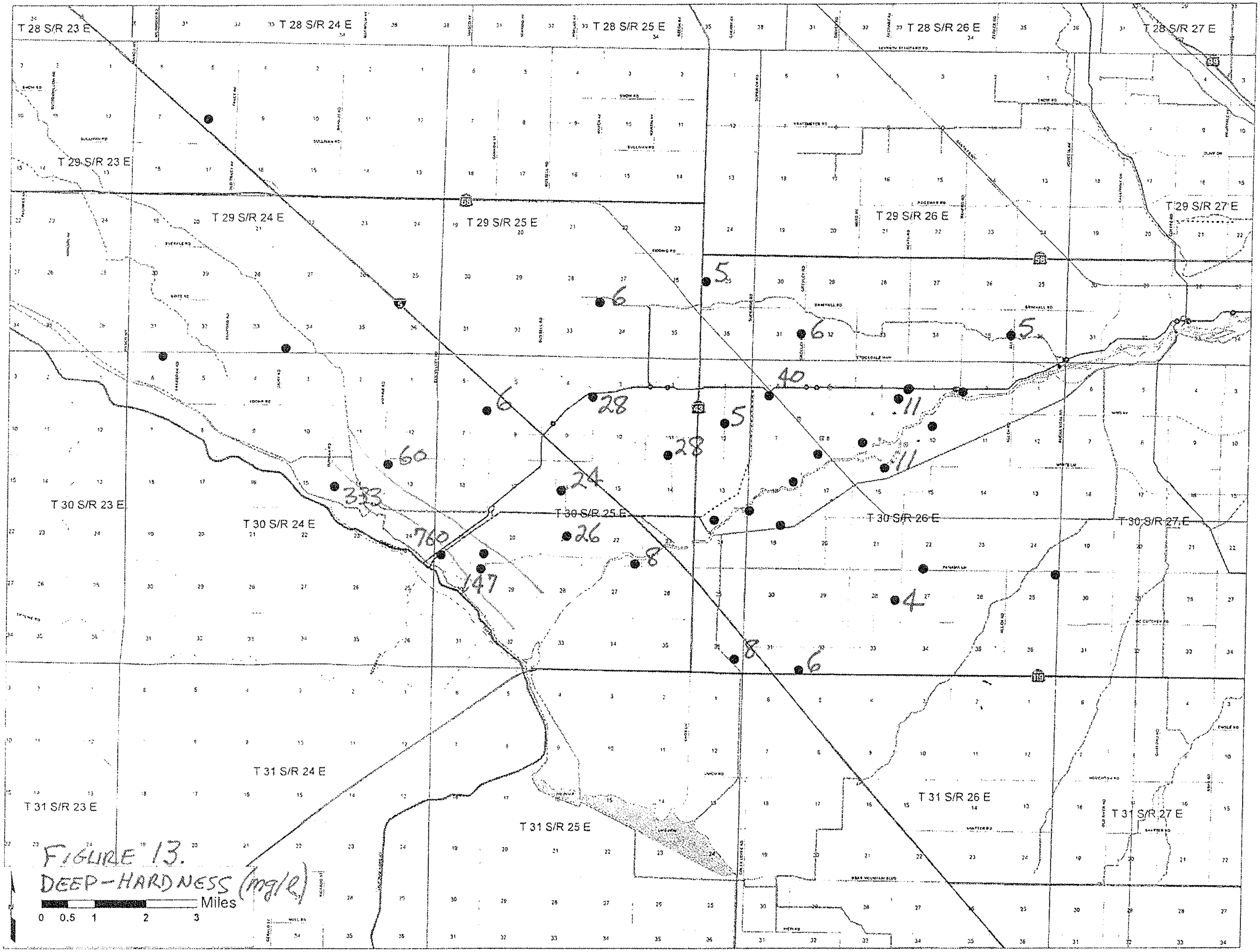


FIGURE 13.
DEEP-HARDNESS (mg/l)

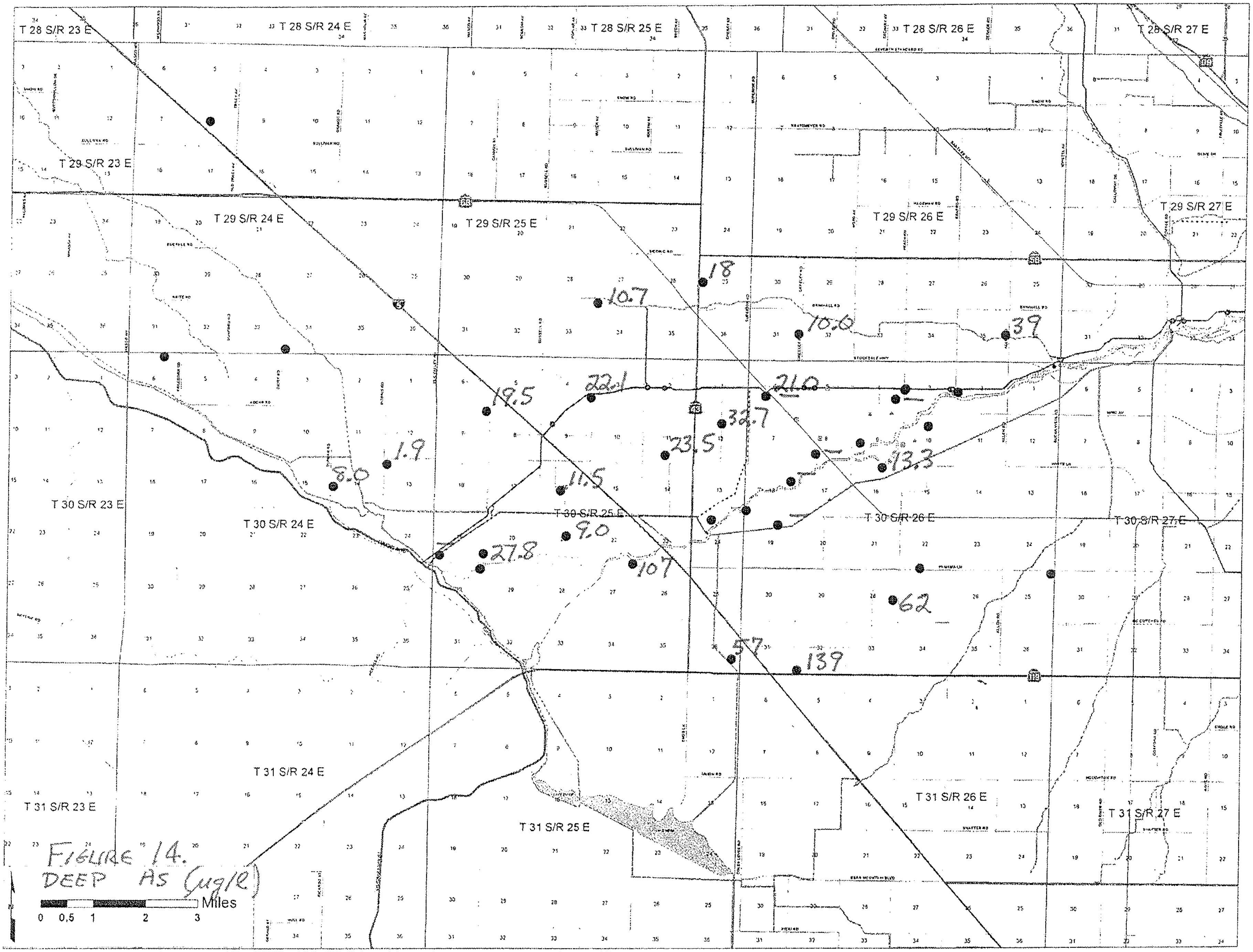


FIGURE 14.
DEEP As (ug/l)

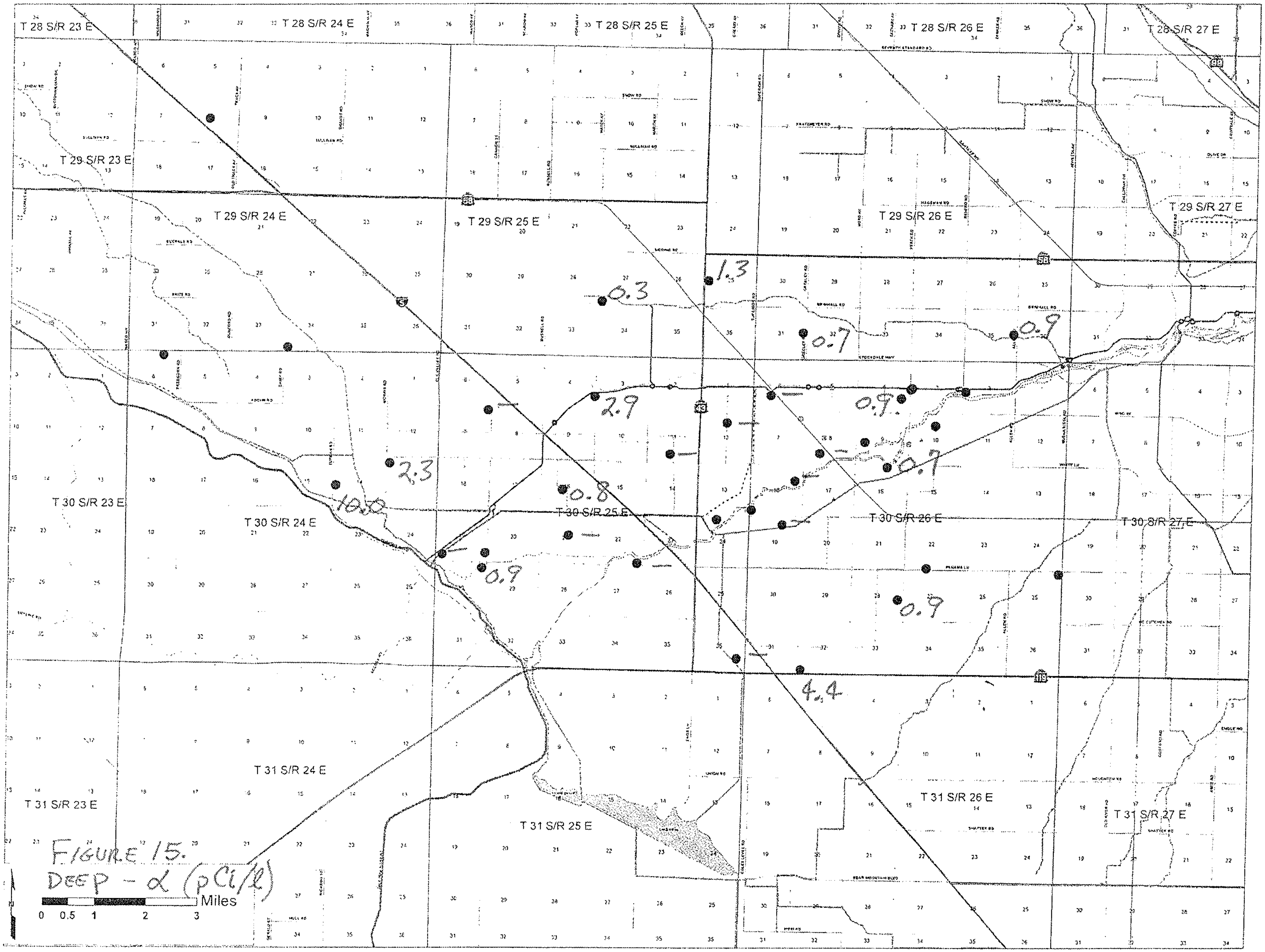
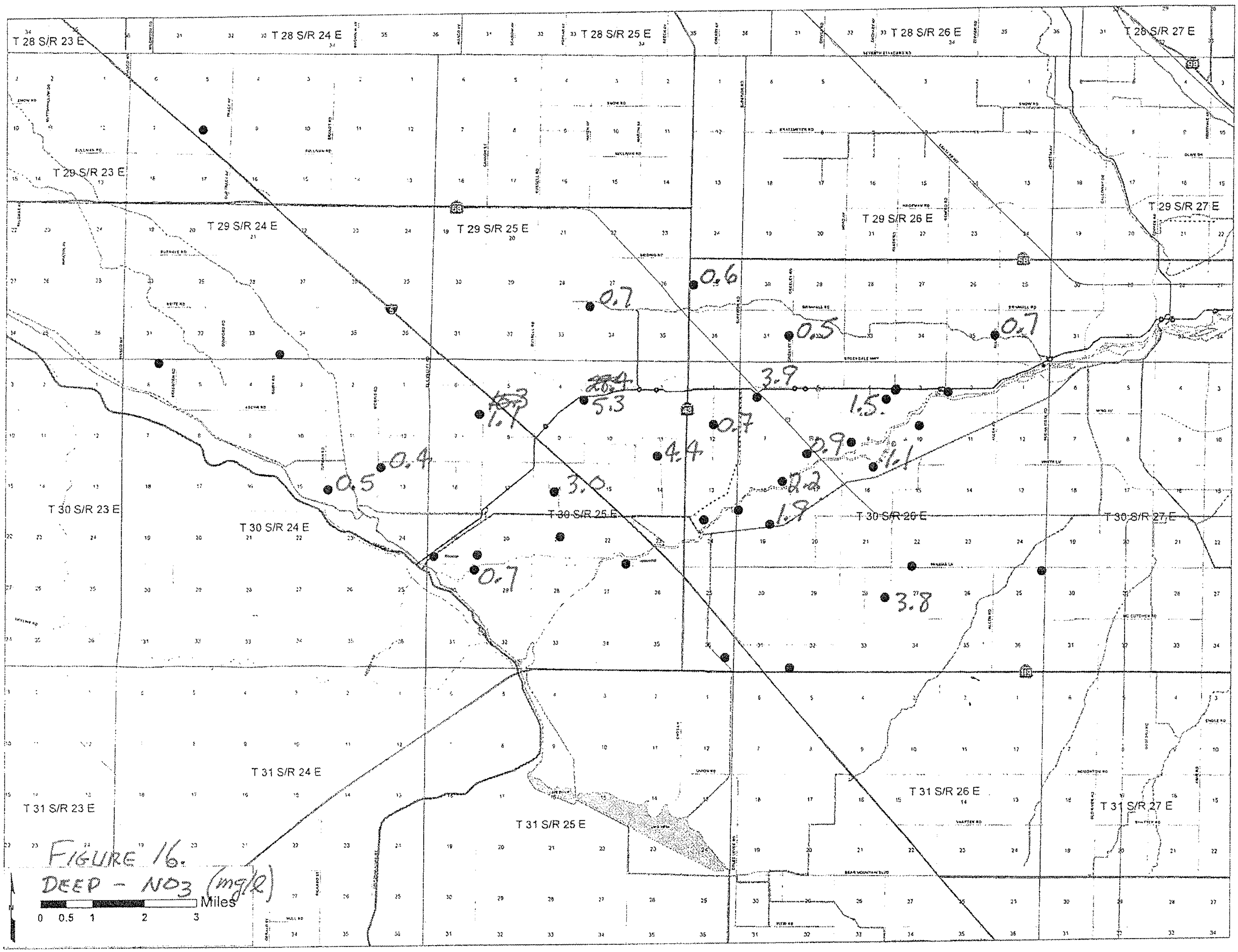


FIGURE 15.
DEEP - α (pCi/l)


T 28 S/R 23 E
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T 30 S/R 26 E
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T 31 S/R 23 E
T 31 S/R 24 E
T 31 S/R 25 E
T 31 S/R 26 E
T 31 S/R 27 E
0.6
0.7
0.5
0.7
3.9
5.3
1.1
1.5
0.7
0.9
4.4
1.1
0.4
2.2
0.5
3.0
1.9
0.7
3.8
FIGURE 16.
DEEP - NO3 (mg/l)
Miles
0 0.5 1 2 3

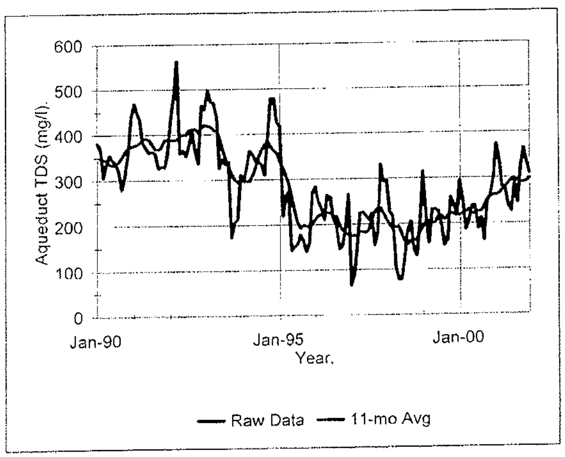
Tables

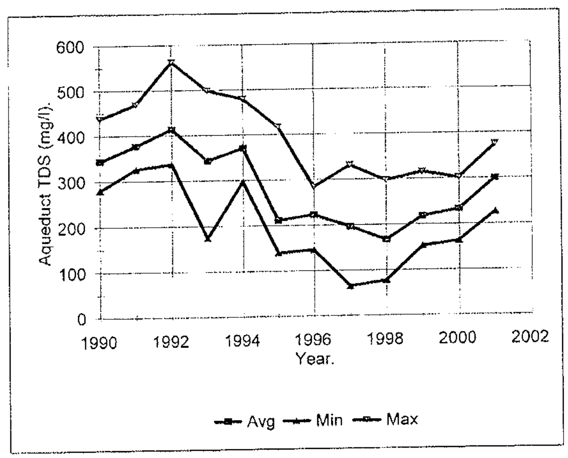
Table 1. SWP Aqueduct Water TDS content by Year, Month, and Wet/Dry Season.

(Measured in the Ca. Aqueduct at check 29, near Taft Hwy.)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001		Avg	Min	Max	Std	5-yr Dry 91-95	5-yr Wet 96-00
Jan	382	469	439	499	297	417	284	66	297	315	295	374	*	345	66	499	110	424	251
Feb	369	448	485	472	328	219	251	88	227	216	250	337	*	308	88	485	116	390	206
Mar	306	433	563	470	363	263	236	147	218	158	187	280	*	302	147	563	125	418	189
Apr	335	382	358	441	357	274	211	225	108	231	206	275	*	284	108	441	90	362	196
May	355	371	366	326	340	144	265	227	78	232	239	239	*	265	78	371	88	309	208
Jun	343	361	353	346	339	152	260	219	78	228	239	227	*	262	78	361	86	310	205
Jul	338	363	377	334	333	158	214	210	124	199	189	291	*	261	124	377	84	313	187
Aug	319	359	410	339	310	178	197	224	186	153	213	245	*	261	153	410	80	319	195
Sep	280	326	361	174	395	165	146	154	206	164	164	323	*	238	146	395	88	284	167
Oct	310	329	337	206	479	141	152	180	142	258	248	365	*	262	141	479	101	298	196
Nov	357	329	464	214	480	160	195	331	130	242	262	333	*	291	130	480	107	329	232
Dec	438	356	456	311	427	270	266	293	207	219	301	310	*	321	207	456	79	364	257
Avg	344	377	414	344	371	212	223	197	167	218	233	300						344	208
Min	280	326	337	174	297	141	146	66	78	153	164	227						284	167
Max	438	469	563	499	480	417	284	331	297	315	301	374						424	257
Std	39	46	65	105	59	79	43	73	64	44	41	47						45	26
Max/Min	1.6	1.4	1.7	2.9	1.6	3.0	1.9	5.0	3.8	2.1	1.8	1.6						1.5	1.5

Data Source: KCWA 2001 Kern Fan Area Operations and Monitoring Report, Table 5D-9, p. 5-32.





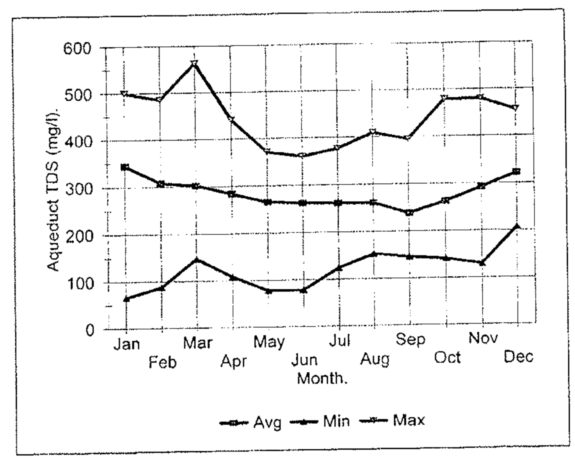


Table 1. SWP Aqueduct Water TDS content by Year, Month, and Wet/Dry Season.

Sierra Scientific Services, 2007. (661) 377 - 0123.)

Table 2. Key Constituents for the Shallow and Deep Aquifer at monitoring Well Locations.

(Avg* excludes MW data west of I-5, excludes 3 plume-related wells (04J, 11P, 12B), and excludes 3 off-fan wells (31H, 36R, 32N).

Shallow Aquifer (excl. west side)		AVG*	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG
Well			25M02	27N02	31H02	35H04	13D01	14M03	04J02	07A02	11P01	12B02	16L01	19N02
Depth		Shallow	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh
Domain			Fan-E2	Fan-E2	Fan-E1	Fan-E2	Fan-W1	Fan-W2	Fan-E3	Fan-E2	Fan-E3	Fan-E3	Fan-E3	Fan-W2
# Wells		21												
# Anal.		190	5	8		14	21	6	24	5	5	2	24	1
General Mineral														
TDS	(mg/l)	225.9	162	256		148	721	689	385	268	408	2380	172	880
pH	(pH)	7.8	8.0	7.7		7.9	7.8	7.8	7.9	8.2	7.6	7.2	7.9	8.1
Hd	(mg/l)	103.4	93	146		69	366	375	181	63	163	991	41	100
COCs														
As	(ug/l)	4.1					4.0		1.8				2.7	
Alpha	pCi/l	7.6	7.8	16.9		2.7	69.5	10.7	10.2				1.2	
NO3	(mg/l)	9.3	16.5	12.9		12.2	6.9	0.5	28.4	10.3	18.9	25.8	4.5	

Deep Aquifer. (excl. west side)		AVG*	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG
Well			25M01	27N01	31H01	35H03	13D03	14M02	04J04	07A04	11P03	12B04	16L03	19N04
Depth		Deep	De	De	De	De	De	De	De	De	De	De	De	De
Domain			Fan-E2	Fan-E2	Fan-E1	Fan-E2	Fan-W1	Fan-W2	Fan-E3	Fan-E2	Fan-E3	Fan-E3	Fan-E3	Fan-W2
# Wells		24												
# Anal.		208	6	8	7	8	22	8	18	4	5	4	21	2
General Mineral														
TDS	(mg/l)	123.9	90	78	85	102	326	1420	151	108	134	112	133	2760
pH	(pH)	9.1	9.4	9.4	9.4	9.2	7.7	8.1	8.6	9.2	9.0	9.4	8.3	8.0
Hd	(mg/l)	13.6	5	6	6	5	59	333	26	6	28	5	23	760
COCs														
As	(ug/l)	35.0	18.0	10.7	10.0	39.0	1.9	8.0	22.1	19.5	23.5	32.7	11.5	
Alpha	pCi/l	1.3	1.3	0.3	0.7	0.9	2.3	10.0	2.9				0.9	
NO3	(mg/l)	2.1	0.6	0.7	0.5	0.7	0.4	0.6	5.3	1.1	4.4	0.7	3.0	

Table 2. Key Constituents for the Shallow and Deep Aquifer at monitoring Well Locations.

Table 2. Key Constituents for the Shallow and Deep Aquifer at monitoring Well Locations.

Shallow Aquifer												
(excl. west side)	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG
Well	19R02	21G03	22R01	36R02	04J01	06L01	08P04	16B01	18H04	19B01	28J01	32N01
Depth	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh	Sh
Domain	Fan-W2	Fan-E3	Fan-E3	Fan-E1	Fan-E3	Fan-E3	Fan-E2	Fan-E2	Fan-E22	Fan-E22	Fan-E2	Fan-E1
# Wells												
# Anal.	5	5	7	5	4	7		25		9	4	4
General Mineral												
TDS (mg/l)	638	180	198	143	170	303		231		309	315	151
pH (pH)	8.1	8.3	7.8	9.3	7.5	7.7		7.9		7.5	7.7	9.5
Hd (mg/l)	186	46	100	5	70	171		122		166	153	2
COCs												
As (ug/l)	3.0	8.0	3.5	44.3				2.2				95.5
Alpha pCi/l	3.3							9.4				3.3
NO3 (mg/l)		7.5	2.7	1.8	3.6	19.7		6.0		6.1		

Deep Aquifer.												
(excl. west side)	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG
Well	19R01	21G02	22R03	36R01	04J03	06L03	08P04	16B03	18H04	19B03	28J03	32N03
Depth	De	De	De	De	De	De	De	De	De	De	De	De
Domain	Fan-W2	Fan-E3	Fan-E3	Fan-E1	Fan-E3	Fan-E3	Fan-E2	Fan-E2	Fan-E22	Fan-E22	Fan-E2	Fan-E1
# Wells												
# Anal.	6	4	7	4	9	7	8	25	7	8	6	4
General Mineral												
TDS (mg/l)	696	158	160	165	111	137	95	109	140	99	134	178
pH (pH)	8.4	8.8	9.2	9.3	9.2	8.7	9.4	8.7	8.6	8.8	9.6	9.4
Hd (mg/l)	146	26	8	8	10	38	9	10	19	26	4	5
COCs												
As (ug/l)	27.8	9.0	106.5	57.0		21.0	0.0	13.3			62.0	138.5
Alpha pCi/l	0.9				0.9		0.0	0.7			0.9	4.4
NO3 (mg/l)	0.7	4.0			1.5	3.9	0.9	1.1	2.2	1.9	3.8	

Table 2. Key Constituents for the Shallow and Deep Aquifer at monitoring Well Locations.

Table 3. Key Constituent Summary for Selected Surface Waters and Aquifer Waters.

WQ Summary.		**SW**	**SW**	**SW**	**GW**	**GW**	**GW**	**Well**	**Well**
Type		**AQ**	**FK**	**KR**	**Type-D**	**Type-A**	**Plume**	**KWB***	**SR1-6**
Zone					**Shallow**	**Deep**	**Shallow**	**Blend**	**Blend**
# Wells		na	na	na	8	11	3	?	5
# Analy.		9	6	48	76	66	31	11	5
General Mineral									
TDS	(mg/l)	334	41	88	229	119	1058	143	618
pH	(pH)	8.3	7.5	7.9	7.8	9.4	7.6	8.7	7.9
Hd	(mg/l)	115	22	39	122	6	445	52	272
COCs									
As	(ug/l)	7.0	2.9	5.2	0.7	44.9	0.6	9.9	0.3
Alpha	(pCi/l)	1.9	2.9	3.2	5.1	0.8	3.4	3.7	10.9
NO3	(mg/l)	2.4	1.4	1.0	9.9	0.8	24.4	2.7	24.0
								estimated blend:	
							Vsh/Vtot =	17%	67%
							Vdp/Vtot =	83%	33%

note: Surface water analyses (Aq, FK, KR) from KCWA, ID4 WWTP raw inlet water analyses.
note GW averages from tabulated long -term average monitoring well data.
note: Plume area-avg of 3 MW (neither max nor source): T30s/R25e, 04J, 11P, and 12B.
note: KWB blend from KCWA, ID4 WWTP raw inlet water analyses.
note: Strand Ranch blend from one set of 2003 well water analyses.

Table 3. Key Constituent Summary for Selected Surface Waters and Aquifer Waters.

Table 4. Kern Fan Banking Project Salt Balance Data.

Yr Project	SWP Rchg (af)	FK Rchg (af)	KR Rchg (af)	Total Rchg (af)	SWP Salt (T)	FK Salt (T)	KR Salt (T)	Total Salt (T)	SWP TDS (T/af)	FK TDS (T/af)	KR TDS (T/af)	Total TDS (T/af)	0.0014 SWP TDS (mg/l)	FK TDS (mg/l)	KR TDS (mg/l)	Total TDS (mg/l)	SWP V wtr (%)	FK V wtr (%)	KR V wtr (%)	SWP M salt (%)	FK M salt (%)	KR M salt (%)
1995 BM	11437	18917	4132	34486	4395	1106	472	5972	0.384	0.058	0.114	0.173	283	43	84	127	33.2%	54.9%	12.0%	73.6%	18.5%	7.9%
1995 2800 ac	48287	30020	30908	109215	15860	1754	3529	21143	0.328	0.058	0.114	0.194	242	43	84	142	44.2%	27.5%	28.3%	75.0%	8.3%	16.7%
1995 KWB	70329	47035	104896	222260	18487	2749	11975	33211	0.263	0.058	0.114	0.149	193	43	84	110	31.6%	21.2%	47.2%	55.7%	8.3%	36.1%
1995 Pioneer	10177	35679	33657	79513	2319	2085	3842	8246	0.228	0.058	0.114	0.104	168	43	84	76	12.8%	44.9%	42.3%	28.1%	25.3%	46.6%
1995 KRC	0	2367	891	3258	0	138	102	240		0.058	0.114	0.074		43	84	54	0.0%	72.7%	27.3%	0.0%	57.5%	42.5%
1996 BM	920	6804	2242	9966	332	398	256	985	0.361	0.058	0.114	0.099	266	43	84	73	9.2%	68.3%	22.5%	33.7%	40.4%	26.0%
1996 2800 ac	8799	17737	12947	39483	3153	1037	1478	5667	0.358	0.058	0.114	0.144	264	43	84	106	22.3%	44.9%	32.8%	55.6%	18.3%	26.1%
1996 KWB	87492	49893	36490	173875	26411	2916	4166	33492	0.302	0.058	0.114	0.193	222	43	84	142	50.3%	28.7%	21.0%	78.9%	8.7%	12.4%
1996 Pioneer	6620	20521	18535	45676	2317	1199	2116	5632	0.350	0.058	0.114	0.123	258	43	84	91	14.5%	44.9%	40.6%	41.1%	21.3%	37.6%
1996 KRC	340	11684	6301	18325	118	683	719	1520	0.347	0.058	0.114	0.083	255	43	84	61	1.9%	63.8%	34.4%	7.8%	44.9%	47.3%
1997 BM	52	4476	2027	6555	5	262	231	498	0.096	0.059	0.114	0.076	71	43	84	56	0.8%	68.3%	30.9%	1.0%	52.6%	46.4%
1997 2800 ac	2562	0	3178	5740	1000	0	363	1363	0.390		0.114	0.237	287		84	175	44.6%	0.0%	55.4%	73.4%	0.0%	26.6%
1997 KWB	40049	28806	43407	112262	13931	1683	4955	20569	0.348	0.058	0.114	0.183	256	43	84	135	35.7%	25.7%	38.7%	67.7%	8.2%	24.1%
1997 Pioneer	3632	7328	19125	30085	1406	428	2183	4017	0.387	0.058	0.114	0.134	285	43	84	98	12.1%	24.4%	63.6%	35.0%	10.7%	54.3%
1997 KRC	0	0	6471	6471	0	0	739	739			0.114	0.114			84	84	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%
1998 BM	986	4232	15131	20349	271	247	1727	2246	0.275	0.058	0.114	0.110	202	43	84	81	4.8%	20.8%	74.4%	12.1%	11.0%	76.9%
1998 2800 ac	2647	4245	49505	56397	857	248	5652	6757	0.324	0.058	0.114	0.120	238	43	84	88	4.7%	7.5%	87.8%	12.7%	3.7%	83.6%
1998 KWB	51155	55248	196312	302715	14427	3229	22411	40067	0.282	0.058	0.114	0.132	208	43	84	97	16.9%	18.3%	64.9%	36.0%	8.1%	55.9%
1998 Pioneer	7646	4835	56634	69115	2296	283	6465	9044	0.300	0.059	0.114	0.131	221	43	84	96	11.1%	7.0%	81.9%	25.4%	3.1%	71.5%
1998 KRC	8	600	264	872	2	35	30	67	0.250	0.058	0.114	0.077	184	43	84	57	0.9%	68.8%	30.3%	3.0%	52.2%	44.8%
1999 BM	0	599	34	633	0	35	4	39		0.058	0.118	0.062		43	87	45	0.0%	94.6%	5.4%	0.0%	89.7%	10.3%
1999 2800 ac	3568	3952	2743	10263	1219	231	313	1763	0.342	0.058	0.114	0.172	251	43	84	126	34.8%	38.5%	26.7%	69.1%	13.1%	17.8%
1999 KWB	26011	10563	179	36753	8846	617	20	9483	0.340	0.058	0.112	0.258	250	43	82	190	70.8%	28.7%	0.5%	93.3%	6.5%	0.2%
1999 Pioneer	6736	5892	1104	13732	2387	344	126	2858	0.354	0.058	0.114	0.208	261	43	84	153	49.1%	42.9%	8.0%	83.5%	12.0%	4.4%
1999 KRC	0	2043	0	2043	0	119	0	119		0.058		0.058		43		43	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%
2000 BM	0	1027	0	1027	0	60	0	60		0.058		0.058		43		43	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%
2000 2800 ac	258	30660	0	30918	78	1792	0	1870	0.302	0.058		0.060	222	43		45	0.8%	99.2%	0.0%	4.2%	95.8%	0.0%
2000 KWB	19455	8124	0	27579	5430	475	0	5905	0.279	0.058		0.214	205	43		158	70.5%	29.5%	0.0%	92.0%	8.0%	0.0%
2000 Pioneer	5589	9707	0	15296	1533	567	0	2100	0.274	0.058		0.137	202	43		101	36.5%	63.5%	0.0%	73.0%	27.0%	0.0%
2000 KRC	0	4073	0	4073	0	238	0	238		0.058		0.058		43		43	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%
2001 BM	0	0	0	0	0	0	0	0														
2001 2800 ac	2539	0	0	2539	966	0	0	966	0.380			0.380	280			280	100.0%	0.0%	0.0%	100.0%	0.0%	0.0%
2001 KWB	10030	0	0	10030	3817	0	0	3817	0.381			0.381	280			280	100.0%	0.0%	0.0%	100.0%	0.0%	0.0%
2001 Pioneer	1253	0	0	1253	477	0	0	477	0.381			0.381	280			280	100.0%	0.0%	0.0%	100.0%	0.0%	0.0%
2001 KRC	139	1262	813	2214	53	74	93	219	0.381	0.059	0.114	0.099	281	43	84	73	6.3%	57.0%	36.7%	24.2%	33.8%	42.5%
XXX																						
Sum	428716	428329	647926	1504971	132393	25032	73967	231389	0.309	0.058	0.114	0.154	227	43	84	113	28.5%	28.5%	43.1%	57.2%	10.8%	32.0%
Data from: KCWA 2001 Kern Fan Monitoring Report, tables 5D-1 to 5D-8.																						
'95 - 01 BM	13395	36055	23566	73016	5003	2108	2690	9800	0.373	0.058	0.114	0.134	275	43	84	99	18.3%	49.4%	32.3%	51.1%	21.5%	27.4%
'95 - 01 2800 ac	68660	86614	99281	254555	23133	5062	11335	39529	0.337	0.058	0.114	0.155	248	43	84	114	27.0%	34.0%	39.0%	58.5%	12.8%	28.7%
'95 - 01 KWB	304521	199669	381284	885474	91349	11669	43527	146544	0.300	0.058	0.114	0.165	221	43	84	122	34.4%	22.5%	43.1%	62.3%	8.0%	29.7%
'95 - 01 Pioneer	41653	83962	129055	254670	12735	4906	14732	32374	0.306	0.058	0.114	0.127	225	43	84	94	16.4%	33.0%	50.7%	39.3%	15.2%	45.5%
'95 - 01 KRC	487	22029	14740	37256	173	1287	1683	3142	0.355	0.058	0.114	0.084	261	43	84	62	1.3%	59.1%	39.6%	5.5%	41.0%	53.6%
'95 - 01 Chk Sum	428716	428329	647926	1504971	132393	25032	73967	231389	0.309	0.058	0.114	0.154	227	43	84	113	28.5%	28.5%	43.1%	57.2%	10.8%	32.0%

Table 4. Kern Fan Banking Project Salt Balance Data.

Exhibits

Exhibit 1.

Water Quality Data Collection and Evaluation Methodology.

Exhibit 1.

Water Quality Data Collection and Evaluation Methodology.

Some of the data and findings in this Report have been excerpted and modified from another ongoing water quality study for the Rosedale - Rio Bravo Water Storage District, with their permission. That study is a baseline water quality (BWQ) analysis of the groundwater aquifer in the RRBWSD area of interest, which happens to include the Strand Ranch Project area because of proximity. The RRBWSD baseline water quality analysis will be completed and presented in report form in Winter, 2007-2008.

The BWQ work program includes groundwater data collection, basic data analysis, and preliminary interpretation. The sources of data include: the Kern County Water Agency water quality database (courtesy of Tom Haslebacher, KCWA Senior Hydrogeologist), Vaughan Water Company water well analyses (courtesy of Mike Huhn, manager, VWC), and the Rosedale - Rio Bravo Water Storage District (courtesy of Robert Coffee, RRBWSD operations manager). Sierra Scientific Services specified the data screening criteria and the methods of analysis according to accepted standards and practices.

For this study, we have added water sample analyses provided by IRWD collected from the accessible irrigation wells on the Strand Ranch property and obtained from other wells located on adjacent property.

The primary task of this study is to collect the available data and describe the observed, historical water quality trends in the surface waters and groundwaters which flow into and out of the Kern Fan aquifer system as they relate to the Strand Ranch Aquifer Storage and Recovery Project.

In the BWQ analysis, SSS focused the main data collection effort on obtaining a "complete set" of water-constituent tabulations and the supporting analytical reports for each and every reported analysis. The goal was to compile and tabulate multiple analyses collected over time for each and every sampling location, from which we could determine the average value and range of natural variability for each constituent at each sample location. We applied quantitative quality control/quality assurance indicators to each dataset. Based on these indicators and our own inspection of the data, we compiled every reported analysis into a standardized reporting format, and edited all of the data, including the rejection of any data which were unacceptable for our purposes based upon our criteria. The basic statistical criteria for the acceptability of data which we applied it to the entire database is as follows:

1: Location and Date: The location, well ID, and sampling date must be known;

2: Sufficiency: To obtain no less than four (4) independent analyses at a given sampling location;

3: Timing: Sampling intervals are preferred to be between quarterly and annually;

4: Variability: Constituent coefficients of variation are no more than 0.30, suggesting normality in constituent distributions;

5: Completeness: For the general mineral constituents, all major cations, anions, and physical properties of TDS, EC, and pH must be included in an analysis in order to be included in our compilation;

6: Depth: The completion interval of the well must be known in order for the data to be used. We give high priority to water quality samples from single-zone monitoring wells. Shallow (<250 ft) irrigation and domestic wells might be included in this category subject to review even if the exact completion interval is not known. We give low - medium priority to water quality samples from irrigation and recovery wells with long, multi-zone completion intervals. We give little or no priority to water quality samples from wells with unknown completion intervals.

7: Analytical Error: The data must pass our internal analytical checks for cation/anion balance (basic analytical accuracy check) and TDS/EC balance (basic ion concentration - electric conduction check).

8: Reporting Conventions: For our purposes and for all statistical analyses such as calculating sample averages and variances, we disagree with the reporting convention of giving a "below detection threshold" measurement a numerical value equal to the detection threshold. When we find such values in the data, we reset them to zero in our database. If there is no reported value for a constituent, we leave the value "blank".

We rejected many individual analyses for failing to meet one or more statistical criteria and rejected other analyses which had no documentation or means of verification. We were reluctant to accept constituent - of - concern (COC) analyses for sample locations which had little or no established general mineral chemistry and did so in only a few case-by-case situations.

Exhibit 2.

Surface Water and Ground Water Geochemical Analyses.

WQ Analyses.		West AVG	West AVG	West AVG	West AVG	West AVG	West AVG	West AVG	West AVG	West AVG	West AVG
Well		30S/24E 13D01	30S/24E 13D02	30S/24E 13D03	30S/24E 14M02	30S/24E 14M03	30S/25E 19N02	30S/25E 19N03	30S/25E 19N04	30S/25E 19R01	30S/25E 19R02
Twp/Rge		30S/24E	30S/24E	30S/24E	30S/24E	30S/24E	30S/25E	30S/25E	30S/25E	30S/25E	30S/25E
Sec/40ac		13D01	13D02	13D03	14M02	14M03	19N02	19N03	19N04	19R01	19R02
Depth		Sh	Mi	De	De	Sh	Sh	Mi	De	De	Sh
Date		21	22	22	8	6	1	3	2	6	5
Domain		Fan-W1	Fan-W1	Fan-W1	Fan-W2	Fan-W2	Fan-W2	Fan-W2	Fan-W2	Fan-W2	Fan-W2
General Mineral											
Ca	(mg/l)	142.2	40.1	23.8	125.0	138.2	33.0	25.3	250.5	56.8	69.2
Mg	(mg/l)	2.8	0.4	0.1	5.1	3.8	5.2	2.5	32.5	1.1	3.1
Na	(mg/l)	71.4	72.2	82.5	284.0	214.1	278.0	208.7	589.5	144.8	126.2
K	(mg/l)	1.5	0.9	0.6	1.8	1.5	1.3		2.3	1.0	1.1
OH	(mg/l)				30.0				0.8		
CO3	(mg/l)							7.3		9.4	
HCO3	(mg/l)	230.0	94.0	41.0	86.5	115.5	156.0	122.0	65.2	41.0	45.6
SO4	(mg/l)	313.1	186.0	167.3	203.4	203.0	221.0	115.3	441.0	93.0	275.4
Cl	(mg/l)	39.6	20.0	28.3	521.4	417.9	262.0	215.0	1223.5	252.0	110.2
NO3	(mg/l)	6.9	1.2	0.4	0.6	0.5				0.7	
NO2	(mg/l)										
F	(mg/l)	0.4	0.3	0.1	0.2			0.5		0.5	0.2
SiO2	(mg/l)	23.8	10.8	13.0							
pH	(pH)	7.8	7.5	7.7	8.1	7.8	8.1	8.4	8.0	8.4	8.1
EC	(uS/cm)	996.1	563.0	533.1	2061.2	1827.7	1480.0	1125.7	4380.0	1068.8	987.6
TDS	(mg/l)	720.7	346.1	326.1	1420.0	689.4	880.0	682.5	2760.0	695.6	638.0
Hd	(mg/l)	366.2	100.3	59.4	333.1	375.4	100.0	73.5	759.5	145.8	185.6
Alk	(mg/l)	139.7	35.9	27.3	72.0	102.5		110.0		35.0	36.7
Water Quality											
TDS	index	Fair-Poor	Xlnt	Xlnt	Unacc.	Good	Fair-Poor	Good	Unacc.	Good	Good
Hard	index	V.Hard	M.Hard	Soft	V.Hard	V.Hard	M.Hard	M.Hard	V.Hard	Hard	V.Hard
SAR	index	Mod	Low	Low	High	High	High	Mod	V.High	Mod	Mod
Calc'd Values											
Cat	(meq/l)	10.47	5.20	4.80	19.05	16.56	14.20	10.55	40.87	9.25	9.23
An	(meq/l)	11.54	6.01	4.97	20.38	17.91	14.55	10.74	44.76	10.07	9.60
Hard	(mg/l)	367	102	60	333	361	104	74	760	147	186
Alk	(mg/l)	188	77	34	247	95	128	106	58	41	37
SAR	ratio	1.62	3.12	4.65	6.77	4.91	11.87	10.58	9.31	5.21	4.03
SUM	(mg/l)	691	367	323	1214	1036	877	635	2572	580	608
ECcalc	(uS/cm)	1275	659	587	2444	2123	1713	1245	5379	1175	1155
TDS/EC	ratio	0.72	0.61	0.61	0.69	0.38	0.59	0.61	0.63	0.65	0.65
Analyt. Checks											
Anal.Com	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL
Cat/An	EV=1	0.90	0.85	0.97	0.93	0.92	0.98	0.98	0.91	0.92	0.96
meq/EC	EV=1	1.10	1.00	0.92	0.96	0.94	0.97	0.95	0.98	0.90	0.95
TDS/SUM	EV=1	1.04	0.94	1.01	1.17	0.67	1.00	1.08	1.07	1.20	1.05
EC/ECcalc	EV=1	0.78	0.85	0.91	0.84	0.86	0.86	0.90	0.81	0.91	0.85
CalcHCO3											
Ternary Ratios		S/24E 13D01 Sh	)S/24E 13D02 Mi	S/24E 13D03 De	S/24E 14M02 De	S/24E 14M03 Sh	S/25E 19N02 Sh	)S/25E 19N03 Mi	S/25E 19N04 De	S/25E 19R01 De	S/25E 19R02 Sh
Ca	(%)	68%	38%	25%	33%	42%	12%	12%	31%	31%	37%
Mg	(%)	2%	1%	0%	2%	2%	3%	2%	7%	1%	3%
Na+K	(%)	30%	61%	75%	65%	56%	85%	86%	63%	68%	60%
SumCat	(%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HCO3+CC	(%)	33%	26%	14%	7%	11%	18%	21%	2%	10%	8%
SO4	(%)	56%	64%	70%	21%	24%	32%	22%	21%	19%	60%
Cl+NO3	(%)	11%	10%	16%	72%	66%	51%	56%	77%	71%	32%
SumAn	(%)	99.8%	99.8%	99.9%	99.9%	100.0%	100.0%	99.8%	100.0%	99.7%	99.9%
Type	Cat-An	Ca-HCO3/SO4	Na-SO4	Na-SO4	Na-Cl	Ca/Na-Cl	Na-Cl/SO4	Na-mxd	Na-Cl	Na-Cl	Ca/Na-Cl/SO4
Type	A,B,D	D21-SO4	B2-SO4	B2-SO4	B1b	B1b	B1-SO4	B2	B1b	B2	B1-SO4
COCs											
As	(ug/l)	4	2.29	1.93	8					27.75	3
Ba	(ug/l)	63.67									
B	(ug/l)	204.83	50.1	70.62	0.39	0.31	0.69	0.77	1.55	0.22	0.42
Alpha	pCi/l	69.53	1.34	2.29	9.97	10.7				0.93	3.3
Radon	pCi/l										
DBCP	(ug/l)										
EDB	(ug/l)										

WQ Analyses.		East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG
Well		30S/25E 04J02	30S/25E 04J03	30S/25E 04J04	30S/25E 07A02	30S/25E 07A03	30S/25E 07A04	30S/25E 11P01	30S/25E 11P02	30S/25E 11P03	30S/25E 12B02
Twp/Rge		30S/25E	30S/25E	30S/25E	30S/25E	30S/25E	30S/25E	30S/25E	30S/25E	30S/25E	30S/25E
Sec/40ac		04J02	04J03	04J04	07A02	07A03	07A04	11P01	11P02	11P03	12B02
Depth		Sh	Mi	De	Sh	Mi	De	Sh	Mi	De	Sh
Date		24	26	18	5	5	4	5	5	5	2
Domain		Fan-E3	Fan-E3	Fan-E3	Fan-E2	Fan-E2	Fan-E2	Fan-E3	Fan-E3	Fan-E3	Fan-E3
General Mineral											
Ca	(mg/l)	71.0	17.3	10.3	25.0	2.3	2.3	59.4	39.8	10.9	351.0
Mg	(mg/l)	1.2	0.1	0.4	0.1	0.1		3.5	0.2	0.1	27.5
Na	(mg/l)	44.7	64.8	40.5	57.0	29.6	33.0	72.6	57.4	40.8	349.5
K	(mg/l)	1.7	0.9	0.7				1.1	1.0	1.0	2.8
OH	(mg/l)										
CO3	(mg/l)		8.7	14.9		16.3	19.5			6.0	
HCO3	(mg/l)	181.2	56.6	34.6	59.8	42.4	26.3	233.6	107.5	60.7	173.0
SO4	(mg/l)	42.3	24.4	18.2	66.2	10.5	12.0	37.4	29.3	14.1	46.0
Cl	(mg/l)	77.8	79.5	27.9	40.6	5.9	6.7	60.4	68.6	30.8	1135.0
NO3	(mg/l)	28.4	11.7	5.3	10.3	0.7	1.1	18.9	17.2	4.4	25.8
NO2	(mg/l)										
F	(mg/l)	0.2	0.2	0.3		0.3	0.4	0.2		0.3	0.1
SiO2	(mg/l)	20.8	15.3	17.3							
pH	(pH)	7.9	7.7	8.6	8.2	9.1	9.2	7.6	7.9	9.0	7.2
EC	(uS/cm)	596.6	439.4	254.4	401.0	157.4	165.5	663.8	500.8	263.8	3955.0
TDS	(mg/l)	384.5	225.0	151.4	267.7	85.0	107.7	408.0	210.0	133.8	2380.0
Hd	(mg/l)	181.1	43.3	26.2	62.6	5.9	5.7	162.8	99.5	27.6	991.0
Alk	(mg/l)	95.0	42.5	57.6	55.0	56.7	50.0	183.3	106.7	60.0	160.0
Water Quality											
TDS	index	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt	Good	Xlnt	Xlnt	Unacc.
Hard	index	V.Hard	Soft	Soft	M.Hard	Soft	Soft	Hard	M.Hard	Soft	V.Hard
SAR	index	Low	Low	Low	Low	Low	Low	Low	Low	Low	V.High
Calc'd Values											
Cat	(meq/l)	5.62	3.72	2.33	3.73	1.41	1.55	6.44	4.52	2.36	35.05
An	(meq/l)	6.51	4.16	2.33	3.67	1.65	1.56	6.62	4.59	2.44	36.23
Hard	(mg/l)	182	44	28	63	6	6	163	100	28	990
Alk	(mg/l)	148	54	41	49	48	38	191	88	55	142
SAR	ratio	1.44	4.26	3.36	3.13	5.13		2.48	2.50	3.36	4.83
SUM	(mg/l)	356	235	136	229	87	88	368	267	138	2023
ECcalc	(uS/cm)	681	447	235	430	129	129	700	517	254	4420
TDS/EC	ratio	0.64	0.51	0.60	0.67	0.54	0.65	0.61	0.42	0.51	0.60
Analyt. Checks											
Anal.Com	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL
Cat/An	EV=1	0.85	0.89	1.00	1.02	0.85	0.99	0.97	0.99	0.96	0.97
meq/EC	EV=1	1.02	0.90	0.92	0.92	0.97	0.94	0.98	0.91	0.91	0.90
TDS/SUM	EV=1	1.08	0.96	1.12	1.17	0.98	1.22	1.11	0.79	0.97	1.18
EC/ECcalc	EV=1	0.88	0.98	1.08	0.93	1.22	1.28	0.95	0.97	1.04	0.89
CalcHCO3											
Ternary Ratios		30S/25E 04J02 Sh	0S/25E 04J03 Mi	)S/25E 04J04 De	)S/25E 07A02 Sh	)S/25E 07A03 Mi	S/25E 07A04 De	)S/25E 11P01 Sh	)S/25E 11P02 Mi	S/25E 11P03 De	S/25E 12B02 Sh
Ca	(%)	63%	23%	22%	33%	8%	7%	46%	44%	23%	50%
Mg	(%)	2%	0%	1%	0%	1%	0%	4%	0%	0%	6%
Na+K	(%)	35%	76%	76%	66%	91%	93%	49%	56%	76%	44%
SumCat	(%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HCO3+CC	(%)	46%	29%	46%	27%	75%	69%	58%	38%	49%	8%
SO4	(%)	14%	12%	16%	38%	13%	16%	12%	13%	12%	3%
Cl+NO3	(%)	41%	58%	37%	36%	11%	13%	30%	48%	38%	90%
SumAn	(%)	99.9%	99.8%	99.3%	100.0%	99.0%	98.6%	99.9%	100.0%	99.4%	100.0%
Type	Cat-An	Ca-HCO3/Cl	Na-HCO3/Cl	Na-HCO3/Cl	Na-mxd	Na-HCO3	Na-HCO3	Ca/Na-HCO3/Cl	Ca/Na-HCO3/Cl	Na-HCO3/Cl	Ca/Na-Cl
Type	A,B,D	D21	B2	B2	B2-SO4	A	A	B1a	B2	B2	D20
COCs											
As	(ug/l)	1.8	2.5	22.07		23	19.5			23.5	
Ba	(ug/l)	127.15		52							
B	(ug/l)	137.56	80.03	100.01	0.11	0.1	0.09	0.51	0.25	0.15	4.81
Alpha	pCi/l	10.15	1.12	2.88							
Radon	pCi/l										
DBCP	(ug/l)										
EDB	(ug/l)										

Sierra Scientific Services, 2007, (661) 377 - 0123.

APP 2

WQ Analyses.		East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG
Well		30S/25E 12B03	30S/25E 12B04	30S/25E 16L01	30S/25E 16L02	30S/25E 16L03	30S/25E 21G02	30S/25E 21G03
Twp/Rge		30S/25E	30S/25E	30S/25E	30S/25E	30S/25E	30S/25E	30S/25E
Sec/40ac		12B03	12B04	16L01	16L02	16L03	21G02	21G03
Depth		Mi	De	Sh	Mi	De	De	Sh
Date		4	4	24	21	21	4	5
Domain		Fan-E3	Fan-E3	Fan-E3	Fan-E3	Fan-E3	Fan-E3	Fan-E3
General Mineral								
Ca	(mg/l)	8.5	2.0	16.4	4.1	9.2	10.3	18.2
Mg	(mg/l)	0.1	0.1	0.2		0.1	0.1	0.2
Na	(mg/l)	34.5	33.8	44.0	31.5	37.0	38.5	42.0
K	(mg/l)			0.6	1.8	0.8		
OH	(mg/l)							
CO3	(mg/l)		15.0	2.6	17.3	8.2	10.5	2.6
HCO3	(mg/l)	68.2	51.2	56.5	50.5	48.0	54.5	75.9
SO4	(mg/l)	15.0	9.5	16.7	11.9	14.4	20.2	23.9
Cl	(mg/l)	18.5	5.9	52.6	8.6	28.8	22.1	30.0
NO3	(mg/l)	3.0	0.7	4.5	0.7	3.0	4.0	7.5
NO2	(mg/l)							
F	(mg/l)	0.2	0.3	0.2	0.3	0.3	0.2	0.2
SiO2	(mg/l)			17.3	23.3	15.7		
pH	(pH)	8.6	9.4	7.9	8.9	8.3	8.8	8.3
EC	(uS/cm)	218.0	173.0	311.8	179.5	234.1	242.8	301.6
TDS	(mg/l)	121.0	111.6	172.2	109.5	133.2	157.9	179.5
Hd	(mg/l)	21.4	5.0	41.0	10.3	22.9	26.0	45.7
Alk	(mg/l)	60.0	60.0	44.1	56.0	47.2	55.0	63.3
Water Quality								
TDS	index	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt
Hard	index	Soft	Soft	Soft	Soft	Soft	Soft	Soft
SAR	index	Low	Low	Low	Low	Low	Low	Low
Calc'd Values								
Cat	(meq/l)	1.93	1.58	2.76	1.62	2.10	2.19	2.75
An	(meq/l)	2.01	1.73	2.92	1.92	2.24	2.36	2.80
Hard	(mg/l)	22	5	42	10	23	26	46
Alk	(mg/l)	56	54	48	56	46	53	64
SAR	ratio	3.22	6.31	2.97		3.33	3.29	2.68
SUM	(mg/l)	113	92	165	101	125	133	162
ECcalc	(uS/cm)	211	142	322	155	226	231	301
TDS/EC	ratio	0.56	0.64	0.55	0.61	0.57	0.65	0.60
Analyt. Checks								
Anal.Com	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL
Cat/An	EV=1	0.96	0.91	0.94	0.83	0.94	0.93	0.98
meq/EC	EV=1	0.90	0.95	0.91	0.99	0.93	0.94	0.92
TDS/SUM	EV=1	1.07	1.21	1.04	1.08	1.06	1.19	1.11
EC/ECcalc	EV=1	1.03	1.22	0.97	1.16	1.04	1.05	1.00
CalcHCO3		S/25E 12B03 Mi	S/25E 12B04 De	S/25E 16L01 Sh	S/25E 16L02 Mi	S/25E 16L03 De	S/25E 21G02 De	S/25E 21G03 Sh
Ternary Ratios								
Ca	(%)	22%	6%	30%	13%	22%	23%	33%
Mg	(%)	1%	1%	0%	0%	0%	0%	1%
Na+K	(%)	78%	93%	70%	87%	78%	76%	66%
SumCat	(%)	100%	100%	100%	100%	100%	100%	100%
HCO3+CO3	(%)	56%	77%	35%	73%	47%	53%	47%
SO4	(%)	15%	11%	12%	13%	13%	18%	18%
Cl+NO3	(%)	28%	10%	53%	13%	38%	29%	34%
SumAn	(%)	99.5%	99.2%	99.7%	99.1%	99.2%	99.6%	99.6%
Type	Cat-An	Na-HCO3/Cl	Na-HCO3	Na-HCO3/Cl	Na-HCO3	Na-HCO3/Cl	Na-HCO3/Cl	Na-HCO3/Cl
Type	A,B,D	B2	A	B2	B2	B2	B2	B2
COCs								
As	(ug/l)		32.67	2.7	19.57	11.5	9	8
Ba	(ug/l)							
B	(ug/l)	1.47	0.1	75.03	87.52	73.72	0.11	0.12
Alpha	pCi/l			1.16	0.58	0.85		
Radon	pCi/l							
DBCP	(ug/l)							
EDB	(ug/l)							

WQ Analyses.		East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG
Well		30S/25E 22R01	30S/25E 22R02	30S/25E 22R03	30S/25E 36R01	30S/25E 36R02	30S/26E 04J01	30S/26E 04J02
Twp/Rge		30S/25E	30S/25E	30S/25E	30S/25E	30S/25E	30S/26E	30S/26E
Sec/40ac		22R01	22R02	22R03	36R01	36R02	04J01	04J02
Depth		Sh	Mi	De	De	Sh	Sh	Mi
Date		7	5	7	4	5	4	3
Domain		Fan-E3	Fan-E3	Fan-E3	Fan-E1	Fan-E1	Fan-E3	Fan-E3
General Mineral								
Ca	(mg/l)	36.1	3.1	3.1	3.2	2.0	21.8	39.0
Mg	(mg/l)	2.5	0.1	0.1	0.1	0.1	4.1	4.1
Na	(mg/l)	18.3	30.2	50.9	47.8	41.6	27.3	26.0
K	(mg/l)							1.2
OH	(mg/l)							
CO3	(mg/l)		10.1	15.1	16.8	20.4		
HCO3	(mg/l)	125.8	60.7	48.2	49.5	46.2	89.2	149.3
SO4	(mg/l)	12.6	10.3	15.4	24.6	12.7	18.6	19.0
Cl	(mg/l)	17.7	5.4	29.1	12.5	7.0	22.9	19.0
NO3	(mg/l)	2.7	0.9			1.8	3.6	3.4
NO2	(mg/l)							
F	(mg/l)	0.2	0.4	0.9	1.1	0.6	0.1	0.2
SiO2	(mg/l)							
pH	(pH)	7.8	8.5	9.2	9.3	9.3	7.5	7.8
EC	(uS/cm)	282.4	158.0	264.4	244.8	202.0	276.5	348.3
TDS	(mg/l)	198.4	82.0	160.0	165.0	142.5	170.3	216.0
Hd	(mg/l)	100.1	8.0	7.7	8.1	4.8	70.3	113.1
Alk	(mg/l)	105.0	60.0	60.0	70.0	70.0	80.0	110.0
Water Quality								
TDS	index	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt
Hard	index	M.Hard	Soft	Soft	Soft	Soft	M.Hard	M.Hard
SAR	index	Low	Low	Low	Low	Low	Low	Low
Calc'd Values								
Cat	(meq/l)	2.81	1.48	2.37	2.24	1.91	2.61	3.44
An	(meq/l)	2.88	1.73	2.48	2.29	1.96	2.56	3.44
Hard	(mg/l)	101	8	8	8	5	71	114
Alk	(mg/l)	103	58	52	54	55	73	122
SAR	ratio	0.79	4.59	7.82	7.23	8.04	1.40	1.06
SUM	(mg/l)	152	90	138	130	109	142	185
ECcalc	(uS/cm)	293	145	237	210	164	276	355
TDS/EC	ratio	0.70	0.52	0.61	0.67	0.71	0.62	0.62
Analyt. Checks								
Anal.Com	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL
Cat/An	EV=1	0.98	0.84	0.96	0.98	0.97	1.02	1.00
meq/EC	EV=1	1.01	1.02	0.92	0.93	0.96	0.93	0.99
TDS/SUM	EV=1	1.30	0.91	1.16	1.27	1.31	1.20	1.16
EC/ECcalc	EV=1	0.96	1.09	1.12	1.16	1.23	1.00	0.98
CalcHCO3		S/25E 22R01 Sh	S/25E 22R02 Mi	S/25E 22R03 De	S/25E 36R01 De	S/25E 36R02 Sh	S/26E 04J01 Sh	S/26E 04J02 Mi
Ternary Ratios								
Ca	(%)	64%	11%	6%	7%	5%	42%	56%
Mg	(%)	7%	0%	0%	0%	0%	13%	10%
Na+K	(%)	28%	89%	93%	93%	95%	45%	34%
SumCat	(%)	100%	100%	100%	100%	100%	100%	100%
HCO3+CO3	(%)	72%	77%	52%	60%	73%	57%	71%
SO4	(%)	9%	12%	13%	22%	13%	15%	11%
Cl+NO3	(%)	19%	10%	33%	15%	12%	28%	17%
SumAn	(%)	99.7%	98.9%	98.1%	97.5%	98.3%	99.8%	99.8%
Type	Cat-An	Ca-HCO3	Na-HCO3	Na-HCO3/Cl	Na-HCO3/SO4	Na-HCO3	Ca/Na-HCO3/Cl	Ca/Na-HCO3
Type	A,B,D	D1	B2	A	A	A	B1a	D1
COCs								
As	(ug/l)	3.5		106.5	57	44.33		
Ba	(ug/l)							
B	(ug/l)	0.09	0.1	0.22	0.28	0.13	0.11	0.13
Alpha	pCi/l							19
Radon	pCi/l							
DBCP	(ug/l)							
EDB	(ug/l)							

WQ Analyses.		East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG
Well		30S/26E 04J03	30S/26E 04J05	30S/26E 06L01	30S/26E 06L02	30S/26E 06L03	30S/26E 08P04	30S/26E 16B01
Twp/Rge		30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E
Sec/40ac		04J03	04J05	06L01	06L02	06L03	08P04	16B01
Depth		De	06	Sh	Mi	De	De	Sh
Date		9	2	7	5	7	8	25
Domain		Fan-E3	Fan-E3	Fan-E3	Fan-E3	Fan-E3	Fan-E2	Fan-E2
General Mineral								
Ca	(mg/l)	4.1	42.5	60.7	26.0	14.9	3.3	40.5
Mg	(mg/l)	0.2	3.5	4.9	0.3	0.8	1.2	5.3
Na	(mg/l)	37.0	22.5	28.0	26.4	27.0	33.8	26.7
K	(mg/l)		1.0		1.0			1.1
OH	(mg/l)							
CO3	(mg/l)	13.2				9.4	18.6	
HCO3	(mg/l)	44.2	130.0	152.7	79.4	57.3	38.0	137.0
SO4	(mg/l)	16.8	24.0	43.5	16.2	15.3	9.7	23.7
Cl	(mg/l)	14.8	26.5	36.1	25.2	16.0	5.5	26.5
NO3	(mg/l)	1.5	6.0	19.7	4.4	3.9	0.9	6.0
NO2	(mg/l)							
F	(mg/l)	0.3	0.2	0.2	0.1	0.3	0.3	0.1
SiO2	(mg/l)							21.6
pH	(pH)	9.2	7.8	7.7	8.0	8.7	9.4	7.9
EC	(uS/cm)	198.4	347.0	485.0	266.6	214.4	172.8	364.9
TDS	(mg/l)	110.5	215.0	302.6	151.3	136.6	95.0	231.0
Hd	(mg/l)	10.3	120.6	171.4	65.4	38.3	8.7	122.1
Alk	(mg/l)	48.3	120.0	130.0	70.0	50.0	60.0	112.9
Water Quality								
TDS	index	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt
Hard	index	Soft	M.Hard	Hard	M.Hard	Soft	Soft	Hard
SAR	index	Low	Low	Low	Low	Low	Low	Low
Calc'd Values								
Cat	(meq/l)	1.83	3.41	4.65	2.49	1.98	1.73	3.64
An	(meq/l)	1.97	3.48	4.75	2.43	2.10	1.63	3.59
Hard	(mg/l)	11	121	172	66	40	13	123
Alk	(mg/l)	47	106	125	65	55	47	112
SAR	ratio	4.84	0.89	0.93	1.41	1.85	4.06	1.05
SUM	(mg/l)	110	190	268	139	116	92	197
ECcalc	(uS/cm)	181	367	512	268	202	140	382
TDS/EC	ratio	0.56	0.62	0.62	0.57	0.64	0.55	0.63
Analyt. Checks								
Anal.Com	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL
Cat/An	EV=1	0.93	0.98	0.98	1.03	0.94	1.06	1.02
meq/EC	EV=1	0.96	0.99	0.97	0.92	0.95	0.97	0.99
TDS/SUM	EV=1	1.01	1.13	1.13	1.09	1.18	1.03	1.17
EC/ECcalc	EV=1	1.10	0.95	0.95	1.00	1.06	1.23	0.95
CalcHCO3		S/26E 04J03 De	S/26E 04J05 06	S/26E 06L01 Sh	S/26E 06L02 Mi	S/26E 06L03 De	S/26E 08P04 De	S/26E 16B01 Sh
Ternary Ratios								
Ca	(%)	11%	62%	65%	52%	37%	9%	55%
Mg	(%)	1%	8%	9%	1%	3%	6%	12%
Na+K	(%)	88%	29%	26%	47%	59%	85%	33%
SumCat	(%)	100%	100%	100%	100%	100%	100%	100%
HCO3+CO3	(%)	59%	61%	53%	54%	60%	76%	63%
SO4	(%)	18%	14%	19%	14%	15%	12%	14%
Cl+NO3	(%)	22%	24%	28%	32%	24%	10%	24%
SumAn	(%)	99.2%	99.7%	99.8%	99.7%	99.2%	99.1%	99.8%
Type	Cat-An	Na-HCO3/Cl	Ca-HCO3	Ca-HCO3/Cl	Ca/Na-HCO3/Cl	Ca/Na-HCO3/Cl	Na-HCO3	Ca/Na-HCO3
Type	A,B,D	B2	D1	D1	D20	B1b	A	D1
COCs								
As	(ug/l)				0	21	0	2.22
Ba	(ug/l)		42.85		0		0	58.6
B	(ug/l)	0.08	0.12	0.21	0.12	0.11	0.09	0.14
Alpha	pCi/l	0.9	10.58		0		0	9.41
Radon	pCi/l							
DBCP	(ug/l)				0		0	0
EDB	(ug/l)				0		0	0

WQ Analyses.		East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG	East AVG
Well		30S/26E 16B02 I	30S/26E 16B03 I	30S/26E 16B04 I	30S/26E 18H04 I	30S/26E 19B01 !	30S/26E 19B02 I	30S/26E 19B03 I	30S/26E 28J01 5	30S/26E 28J02 N	30S/26E 28J03 C	30S/26E 32N01	30S/26E 32N02 I	30S/26E 32N03 De
Twp/Rge		30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E	30S/26E
Sec/40ac		16B02	16B03	16B04	18H04	19B01	19B02	19B03	28J01	28J02	28J03	32N01	32N02	32N03
Depth		Mi	De	Sh	De	Sh	Mi	De	Sh	Mi	De	Sh	Mi	De
Date		21	25	1	7	9	2	8	4	5	6	4	4	4
Domain		Fan-E2	Fan-E2	Fan-E2					Fan-E2	Fan-E2	Fan-E2	Fan-E1	Fan-E1	Fan-E1
General Mineral														
Ca	(mg/l)	9.2	3.9	35.0	7.6	56.0	7.5	9.3	58.5	3.4	1.6	0.8	0.5	1.9
Mg	(mg/l)	0.0	0.3	3.9	0.1	6.2		1.3		0.1	0.1			0.2
Na	(mg/l)	26.8	33.4	23.0	33.3	37.9	40.0	35.5	44.3	50.4	44.3	62.8	52.8	63.0
K	(mg/l)	1.2	0.6			1.0								
OH	(mg/l)													
CO3	(mg/l)	10.0	16.6		5.1			18.7		16.3	22.3	28.8	42.9	23.2
HCO3	(mg/l)	56.7	45.3	117.0	67.6	216.8	75.0	66.4	149.5	50.8	44.2	53.7	37.9	63.8
SO4	(mg/l)	14.6	10.4	19.0	16.6	33.3	30.0	15.9	77.0	30.0	12.8	17.4	11.4	19.7
Cl	(mg/l)	11.0	7.8	22.0	12.7	23.4	17.5	10.5	26.3	15.5	7.0	20.4	7.7	16.0
NO3	(mg/l)	1.7	1.1	3.5	2.2	6.1	4.3	1.9			3.8			
NO2	(mg/l)													
F	(mg/l)	0.2	0.3	0.2	0.2	0.3	0.2	0.4	0.2	0.2	0.6	1.5	0.8	2.4
SiO2	(mg/l)	18.0	16.3											
pH	(pH)	8.3	8.7	8.2	8.6	7.5	8.7	8.8	7.7	9.3	9.6	9.5	9.6	9.4
EC	(uS/cm)	180.2	173.5	240.0	203.9	487.6	257.0	218.4	512.5	267.0	214.3	307.0	250.0	301.5
TDS	(mg/l)	112.7	108.9	223.0	140.0	309.0		99.0	314.7	120.5	134.2	151.0	127.0	178.0
Hd	(mg/l)	22.9	10.4	104.0	19.2	166.5	18.8	25.8	152.5	8.5	4.0	2.1	1.6	4.8
Alk	(mg/l)	52.4	57.9		60.0	168.3	60.0	78.0	140.0	53.3	77.5	90.0	110.0	95.0
Water Quality														
TDS	index	Xint	Xint	Xint	Xint	Xint	Xint	Xint	Xint	Xint	Xint	Xint	Xint	Xint
Hard	index	Soft	Soft	M.Hard	Soft	Hard	Soft	Soft	Hard	Soft	Soft	Soft	Soft	Soft
SAR	index	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Calc'd Values														
Cat	(meq/l)	1.65	1.68	3.07	1.84	4.98	2.11	2.11	4.84	2.37	2.01	2.77	2.32	2.85
An	(meq/l)	1.91	1.77	3.00	2.03	5.02	2.42	2.39	4.81	2.45	2.02	2.86	2.55	2.81
Hard	(mg/l)	23	11	103	19	165	19	28	146	9	4	2	1	5
Alk	(mg/l)	55	51	96	60	178	61	70	122	55	55	68	67	71
SAR	ratio	2.43	4.45	0.98	3.29	1.28		2.90		7.44	9.44			11.71
SUM	(mg/l)	103	97	164	111	271	136	126	280	141	114	158	135	158
ECcalc	(uS/cm)	172	150	319	195	515	247	201	528	232	169	245	175	250
TDS/EC	ratio	0.63	0.63	0.93	0.69	0.63		0.45	0.61	0.45	0.63	0.49	0.51	0.59
Analyt. Checks														
Anal.Com	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL
Cat/An	EV=1	0.85	0.95	1.02	0.90	0.99	0.86	0.88	1.01	0.97	0.99	0.97	0.91	1.02
meq/EC	EV=1	0.99	0.99	1.26	0.95	1.03	0.88	1.03	0.94	0.90	0.94	0.92	0.97	0.94
TDS/SUM	EV=1	1.10	1.13	1.36	1.26	1.14		0.79	1.12	0.86	1.17	0.95	0.94	1.13
EC/ECcalc	EV=1	1.05	1.16	0.75	1.05	0.95	1.04	1.09	0.97	1.15	1.27	1.25	1.43	1.21
CalcHCO3														
Ternary Ratios		)S/26E 16B02 Mi	S/26E 16B03 De	S/26E 16B04 Sh	S/26E 18H04 De	S/26E 19B01 Sh	)S/26E 19B02 Mi	S/26E 19B03 De	)S/26E 28J01 Sh	0S/26E 28J02 Mi	)S/26E 28J03 De	S/26E 32N01 Sh	)S/26E 32N02 Mi	32N03 De
Ca	(%)	28%	11%	57%	21%	56%	18%	22%	60%	7%	4%	2%	1%	3%
Mg	(%)		1%	10%	0%	10%	0%	5%	0%	0%	0%	0%	0%	1%
Na+K	(%)	72%	87%	33%	79%	34%	82%	73%	40%	93%	96%	98%	99%	96%
SumCat	(%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HCO3+CC	(%)	66%	73%	64%	63%	71%	51%	72%	51%	56%	73%	64%	80%	65%
SO4	(%)	16%	12%	13%	17%	14%	26%	14%	33%	26%	13%	13%	9%	15%
Cl+NO3	(%)	18%	13%	23%	19%	15%	23%	14%	15%	18%	13%	20%	9%	16%
SumAn	(%)	99.5%	99.1%	99.6%	99.5%	99.7%	99.7%	99.2%	99.8%	99.6%	98.5%	97.2%	98.3%	95.5%
Type	Cat-An	Na-HCO3	Na-HCO3	Ca/Na-HCO3	Na-HCO3	Ca/Na-HCO3	Na-mxd	Na-HCO3	Ca-HCO3/SO4	Na-HCO3/SO4	Na-HCO3	Na-HCO3	Na-HCO3	Na-HCO3
Type	A,B,D	B2	B2	D1	B2	D1	B2-SO4	B1b	D21-SO4	A-SO4	A	A	A	A
COCs														
As	(ug/l)	4.35	13.33	0							62	95.5		138.5
Ba	(ug/l)			0										
B	(ug/l)	0.1	0.07	0.16	0.1	0.2	0.1	0.12	0.31	0.1	0.1	0.35	0.17	0.38
Alpha	pCi/l	1.17	0.7	4							0.91	3.31		4.43
Radon	pCi/l													
DBCP	(ug/l)	0	0	0										
EDB	(ug/l)	0	0	0										

WQ Analyses.		RRB AVG	RRB AVG	RRB AVG	RRB AVG	RRB AVG	RRB AVG	RRB AVG
Well		29S/25E 25M02	29S/25E 25M01	29S/25E 27N02 :	29S/25E 27N01 I	29S/26E 31H02 :	29S/26E 31H01 I	29S/26E 35H04 :
Twp/Rge		29S/25E	29S/25E	29S/25E	29S/25E	29S/26E	29S/26E	29S/26E
Sec/40ac		25M02	25M01	27N02	27N01	31H02	31H01	35H04
Depth		Sh	De	Sh	De	Sh	De	Sh
Date		5	6	8	8	14	7	14
Domain		Fan-E2	Fan-E2	Fan-E2	Fan-E2	Fan-E1	Fan-E1	Fan-E2
General Mineral								
Ca	(mg/l)	35.4	1.9	53.1	2.3	6.1	2.2	27.3
Mg	(mg/l)	1.2	0.0	3.2	0.0	0.1	0.0	1.1
Na	(mg/l)	27.0	32.5	33.1	28.1	27.1	29.7	23.8
K	(mg/l)	1.2	0.0	1.0	0.0	0.1	0.0	1.5
OH	(mg/l)	0.0	0.0	0.0	0.0	0.0	0.0	
CO3	(mg/l)	0.0	19.0	0.0	15.3	4.2	16.3	6.0
HCO3	(mg/l)	102.6	33.8	155.8	28.7	64.4	33.3	78.3
SO4	(mg/l)	33.4	8.7	25.8	8.8	8.8	8.4	19.4
Cl	(mg/l)	16.0	5.8	36.4	5.1	4.6	5.3	22.4
NO3	(mg/l)	16.5	0.6	12.9	0.7	2.0	0.5	12.2
NO2	(mg/l)	1.7	0.1	1.3	0.2	0.4	0.1	2.6
F	(mg/l)	0.1	0.4	0.1	0.4	0.1	0.5	0.2
SiO2	(mg/l)							
pH	(pH)	8.0	9.4	7.7	9.4	8.8	9.4	7.9
EC	(uS/cm)	321.4	164.0	444.4	144.6	152.2	151.6	276.4
TDS	(mg/l)	161.7	89.8	255.8	78.0	87.9	84.8	148.0
Hd	(mg/l)	93.0	4.7	145.6	5.7	15.4	5.6	69.4
Alk	(mg/l)	86.7	46.0	128.0	50.0	57.5	50.0	66.3
Water Quality								
TDS	index	Xint	Xint	Xint	Xint	Xint	Xint	Xint
Hard	index	M.Hard	Soft	Hard	Soft	Soft	Soft	M.Hard
SAR	index	Low	Low	Low	Low	Low	Low	Low
Calc'd Values								
Cat	(meq/l)	3.07	1.51	4.38	1.34	1.49	1.40	2.53
An	(meq/l)	3.10	1.57	4.33	1.34	1.55	1.45	2.73
Hard	(mg/l)	93	5	146	6	15	6	73
Alk	(mg/l)	84	43	128	36	56	41	69
SAR	ratio	1.22	6.52	1.19	5.11	3.00	5.47	1.21
SUM	(mg/l)	183	86	244	75	85	79	155
ECcalc	(uS/cm)	334	125	467	112	146	118	276
TDS/EC	ratio	0.50	0.55	0.58	0.54	0.58	0.56	0.54
Analyt. Checks								
Anal.Com	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL
Cat/An	EV=1	0.99	0.96	1.01	1.00	0.96	0.97	0.92
meq/EC	EV=1	0.96	0.94	0.98	0.92	1.00	0.94	0.95
TDS/SUM	EV=1	0.88	1.05	1.05	1.04	1.03	1.07	0.95
EC/ECcalc	EV=1	0.96	1.31	0.95	1.30	1.05	1.29	1.00
CalcHCO3								
Ternary Ratios		29S/25E 2	29S/25E 2	29S/25E 2	29S/25E 2	29S/26E 3	29S/26E 3	29S/26E 3
Ca	(%)	58%	6%	60%	9%	20%	8%	54%
Mg	(%)	3%		6%		0%	0%	4%
Na+K	(%)	39%	94%	33%	91%	79%	92%	42%
SumCat	(%)	100%	100%	100%	100%	100%	100%	100%
HCO3+CC	(%)	54%	76%	59%	73%	77%	75%	54%
SO4	(%)	22%	12%	12%	14%	12%	12%	15%
Cl+NO3	(%)	23%	11%	28%	12%	11%	11%	30%
SumAn	(%)	99.8%	98.5%	99.8%	98.6%	99.6%	98.3%	99.6%
Type	Cat-An	Ca/Na-mxd	Na-HCO3	ι-HCO3/Cl	Na-HCO3	Na-HCO3	Na-HCO3	ι-HCO3/Cl
Type	A,B,D	D21	A	D1	A	B2	A	D20
COCs								
As	(ug/l)		18		10.67	4.75	10	
Ba	(ug/l)	57.5	4.2	70.93	2.27	7.07	1.17	37.53
B	(ug/l)	0.11	0.08	0.14	0.03	7.75	0.02	0.1
Alpha	pCi/l	7.83	1.28	16.93	0.26	2.04	0.68	2.69
Radon	pCi/l							
DBCP	(ug/l)	0.05						
EDB	(ug/l)	0.088		0.054				

WQ Analyses.		RRB	ID4RAW	ID4RAW	ID4RAW	ID4RAW													
		AVG	AVG	AVG	AVG	AVG						AVG	KWB	KWB	KWB	KWB	Enns-N	Enns-S	Nikkel
Well		29S/26E 35H03 De	KWB	CAL AQ	FK	KR	SR 1	SR 2	SR 3	SR 4	SR 6	SR1-6	30s/25e 0:	30s/25e 0:	30s/25e 1	30s/25e 11C	29s/25e 3	29s/25e 3	29s/25e 35F01 ??
Twp/Rge		29S/26E	*KWB	*MCH	*MFK	*MKR	T30s/R25e	T30s/R25e	T30s/R25e	T30s/R25e	T30s/R25e	T30s/R25e	30s/25e	30s/25e	30s/25e	30s/25e	29s/25e	29s/25e	29s/25e
Sec/40ac		35H03	KWB	CAL AQ	FK	KR	02B01	02H01	02J01	02K	02L	02x	03Q01	03R01	11A01	11C01	34A01	34H01	35F01
Depth		De					99	504	251	504	504	99 - 504	SD	SD	SD	SD	??	??	??
Date		8	11	9	6	48	12/03	12/03	12/03	12/03	12/03	12/03	37727	37732	37732	36916	37272	37272	37272
Domain		Fan-E2	KWB	AQ	FK	KR													
General Mineral																			
Ca	(mg/l)	2.1	17.7	26.7	6.5	12.3	110	110	130	85	78	103	43	63	12	110	75	83	62
Mg	(mg/l)		1.8	12.6	1.9	2.5	4.4	2.7	4.8	3.2	4.3	3.9	0.78	2.6	bdt	4.7	6.1	9.8	3.6
Na	(mg/l)	37.6	31.1	63.8	5.8	10.8	52	75	83	52	49	62	49	44	33	51	41	43	33
K	(mg/l)		1.2	2.9	1.1	1.4	1.7	1.7	1.8	1.4	1.3	1.6				1.6	1.6	1.1	1.5
OH	(mg/l)	0.0	0.0	0.0	0.0	0.0	0.01	0.01	0.01	0.01	0.01	0.01	114						
CO3	(mg/l)	14.8	12.6	0.9	0.5	0.7	0.568	0.345	0.447	0.604	0.783	0.55	0.74	0.58	3.3				
HCO3	(mg/l)	55.5	69.6	97.1	30.2	58.1	110	66.8	109	117	191	119	114	179	64	207	140	179	121
SO4	(mg/l)	9.1	19.2	44.6	5.0	9.0	37	21	28	30	82	40	28	32	16	53	51	70	49
Cl	(mg/l)	5.1	16.8	84.1	3.9	3.8	180	260	270	140	200	210	65	65	22	98	65	70	42
NO3	(mg/l)	0.7	2.7	2.4	1.4	1.0	28				19	24					6.2	6.7	6
NO2	(mg/l)	0.2															bdt	bdt	bdt
F	(mg/l)	0.4	0.2	0.3	0.1	0.9	0.05	0.08	0.08	0.06	0.05	0.06	0.06	0.07	0.16	bdt	bdt	bdt	bdt
SiO2	(mg/l)		6.2	6.7	4.7	4.8													
pH	(pH)	9.2	8.7	8.3	7.5	7.9	7.9	7.9	7.8	7.9	7.8	7.9	8	7.7	8.9	7.4	7.5	7.5	7.8
EC	(uS/cm)	182.0	230.9	483.9	77.6	128.0	944	1070	1190	775	683	932	487	546	221	730	631	742	510
TDS	(mg/l)	102.0	142.8	334.0	41.5	87.7	660	710	800	510	410	618	285	345	140	530	390	448	312
Hd	(mg/l)	5.1	51.8	115.3	22.0	39.3	293	286	344	225	212	272	111	168	30	294	216	236	174
Alk	(mg/l)	70.0	67.8	79.3	22.8	48.0	90.1	54.9	89.6	95.9	157	98	94	147	54	170	140	179	121
Water Quality																			
TDS	index	Xlnt	Xlnt	Xlnt	Xlnt	Xlnt	Good	Fair-Poor	Fair-Poor	Good	Good	Good	Xlnt	Xlnt	Xlnt	Good	Xlnt	Good	Xlnt
Hard	index	Soft	Soft	M.Hard	Soft	Soft	V.Hard	V.Hard	V.Hard	V.Hard	V.Hard	V.Hard	M.Hard	Hard	Soft	V.Hard	V.Hard	V.Hard	Hard
SAR	index	Low	Low	Low	Low	Low	Mod	Mod	Mod	Low	Mod	Mod	Low	Low	Low	Low	Low	Low	Low
Calc'd Values																			
Cat	(meq/l)	1.74	2.42	5.22	0.76	1.32	8.16	9.02	10.54	6.80	6.41	8.18	4.34	5.27	2.03	8.13	6.07	6.85	4.86
An	(meq/l)	1.77	2.49	4.97	0.76	1.33	8.12	8.88	10.00	6.51	10.81	9.10	4.31	5.46	2.12	7.26	5.29	6.47	4.28
Hard	(mg/l)	5	52	119	24	41	293	286	345	226	213	272	111	168	30	294	212	248	170
Alk	(mg/l)	58	67	80	25	48	91	55	90	96	157	98	764	147	55	170	115	147	99
SAR	ratio		1.88	2.55	0.52	0.74	1.32	1.93	1.95	1.51	1.46	1.64	2.03	1.48		1.29	1.22	1.19	1.10
SUM	(mg/l)	97	138	286	41	71	468	504	572	370	529	502	357	295	118	420	315	372	257
ECcalc	(uS/cm)	151	240	580	78	132	970	1096	1235	776	1039	1039	483	584	219	855	633	740	507
TDS/EC	ratio	0.56	0.62	0.69	0.53	0.69	0.70	0.66	0.67	0.66	0.60	0.66	0.59	0.63	0.63	0.73	0.62	0.60	0.61
Analyt. Checks																			
Anal.Com	FULL	FULL	FULL	FULL	FULL	FULL	FULL	FULL-min	FULL-min	FULL-min	FULL	FULL	FULL-min	FULL-min	FULL-min	FULL-min	FULL-min	FULL-min	FULL-min
Cat/An	EV=1	0.98	0.97	1.05	1.00	0.99	1.00	1.02	1.05	1.04	0.49	0.89	1.01	0.97	0.96	1.11	1.14	1.06	1.13
meq/EC	EV=1	0.96	1.06	1.05	0.98	1.04	0.86	0.84	0.86	0.86	1.26	0.93	0.89	0.98	0.94	1.05	0.90	0.90	0.90
TDS/SUM	EV=1	1.05	1.04	1.17	1.01	1.24	1.41	1.41	1.40	1.38	0.78	1.23	0.80	1.17	1.19	1.26	1.24	1.21	1.22
EC/ECcalc	EV=1	1.21	0.96	0.83	1.00	0.97	0.97	0.98	0.96	1.00	0.66	0.90	1.01	0.94	1.01	0.85	1.00	1.00	1.01
CalcHCO3																			
Ternary Ratios		35H03 De	KWB	CAL AQ	FK	KR	SR 1	SR 2	SR 3	SR 4	SR 6	SR1-6	30s/25e 03Q	30s/25e 03R	30s/25e 11A	30s/25e 11C01 !	29s/25e 34A	29s/25e 34H	29s/25e 35F01 ??
Ca	(%)	6%	37%	26%	43%	46%	67%	61%	62%	62%	61%	63%	49%	60%	29%	67%	62%	60%	64%
Mg	(%)	0%	6%	20%	21%	15%	4%	2%	4%	4%	6%	4%	1%	4%	0%	5%	8%	12%	6%
Na+K	(%)	94%	57%	55%	37%	38%	28%	37%	35%	34%	34%	34%	49%	36%	71%	28%	30%	28%	30%
SumCat	(%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
HCO3+CO	(%)	79%	63%	33%	68%	73%	22%	12%	18%	30%	29%	22%	44%	54%	55%	47%	43%	45%	46%
SO4	(%)	11%	16%	19%	14%	14%	9%	5%	6%	10%	16%	9%	14%	12%	16%	15%	20%	23%	24%
Cl+NO3	(%)	9%	21%	48%	18%	9%	68%	83%	76%	61%	55%	69%	43%	34%	29%	38%	37%	32%	30%
SumAn	(%)	98.9%	99.5%	99.7%	99.2%	96.6%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.9%	99.9%	99.6%	100.0%	100.0%	100.0%	100.0%
Type	Cat-An	Na-HCO3	Ca/Na-HCO3	Ca/Na-HCO3/Cl	mxd-HCO3	Ca/Na-HCO3	Ca-Cl	Ca-Cl	Ca-Cl	Ca-Cl	Ca-HCO3/Cl	Ca-Cl	Ca/Na-HCO3/Cl	Ca/Na-HCO3/Cl	Na-HCO3/Cl	Ca-HCO3/Cl	Ca-mxd	Ca-mxd	Ca-mxd
Type	A,B,D	A	B1b	B1a	B1a	B1a	D21	D21	D21	D21	D21	D21	D20	D21	B2	D21	D1	D1	D1
COCs																			
As	(ug/l)	39	9.85	6.97	2.9	5.17	0	1.4	0	0	0	0.28	1.2	3.1	6.6	1.8	0.8	0.8	0.8
Ba	(ug/l)	1.57					170	170	200	130	100	154	66	93	16	170	110	88	86
B	(ug/l)	0.09															200	300	200
Alpha	pCi/l	0.92	3.67	1.89	2.87	3.18	7.8	9.2	7.6	8	22	10.92				40	20.5	30.8	21.4
Radon	pCi/l																679	664	667
DBCP	(ug/l)															0	0.05	0.36	0.11
EDB	(ug/l)															0	0	0	0.02

Exhibit 3.

Strand Ranch ASR Project
Salt Balance Analysis.

Exhibit 3. IRWD Strand Ranch Salt Balance.

Table 3.1 Hypothetical Recharge-TDS Blends.

Hypothetical Instantaneous Recharge TDS for Various Recharge Blends.

Source:	SWP1	KR	FK	Blend
Source TDS:	334	88	41 (mg/l)	
In-Blend 11	100%	0%	0%	334
In-Blend 12	60%	30%	10%	231
In-Blend 13	30%	60%	10%	157
In-Blend 14	20%	70%	10%	133
In-Blend 15	10%	80%	10%	108
In-Blend 16	0%	100%	0%	88

Note: SWP1 at 334 mg/l is the long-term average in-aqueduct TDS.
Note: Blend is positive to represent salt added to aquifer.

Hypothetical Instantaneous Recharge TDS for Various Recharge Blends.

Source:	SWP2	KR	FK	Blend
Source TDS:	227	88	41 (mg/l)	
In-Blend 21	100%	0%	0%	227
In-Blend 22	60%	30%	10%	167
In-Blend 23	30%	60%	10%	125
In-Blend 24	20%	70%	10%	**111**
In-Blend 25	10%	80%	10%	97
In-Blend 26	0%	100%	0%	88

Note: SWP2 at 227 mg/l is the 5-year average wet-cycle SWP TDS delivered to the Kern Fan.
Note: Blend is positive to represent salt added to aquifer.

Table 3.2 Hypothetical Recovery-TDS Blends.

Hypothetical Instantaneous Recovery TDS for Various Recovery Blends.

Source:	Shal Aq	Deep Aq	Blend
Source TDS:	559	119 (mg/l)	
Out-Blend 31	100%	0%	(559)
Out-Blend 32	80%	20%	(471)
Out-Blend 33	60%	40%	(383)
Out-Blend 33	40%	60%	(295)
Out-Blend 35	30%	70%	(251)
Out-Blend 36	25%	75%	**(229)**
Out-Blend 37	10%	90%	(163)
Out-Blend 38	0%	100%	(119)

Note: Shallow Aq at 559 mg/l is the average plume-impacted TDS.
Note: Blend is negative to represent salt removed from aquifer.

Hypothetical Instantaneous Recovery TDS for Various Recovery Blends.

Source:	Shal Aq	Deep Aq	Blend
Source TDS:	237	119 (mg/l)	
Out-Blend 41	100%	0%	(237)
Out-Blend 42	80%	20%	(213)
Out-Blend 43	60%	40%	(190)
Out-Blend 44	40%	60%	(166)
Out-Blend 45	30%	70%	(154)
Out-Blend 46	20%	80%	(143)
Out-Blend 47	10%	90%	(131)
Out-Blend 48	0%	100%	(119)

Note: Shallow Aq at 237mg/l is the average unimpacted TDS.
Note: Blend is negative to represent salt removed from aquifer.

Exhibit 3. IRWD Strand Ranch Salt Balance.

Table 3.3 Hypothetical Project Salt Balance Matrix.

Recharge	SWP1	227	100%	60%	30%	**20%**	10%	0%
Recharge	KR	88	0%	30%	60%	**70%**	80%	100%
Recharge	FK	41	0%	10%	10%	**10%**	10%	0%
Recharge	Blend	(mg/l)	227	167	125	**111**	97	88

	Shal Aq	Deep Aq	Blend						
Recovery	559	119	(mg/l)						
Out-Blend 31	100%	0%	(559)	(332)	(392)	(434)	(448)	(462)	(471)
Out-Blend 32	80%	20%	(471)	(244)	(304)	(346)	(360)	(374)	(383)
Out-Blend 33	60%	40%	(383)	(156)	(216)	(258)	(272)	(286)	(295)
Out-Blend 33	40%	60%	(295)	**(68)**	(128)	(170)	(184)	(198)	(207)
Out-Blend 35	30%	70%	(251)	**(24)**	(84)	(126)	(140)	(154)	(163)
Out-Blend 36	**25%**	**75%**	**(229)**	**(2)**	**(62)**	(104)	**(118)**	(132)	(141)
Out-Blend 37	10%	90%	(163)	**64**	**4**	(38)	(52)	(66)	(75)
Out-Blend 38	0%	100%	(119)	**108**	**48**	**6**	**(8)**	(22)	(31)

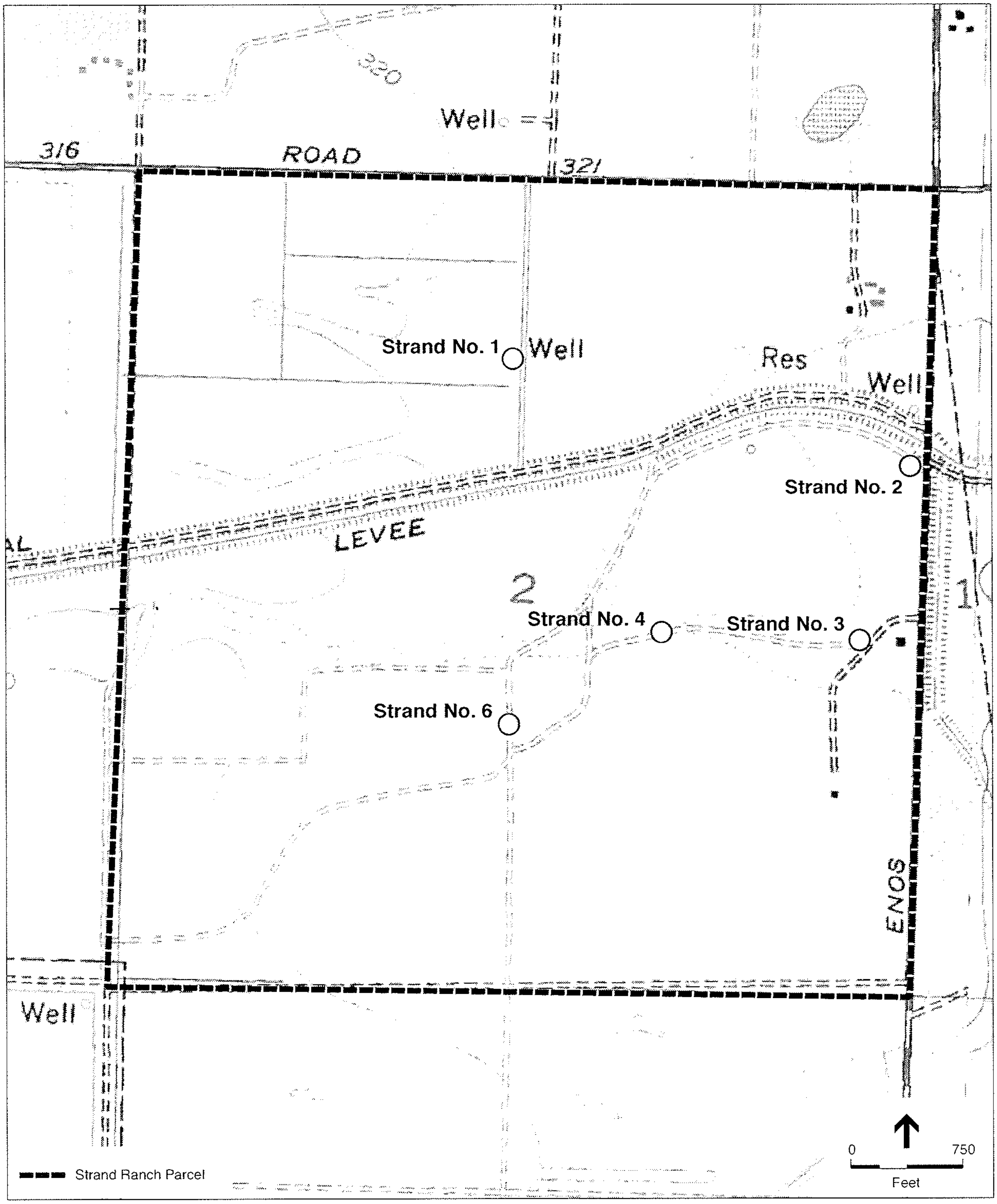
Note: Shallow Aq at 559mg/l is the average plume-impacted TDS.

	Shal Aq	Deep Aq	Blend						
Recovery	237	119	(mg/l)						
Out-Blend 41	100%	0%	(237)	**(10)**	(70)	(112)	(126)	(140)	(149)
Out-Blend 42	80%	20%	(213)	**14**	**(47)**	(88)	(102)	(116)	(125)
Out-Blend 43	60%	40%	(190)	**37**	**(23)**	(65)	(79)	(93)	(102)
Out-Blend 44	40%	60%	(166)	**61**	**1**	(41)	(55)	(69)	(78)
Out-Blend 45	30%	70%	(154)	**73**	**12**	**(29)**	(43)	(57)	(66)
Out-Blend 46	20%	80%	(143)	**84**	**24**	**(18)**	(32)	(45)	(55)
Out-Blend 47	10%	90%	(131)	**96**	**36**	**(6)**	**(20)**	(34)	(43)
Out-Blend 48	0%	100%	(119)	**108**	**48**	**6**	**(8)**	(22)	(31)

Note: Shallow Aq at 237mg/l is the average unimpacted TDS.

Appendix H

Title 22 Sample Analysis Results



SOURCE: USGS; ESA, 2007.

Irvine Ranch Water District . 205426

Figure H-1
Operable Existing Wells
on Strand Ranch

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Laboratory Report

for

Layne Christensen
11001 Etiwanda Ave.

Fontana , CA 92337

Attention: Tony Morgan
Fax: (909) 390-6097

ACCREDITED IN ACCORDANCE WITH nelac 01114CA

LXG Linda Geddes
Project Manager

Report#: 153979
DRINKING

Laboratory certifies that the test results meet all **NELAC** requirements unless noted in the Comments section or the Case Narrative. Following the cover page are Comments,QC Report,QC Summary,Data Report,Hits Report, totaling 58 page[s].

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Laboratory Hits Report #153979

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08-aug-2005 19:31:00

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080247	**STRAND #1**				
08/17/05	Alpha, Gross		7.8	15	pCi/l	2.0
08/17/05	Alpha, Min Detectable Activity		2.00		pCi/l	
08/17/05	Alpha, Two Sigma Error		2.4		pCi/l	
08/16/05	Agressiveness Index-Calculated		12.44		Not Appl.	0.10
08/12/05	Alkalinity in CaCO3 units		90.1		mg/l	2.0
08/09/05	Barium, dissolved, ICAP/MS		170		ug/l	2.0
08/16/05	Bicarb.Alkalinity as HCO3,calc		110.		mg/l	0.001
08/17/05	Bromide		1100		ug/l	25
08/09/05	Calcium, Total, ICAP		110		mg/l	1.0
08/16/05	Carbon Dioxide,Free(25C)-Calc.		2.27		mg/l	0.001
08/16/05	Carbonate as CO3, Calculated		0.568		mg/l	0.001
08/09/05	Chloride		180	250	mg/l	10
08/09/05	Chromium, dissolved, ICAP/MS		3.6		ug/l	2.0
08/08/05	Field pH		7.4		Units	
08/11/05	Fluoride		0.05	4	mg/l	0.050
08/08/05	Hexavalent chromium(Dissolved)		1.9		ug/l	0.10
08/15/05	Hydroxide as OH, Calculated		0.01		mg/l	0.001
08/16/05	Langelier Index - 25 degree		0.54		None	
08/09/05	Magnesium, Total, ICAP		4.4		mg/l	0.10
08/08/05	Odor		2	3	TON	1.0
08/11/05	PH (H1=past HT, not compliant)		7.9	6.5-8.5	Units	0.001
08/09/05	Potassium, Total, ICAP		1.7		mg/l	1.0
08/09/05	Sodium, Total, ICAP		52		mg/l	1.0
08/08/05	Source Temperature		24.1		Degrees C	
08/09/05	Specific Conductance		944		umho/cm	2.0
08/08/05	Sulfate		37	250	mg/l	1.0
08/09/05	Total Dissolved Solid (TDS)		660	500	mg/l	10
08/10/05	Total Hardness as CaCO3 by ICP		293.		mg/l	3.0
08/09/05	Turbidity		0.35	5	NTU	0.050
08/25/05	Uranium by ICPMS as pCi/L		14.1		pCi/l	0.70

SUMMARY OF POSITIVE DATA <u>ONLY</u>.

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Laboratory
Hits Report
#153979

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08-aug-2005 19:31:00

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080247	STRAND #1				
08/24/05	Uranium, ICAP/MS		21	30	ug/l	1.0
08/16/05	pH of CaCO3 saturation(25C)		7.36		Units	0.10
08/16/05	pH of CaCO3 saturation(60C)		6.92		Units	0.10
	2508080248	TRAVEL BLANK-ANALYZE				

SUMMARY OF POSITIVE DATA ONLY.

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Laboratory
Data Report
#153979

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08/08/05

STRAND #1 (2508080247) Sampled on 08/08/05 11:40

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 13:05	282802	(EPA/ML 200.8)	Silver, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/16/05 22:58		(ML/SM2330)	Agressiveness Index-Calculated	12.44	NA	0.10	1
	08/09/05 13:05	282808	(EPA/ML 200.8)	Aluminum, dissolved, ICAP/MS	ND	ug/l	25	1
	08/12/05 12:41	283063	(SM2320B/ 310.1)	Alkalinity in CaCO3 units	90.1	mg/l	2.0	1
	08/09/05 13:05	282801	(EPA/ML 200.8)	Arsenic, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 13:05	282805	(EPA/ML 200.8)	Barium, dissolved, ICAP/MS	170	ug/l	2.0	1
	08/09/05 13:05	282799	(EPA/ML 200.8)	Beryllium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/17/05 00:00	283494	(ML/EPA 300.0)	Bromide	1100	ug/l	25	5
	08/09/05 16:16	282400	(ML/EPA 200.7)	Calcium, Total, ICAP	110	mg/l	1.0	1
	08/09/05 13:05	282803	(EPA/ML 200.8)	Cadmium, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/09/05 14:26	282412	(ML/EPA 300.0)	Chloride	180	mg/l	10	10
	08/16/05 22:44		(SM4500-CO2-D)	Carbon Dioxide,Free(25C)-Calc.	2.27	mg/l	0.001	1
	08/16/05 22:39		(SM2320B/E310.1)	Carbonate as CO3, Calculated	0.568	mg/l	0.001	1
	08/08/05 00:00	282314	(ML/S2120B)	Apparent Color	ND	ACU	3.0	1
	08/09/05 13:05	282810	(EPA/ML 200.8)	Chromium, dissolved, ICAP/MS	3.6	ug/l	2.0	1
	08/08/05 23:03	283768	(EPA 218.6)	Hexavalent chromium(Dissolved)	1.9	ug/l	0.10	1
	08/09/05 13:05	282813	(EPA/ML 200.8)	Copper, dissolved, ICAP/MS	ND	ug/l	2.0	1
	08/29/05 08:37	285047	(ML/SM 5310C)	Dissolved Organic Carbon	ND	mg/l	0.30	1
	08/09/05 13:34	282308	(2510B/ SW9050)	Specific Conductance	944	umho/cm	2.0	1
08/12/05	08/16/05 00:00	283673	(ML/EPA 548.1)	Endothall	ND	ug/l	20	4
	08/11/05 00:00	282675	(SM 4500C)	Fluoride	0.05	mg/l	0.050	1
	08/11/05 00:00	282726	(ML/EPA 200.7)	Iron, Dissolved, ICAP	ND	mg/l	0.020	1
	08/10/05 18:49		(ML/SM2340B)	Total Hardness as CaCO3 by ICP	293.	mg/l	3.0	1
	08/16/05 22:27		(SM2320B/E310.1)	Bicarb.Alkalinity as HCO3,calc	110.	mg/l	0.001	1
	08/17/05 12:13	283386	(EPA/ML 245.1)	Mercury, dissolved	ND	ug/l	0.20	1
	08/09/05 16:16	282385	(ML/EPA 200.7)	Potassium, Total, ICAP	1.7	mg/l	1.0	1
	08/16/05 22:47		(ML/SM2330B)	Langelier Index - 25 degree	0.54	None	0.0000	1
	08/09/05 13:30	282466	(SM5540C/E425.1)	Surfactants	ND	mg/l	0.050	1
	08/09/05 16:16	282389	(ML/EPA 200.7)	Magnesium, Total, ICAP	4.4	mg/l	0.10	1
	08/09/05 13:05	282811	(EPA/ML 200.8)	Manganese, dissolved, ICAP/MS	ND	ug/l	2.0	1
	08/09/05 16:16	282392	(ML/EPA 200.7)	Sodium, Total, ICAP	52	mg/l	1.0	1
	08/09/05 00:00	284112	(EPA/ML 200.8)	Nickel, dissolved, ICAP/MS	ND	ug/l	5.0	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 17:00	282312	(ML/S2150B)	Odor	2	TON	1.0	1
	08/15/05 14:59		(SM2320B/E310.1)	Hydroxide as OH, Calculated	0.01	mg/l	0.001	1
	08/09/05 13:05	282807	(EPA/ML 200.8)	Lead, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/11/05 00:00	282674	(4500HB/ E 150)	PH (H1=past HT, not compliant)	7.9	Units	0.001	1
	08/08/05 00:00		(ML/EPA 150.1)	Field pH	7.4	Units	0.0000	1
	08/16/05 22:45		(ML/SM2330B)	pH of CaCO3 saturation(25C)	7.36	Units	0.10	1
	08/16/05 22:47		(ML/SM2330B)	pH of CaCO3 saturation(60C)	6.92	Units	0.10	1
	08/09/05 13:05	282804	(EPA/ML 200.8)	Antimony, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/23/05 00:00	284107	(EPA/ML 200.8)	Selenium, dissolved, ICAP/MS	ND	ug/l	5.0	1
	08/08/05 22:07	282253	(ML/EPA 300.0)	Sulfate	37	mg/l	1.0	2
08/09/05	08/09/05 12:00	282564	(SM 2540C)	Total Dissolved Solid (TDS)	660	mg/l	10	1
	08/08/05 00:00		(FIELD/SM2550B)	Source Temperature	24.1	DEGC	0.0000	1
	08/09/05 13:05	282806	(EPA/ML 200.8)	Thallium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 15:59	282493	(ML/EPA 180.1)	Turbidity	0.35	NTU	0.050	1
	08/24/05 13:45	284243	(ML/EPA 200.8)	Uranium, ICAP/MS	21	ug/l	1.0	1
	08/25/05 20:33		(EPA/ML 200.8)	Uranium by ICPMS as pCi/L	14.1	pCi/l	0.70	1
	08/09/05 13:05	282800	(EPA/ML 200.8)	Zinc, dissolved, ICAP/MS	ND	ug/l	5.0	1

525 Semivolatiles by GC/MS

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	2,4-Dinitrotoluene	ND	ug/l	0.10	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	alpha-Chlordane	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Diazinon (Qualitative)	ND	ug/l	0.10	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Acenaphthylene	ND	ug/l	0.10	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Alachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Aldrin	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Anthracene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Atrazine	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Benz(a)Anthracene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Benzo(a)pyrene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Benzo(b)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Benzo(g,h,i)Perylene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Benzo(k)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Di(2-Ethylhexyl)phthalate	ND	ug/l	0.60	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Butylbenzylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Bromacil	ND	ug/l	0.20	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Butachlor	ND	ug/l	0.050	1

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Laboratory
Data Report
#153979

Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Caffeine	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Chrysene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Dibenz(a,h)Anthracene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Di-(2-Ethylhexyl)adipate	ND	ug/l	0.60	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Diethylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Dieldrin	ND	ug/l	0.20	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Dimethylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Dimethoate	ND	ug/l	0.10	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Di-n-Butylphthalate	ND	ug/l	1.0	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Endrin	ND	ug/l	0.10	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Fluoranthene	ND	ug/l	0.10	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Fluorene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	gamma-Chlordane	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Hexachlorobenzene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Hexachlorocyclopentadiene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Heptachlor	ND	ug/l	0.040	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Heptachlor Epoxide (isomer B)	ND	ug/l	0.020	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Indeno(1,2,3,c,d)Pyrene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Isophorone	ND	ug/l	0.50	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Lindane	ND	ug/l	0.020	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Methoxychlor	ND	ug/l	0.10	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Metribuzin	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Molinate	ND	ug/l	0.10	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Metolachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	trans-Nonachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Pentachlorophenol	ND	ug/l	1.0	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Phenanthrene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Prometryn	ND	ug/l	0.50	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Propachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Pyrene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Simazine	ND	ug/l	0.050	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Thiobencarb	ND	ug/l	0.20	1
08/18/05	09/01/05 12:55	285766	(ML/EPA 525.2)	Trifluralin	ND	ug/l	0.10	1
			(ML/EPA 525.2)	Triphenylphosphate(70-130)	94	% Rec		
			(ML/EPA 525.2)	Perylene-d12(70-130)	88	% Rec		
			(ML/EPA 525.2)	1.3-dimethyl-2-nbenz(70-130)	99	% Rec		

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Layne Christensen
(continued)

Aldicarbs by 531.2

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/25/05 00:00	284485	(ML/EPA 531.2)	3-Hydroxycarbofuran	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Aldicarb (Temik)	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfone	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfoxide	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Baygon (Propoxur)	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Carbofuran (Furadan)	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Carbaryl	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Methiocarb	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Methomyl	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Oxamyl (Vydate)	ND	ug/l	0.50	1
			(ML/EPA 531.2)	BDMC(70-130)	100	% Rec		

Diuron by method 532

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/11/05	08/24/05 00:00	284321	(EPA 532)	Diuron	ND	ug/l	1.0	1
			(EPA 532)	Monuron(70-130)	83	% Rec		
			(EPA 532)	Carbazole(70-130)	79	% Rec		

EDB and DBCP by GC-ECD

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/16/05	08/16/05 07:08	283338	(ML/EPA 504.1)	Dibromochloropropane (DBCP)	ND	ug/l	0.010	1
08/16/05	08/16/05 07:08	283338	(ML/EPA 504.1)	Ethylene Dibromide (EDB)	ND	ug/l	0.010	1

Gross Alpha Radiation

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/17/05 00:00	284048	(ML/EPA 900.0)	Alpha, Gross	7.8	pCi/l	2.0	1
	08/17/05 00:00	284048	(ML/EPA 900.0)	Alpha, Two Sigma Error	2.4	pCi/l	0.0000	1
	08/17/05 00:00	284048	(ML/EPA 900.0)	Alpha, Min Detectable Activity	2.00	pCi/l	0.0000	1

Herbicides by 515.4

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4,5-T	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4,5-TP (Silvex)	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4-D	ND	ug/l	0.10	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4-DB	ND	ug/l	2.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dichlorprop	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Acifluorfen	ND	ug/l	0.20	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Bentazon	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dalapon	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	3,5-Dichlorobenzoic acid	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Tot DCPA Mono&Diacid Degradate	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dicamba	ND	ug/l	0.080	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dinoseb	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Pentachlorophenol	ND	ug/l	0.040	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Picloram	ND	ug/l	0.10	1
			(ML/EPA 515.4)	4.4-Dibrombiphenyl(60-140)	114	% Rec		
			(ML/EPA 515.4)	2.4-DCPAA (70-130)	93	% Rec		

Pesticides by EPA 505

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	PCB 1016 Aroclor	ND	ug/l	0.070	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	PCB 1221 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	PCB 1232 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	PCB 1242 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	PCB 1248 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	PCB 1254 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	PCB 1260 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Alachlor (Alanex)	ND	ug/l	0.050	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Aldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Chlordane	ND	ug/l	0.10	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Dieldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Endrin	ND	ug/l	0.010	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Heptachlor	ND	ug/l	0.010	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Heptachlor Epoxide	ND	ug/l	0.010	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Lindane (gamma-BHC)	ND	ug/l	0.010	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Methoxychlor	ND	ug/l	0.050	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Total PCBs	ND	ug/l	0.070	1
08/10/05	08/10/05 22:25	283059	(ML/EPA 505)	Toxaphene	ND	ug/l	0.50	1

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1

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(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Benzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 22:36	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/08/05 22:36	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1
			(EPA 524.2)	4-Bromofluorobenzene(70-130)	102	% Rec		
			(EPA 524.2)	Toluene-d8(70-130)	94	% Rec		
			(EPA 524.2)	1,2-Dichloroethane-d4(70-130)	119	% Rec		

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Laboratory
Data Report
#153979

Layne Christensen
(continued)

TRAVEL BLANK-ANALYZE (2508080248) Sampled on 08/08/05 00:00

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Benzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 00:49	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/09/05 00:49	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
			(EPA 524.2)	Toluene-d8(70-130)	94	% Rec		
			(EPA 524.2)	4-Bromofluorobenzene(70-130)	103	% Rec		
			(EPA 524.2)	1,2-Dichloroethane-d4(70-130)	121	% Rec		

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Laboratory Report

for

Layne Christensen
11001 Etiwanda Ave.

Fontana , CA 92337

Attention: Tony Morgan
Fax: (909) 390-6097

ACCREDITED IN ACCORDANCE WITH nelac 01114CA

LXG Linda Geddes
Project Manager

Report#: 153971
DRINKING

Laboratory certifies that the test results meet all **NELAC** requirements unless noted in the Comments section or the Case Narrative. Following the cover page are Comments,QC Report,QC Summary,Data Report,Hits Report, totaling 58 page[s].

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Laboratory
Hits Report
#153971

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08-aug-2005 18:46:01

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080235	**STRAND #2**				
08/15/05	Alpha, Gross		9.2	15	pCi/l	2.0
08/15/05	Alpha, Min Detectable Activity		2.00		pCi/l	
08/15/05	Alpha, Two Sigma Error		2.5		pCi/l	
08/08/05	Benzene		0.7	5	ug/l	0.50
08/16/05	Agressiveness Index-Calculated		12.22		Not Appl.	0.10
08/12/05	Alkalinity in CaCO3 units		54.9		mg/l	2.0
08/09/05	Arsenic, dissolved, ICAP/MS		1.4		ug/l	1.0
08/09/05	Barium, dissolved, ICAP/MS		170		ug/l	2.0
08/16/05	Bicarb.Alkalinity as HCO3,calc		66.8		mg/l	0.001
08/09/05	Calcium, Total, ICAP		110		mg/l	1.0
08/16/05	Carbon Dioxide,Free(25C)-Calc.		1.38		mg/l	0.001
08/16/05	Carbonate as CO3, Calculated		0.345		mg/l	0.001
08/09/05	Chloride		260	250	mg/l	10
08/09/05	Chromium, dissolved, ICAP/MS		6.9		ug/l	2.0
08/08/05	Field pH		7.6		Units	
08/11/05	Fluoride		0.08	4	mg/l	0.050
08/08/05	Hexavalent chromium(Dissolved)		1.9		ug/l	0.10
08/15/05	Hydroxide as OH, Calculated		0.01		mg/l	0.001
08/16/05	Langelier Index - 25 degree		0.32		None	
08/09/05	Magnesium, Total, ICAP		2.7		mg/l	0.10
08/09/05	Manganese, dissolved, ICAP/MS		4.4		ug/l	2.0
08/17/05	Mercury, dissolved		1.01		ug/l	0.20
08/08/05	Odor		1	3	TON	1.0
08/11/05	PH (H1=past HT, not compliant)		7.9	6.5-8.5	Units	0.001
08/09/05	Potassium, Total, ICAP		1.7		mg/l	1.0
08/09/05	Sodium, Total, ICAP		75		mg/l	1.0
08/08/05	Source Temperature		23.4		Degrees C	
08/09/05	Specific Conductance		1070		umho/cm	2.0
08/08/05	Sulfate		21	250	mg/l	2.5
08/09/05	Total Dissolved Solid (TDS)		710	500	mg/l	10

SUMMARY OF POSITIVE DATA <u>ONLY</u>.

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Laboratory
Hits Report
#153971

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08-aug-2005 18:46:01

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080235	**STRAND #2**				
08/10/05	Total Hardness as CaCO3 by ICP		286.		mg/l	3.0
08/09/05	Turbidity		0.30	5	NTU	0.050
08/25/05	Uranium by ICPMS as pCi/L		6.70		pCi/l	0.70
08/24/05	Uranium, ICAP/MS		10	30	ug/l	1.0
08/16/05	pH of CaCO3 saturation(25C)		7.58		Units	0.10
08/16/05	pH of CaCO3 saturation(60C)		7.14		Units	0.10
	2508080236	**TRAVEL BLANK-ANALYZE**				

SUMMARY OF POSITIVE DATA ONLY.

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Laboratory Data Report #153971

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08/08/05

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
STRAND #2 (2508080235)	**Sampled on 08/08/05 09:00**							
	08/09/05 12:57	282802	(EPA/ML 200.8)	Silver, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/16/05 22:58		(ML/SM2330)	Agressiveness Index-Calculated	12.22	NA	0.10	1
	08/09/05 12:57	282808	(EPA/ML 200.8)	Aluminum, dissolved, ICAP/MS	ND	ug/l	25	1
	08/12/05 12:41	283063	(SM2320B/ 310.1)	Alkalinity in CaCO3 units	54.9	mg/l	2.0	1
	08/09/05 12:57	282801	(EPA/ML 200.8)	Arsenic, dissolved, ICAP/MS	1.4	ug/l	1.0	1
	08/09/05 12:57	282805	(EPA/ML 200.8)	Barium, dissolved, ICAP/MS	170	ug/l	2.0	1
	08/09/05 12:57	282799	(EPA/ML 200.8)	Beryllium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 16:30	282400	(ML/EPA 200.7)	Calcium, Total, ICAP	110	mg/l	1.0	1
	08/09/05 12:57	282803	(EPA/ML 200.8)	Cadmium, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/09/05 14:38	282412	(ML/EPA 300.0)	Chloride	260	mg/l	10	10
	08/16/05 22:44		(SM4500-CO2-D)	Carbon Dioxide,Free(25C)-Calc.	1.38	mg/l	0.001	1
	08/16/05 22:39		(SM2320B/E310.1)	Carbonate as CO3, Calculated	0.345	mg/l	0.001	1
	08/08/05 00:00	282313	(ML/S2120B)	Apparent Color	ND	ACU	3.0	1
	08/09/05 12:57	282810	(EPA/ML 200.8)	Chromium, dissolved, ICAP/MS	6.9	ug/l	2.0	1
	08/08/05 22:39	283768	(EPA 218.6)	Hexavalent chromium(Dissolved)	1.9	ug/l	0.10	1
	08/09/05 12:57	282813	(EPA/ML 200.8)	Copper, dissolved, ICAP/MS	ND	ug/l	2.0	1
	08/29/05 08:37	285047	(ML/SM 5310C)	Dissolved Organic Carbon	ND	mg/l	0.30	1
	08/09/05 13:34	282308	(2510B/ SW9050)	Specific Conductance	1070	umho/cm	2.0	1
08/09/05	08/11/05 00:00	282734	(ML/EPA 548.1)	Endothall	ND	ug/l	20	4
	08/11/05 00:00	282675	(SM 4500C)	Fluoride	0.08	mg/l	0.050	1
	08/11/05 00:00	282726	(ML/EPA 200.7)	Iron, Dissolved, ICAP	ND	mg/l	0.020	1
	08/10/05 18:49		(ML/SM2340B)	Total Hardness as CaCO3 by ICP	286.	mg/l	3.0	1
	08/16/05 22:27		(SM2320B/E310.1)	Bicarb.Alkalinity as HCO3,calc	66.8	mg/l	0.001	1
	08/17/05 12:13	283386	(EPA/ML 245.1)	Mercury, dissolved	1.01	ug/l	0.20	1
	08/09/05 16:30	282385	(ML/EPA 200.7)	Potassium, Total, ICAP	1.7	mg/l	1.0	1
	08/16/05 22:47		(ML/SM2330B)	Langelier Index - 25 degree	0.32	None	0.0000	1
	08/09/05 13:30	282466	(SM5540C/E425.1)	Surfactants	ND	mg/l	0.050	1
	08/09/05 16:30	282389	(ML/EPA 200.7)	Magnesium, Total, ICAP	2.7	mg/l	0.10	1
	08/09/05 12:57	282811	(EPA/ML 200.8)	Manganese, dissolved, ICAP/MS	4.4	ug/l	2.0	1
	08/09/05 16:30	282392	(ML/EPA 200.7)	Sodium, Total, ICAP	75	mg/l	1.0	1
	08/09/05 00:00	284112	(EPA/ML 200.8)	Nickel, dissolved, ICAP/MS	ND	ug/l	5.0	1
	08/08/05 17:00	282311	(ML/S2150B)	Odor	1	TON	1.0	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/15/05 14:59		(SM2320B/E310.1)	Hydroxide as OH, Calculated	0.01	mg/l	0.001	1
	08/09/05 12:57	282807	(EPA/ML 200.8)	Lead, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/11/05 00:00	282674	(4500HB/ E 150)	PH (H1=past HT, not compliant)	7.9	Units	0.001	1
	08/08/05 00:00		(ML/EPA 150.1)	Field pH	7.6	Units	0.0000	1
	08/16/05 22:45		(ML/SM2330B)	pH of CaCO3 saturation(25C)	7.58	Units	0.10	1
	08/16/05 22:47		(ML/SM2330B)	pH of CaCO3 saturation(60C)	7.14	Units	0.10	1
	08/09/05 12:57	282804	(EPA/ML 200.8)	Antimony, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/23/05 00:00	284107	(EPA/ML 200.8)	Selenium, dissolved, ICAP/MS	ND	ug/l	5.0	1
	08/08/05 22:19	282253	(ML/EPA 300.0)	Sulfate	21	mg/l	2.5	5
08/09/05	08/09/05 12:00	282564	(SM 2540C)	Total Dissolved Solid (TDS)	710	mg/l	10	1
	08/08/05 00:00		(FIELD/SM2550B)	Source Temperature	23.4	DEGC	0.0000	1
	08/09/05 12:57	282806	(EPA/ML 200.8)	Thallium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 15:59	282492	(ML/EPA 180.1)	Turbidity	0.30	NTU	0.050	1
	08/24/05 13:41	284243	(ML/EPA 200.8)	Uranium, ICAP/MS	10	ug/l	1.0	1
	08/25/05 20:33		(EPA/ML 200.8)	Uranium by ICPMS as pCi/L	6.70	pCi/l	0.70	1
	08/09/05 12:57	282800	(EPA/ML 200.8)	Zinc, dissolved, ICAP/MS	ND	ug/l	5.0	1

525 Semivolatiles by GC/MS

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	2,4-Dinitrotoluene	ND	ug/l	0.10	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	alpha-Chlordane	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Diazinon (Qualitative)	ND	ug/l	0.10	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Acenaphthylene	ND	ug/l	0.10	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Alachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Aldrin	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Anthracene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Atrazine	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Benz(a)Anthracene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Benzo(a)pyrene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Benzo(b)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Benzo(g,h,i)Perylene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Benzo(k)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Di(2-Ethylhexyl)phthalate	ND	ug/l	0.60	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Butylbenzylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Bromacil	ND	ug/l	0.20	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Butachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Caffeine	ND	ug/l	0.050	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Chrysene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Dibenz(a,h)Anthracene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Di-(2-Ethylhexyl)adipate	ND	ug/l	0.60	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Diethylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Dieldrin	ND	ug/l	0.20	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Dimethylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Dimethoate	ND	ug/l	0.10	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Di-n-Butylphthalate	ND	ug/l	1.0	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Endrin	ND	ug/l	0.10	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Fluoranthene	ND	ug/l	0.10	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Fluorene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	gamma-Chlordane	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Hexachlorobenzene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Hexachlorocyclopentadiene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Heptachlor	ND	ug/l	0.040	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Heptachlor Epoxide (isomer B)	ND	ug/l	0.020	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Indeno(1,2,3,c,d)Pyrene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Isophorone	ND	ug/l	0.50	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Lindane	ND	ug/l	0.020	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Methoxychlor	ND	ug/l	0.10	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Metribuzin	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Molinate	ND	ug/l	0.10	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Metolachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	trans-Nonachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Pentachlorophenol	ND	ug/l	1.0	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Phenanthrene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Prometryn	ND	ug/l	0.50	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Propachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Pyrene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Simazine	ND	ug/l	0.050	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Thiobencarb	ND	ug/l	0.20	1
08/18/05	09/01/05 12:11	285766	(ML/EPA 525.2)	Trifluralin	ND	ug/l	0.10	1
			(ML/EPA 525.2)	Triphenylphosphate(70-130)	97	% Rec		
			(ML/EPA 525.2)	1,3-dimethyl-2-nbenz(70-130)	95	% Rec		
			(ML/EPA 525.2)	Perylene-d12(70-130)	91	% Rec		

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Layne Christensen
(continued)

Aldicarbs by 531.2

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/24/05 00:00	284485	(ML/EPA 531.2)	3-Hydroxycarbofuran	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Aldicarb (Temik)	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfone	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfoxide	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Baygon (Propoxur)	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Carbofuran (Furadan)	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Carbaryl	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Methiocarb	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Methomyl	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Oxamyl (Vydate)	ND	ug/l	0.50	1
			(ML/EPA 531.2)	BDMC(70-130)	103	% Rec		

Diuron by method 532

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/11/05	08/24/05 00:00	284321	(EPA 532)	Diuron	ND	ug/l	1.0	1
			(EPA 532)	Monuron(70-130)	108	% Rec		
			(EPA 532)	Carbazole(70-130)	103	% Rec		

EDB and DBCP by GC-ECD

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/16/05	08/17/05 00:40	283333	(ML/EPA 504.1)	Dibromochloropropane (DBCP)	ND	ug/l	0.010	1
08/16/05	08/17/05 00:40	283333	(ML/EPA 504.1)	Ethylene Dibromide (EDB)	ND	ug/l	0.010	1

Gross Alpha Radiation

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/15/05 00:00	283971	(ML/EPA 900.0)	Alpha, Gross	9.2	pCi/l	2.0	1
	08/15/05 00:00	283971	(ML/EPA 900.0)	Alpha, Two Sigma Error	2.5	pCi/l	0.0000	1
	08/15/05 00:00	283971	(ML/EPA 900.0)	Alpha, Min Detectable Activity	2.00	pCi/l	0.0000	1

Herbicides by 515.4

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4,5-T	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4,5-TP (Silvex)	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4-D	ND	ug/l	0.10	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4-DB	ND	ug/l	2.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dichlorprop	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Acifluorfen	ND	ug/l	0.20	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Bentazon	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dalapon	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	3,5-Dichlorobenzoic acid	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Tot DCPA Mono&Diacid Degradate	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dicamba	ND	ug/l	0.080	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dinoseb	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Pentachlorophenol	ND	ug/l	0.040	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Picloram	ND	ug/l	0.10	1
			(ML/EPA 515.4)	4.4-Dibrombiphenyl(60-140)	105	% Rec		
			(ML/EPA 515.4)	2.4-DCPAA (70-130)	96	% Rec		

Pesticides by EPA 505

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	PCB 1016 Aroclor	ND	ug/l	0.070	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	PCB 1221 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	PCB 1232 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	PCB 1242 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	PCB 1248 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	PCB 1254 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	PCB 1260 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Alachlor (Alanex)	ND	ug/l	0.050	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Aldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Chlordane	ND	ug/l	0.10	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Dieldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Endrin	ND	ug/l	0.010	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Heptachlor	ND	ug/l	0.010	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Heptachlor Epoxide	ND	ug/l	0.010	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Lindane (gamma-BHC)	ND	ug/l	0.010	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Methoxychlor	ND	ug/l	0.050	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Total PCBs	ND	ug/l	0.070	1
08/10/05	08/10/05 19:29	283059	(ML/EPA 505)	Toxaphene	ND	ug/l	0.50	1

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1

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(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Benzene	0.7	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 23:03	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/08/05 23:03	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1
			(EPA 524.2)	4-Bromofluorobenzene(70-130)	99	% Rec		
			(EPA 524.2)	1,2-Dichloroethane-d4(70-130)	118	% Rec		
			(EPA 524.2)	Toluene-d8(70-130)	95	% Rec		

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution

TRAVEL BLANK-ANALYZE (2508080236) Sampled on 08/08/05 00:00

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Benzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1

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Laboratory
Data Report
#153971

Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 01:16	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/09/05 01:16	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
			(EPA 524.2)	4-Bromofluorobenzene(70-130)	100	% Rec		
			(EPA 524.2)	Toluene-d8(70-130)	95	% Rec		
			(EPA 524.2)	1,2-Dichloroethane-d4(70-130)	120	% Rec		

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Laboratory Report

for

Layne Christensen
11001 Etiwanda Ave.

Fontana , CA 92337

Attention: Tony Morgan
Fax: (909) 390-6097

ACCREDITED IN ACCORDANCE WITH nelac 01114CA

LXG Linda Geddes
Project Manager

Report#: 153978
DRINKING

Laboratory certifies that the test results meet all **NELAC** requirements unless noted in the Comments section or the Case Narrative. Following the cover page are Comments,QC Report,QC Summary,Data Report,Hits Report, totaling 58 page[s].

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Laboratory Hits Report #153978

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08-aug-2005 19:18:32

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080245	**STRAND #3**				
08/17/05	Alpha, Gross		7.6	15	pCi/l	2.0
08/17/05	Alpha, Min Detectable Activity		2.00		pCi/l	
08/17/05	Alpha, Two Sigma Error		2.3		pCi/l	
08/16/05	Agressiveness Index-Calculated		12.41		Not Appl.	0.10
08/12/05	Alkalinity in CaCO3 units		89.6		mg/l	2.0
08/09/05	Barium, dissolved, ICAP/MS		200		ug/l	2.0
08/16/05	Bicarb.Alkalinity as HCO3,calc		109.		mg/l	0.001
08/17/05	Bromide		1700		ug/l	25
08/09/05	Calcium, Total, ICAP		130		mg/l	1.0
08/16/05	Carbon Dioxide,Free(25C)-Calc.		2.83		mg/l	0.001
08/16/05	Carbonate as CO3, Calculated		0.447		mg/l	0.001
08/09/05	Chloride		270	250	mg/l	10
08/09/05	Chromium, dissolved, ICAP/MS		2		ug/l	2.0
08/29/05	Dissolved Organic Carbon		0.30		mg/l	0.30
08/08/05	Field pH		7.5		Units	
08/11/05	Fluoride		0.08	4	mg/l	0.050
08/08/05	Hexavalent chromium(Dissolved)		1.8		ug/l	0.10
08/15/05	Hydroxide as OH, Calculated		0.01		mg/l	0.001
08/16/05	Langelier Index - 25 degree		0.51		None	
08/09/05	Magnesium, Total, ICAP		4.8		mg/l	0.10
08/09/05	Manganese, dissolved, ICAP/MS		6.6		ug/l	2.0
08/08/05	Odor		2	3	TON	1.0
08/11/05	PH (H1=past HT, not compliant)		7.8	6.5-8.5	Units	0.001
08/09/05	Potassium, Total, ICAP		1.8		mg/l	1.0
08/09/05	Sodium, Total, ICAP		83		mg/l	1.0
08/08/05	Source Temperature		23.3		Degrees C	
08/09/05	Specific Conductance		1190		umho/cm	2.0
08/08/05	Sulfate		28	250	mg/l	2.5
08/09/05	Total Dissolved Solid (TDS)		800	500	mg/l	10
08/10/05	Total Hardness as CaCO3 by ICP		344.		mg/l	3.0

SUMMARY OF POSITIVE DATA ONLY.

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Laboratory
Hits Report
#153978

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08-aug-2005 19:18:32

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080245	**STRAND #3**				
08/09/05	Turbidity		0.25	5	NTU	0.050
08/25/05	Uranium by ICPMS as pCi/L		14.1		pCi/l	0.70
08/24/05	Uranium, ICAP/MS		21	30	ug/l	1.0
08/16/05	pH of CaCO3 saturation(25C)		7.29		Units	0.10
08/16/05	pH of CaCO3 saturation(60C)		6.85		Units	0.10
	2508080246	**TRAVEL BLANK-ANALYZE**				

SUMMARY OF POSITIVE DATA ONLY.

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Laboratory
Data Report
#153978

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08/08/05

STRAND #3 (2508080245) Sampled on 08/08/05 09:40

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 13:01	282802	(EPA/ML 200.8)	Silver, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/16/05 22:58		(ML/SM2330)	Agressiveness Index-Calculated	12.41	NA	0.10	1
	08/09/05 13:01	282808	(EPA/ML 200.8)	Aluminum, dissolved, ICAP/MS	ND	ug/l	25	1
	08/12/05 12:41	283063	(SM2320B/ 310.1)	Alkalinity in CaCO3 units	89.6	mg/l	2.0	1
	08/09/05 13:01	282801	(EPA/ML 200.8)	Arsenic, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 13:01	282805	(EPA/ML 200.8)	Barium, dissolved, ICAP/MS	200	ug/l	2.0	1
	08/09/05 13:01	282799	(EPA/ML 200.8)	Beryllium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/17/05 00:00	283494	(ML/EPA 300.0)	Bromide	1700	ug/l	25	5
	08/09/05 16:34	282400	(ML/EPA 200.7)	Calcium, Total, ICAP	130	mg/l	1.0	1
	08/09/05 13:01	282803	(EPA/ML 200.8)	Cadmium, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/09/05 14:50	282412	(ML/EPA 300.0)	Chloride	270	mg/l	10	10
	08/16/05 22:44		(SM4500-CO2-D)	Carbon Dioxide,Free(25C)-Calc.	2.83	mg/l	0.001	1
	08/16/05 22:39		(SM2320B/E310.1)	Carbonate as CO3, Calculated	0.447	mg/l	0.001	1
	08/08/05 00:00	282313	(ML/S2120B)	Apparent Color	ND	ACU	3.0	1
	08/09/05 13:01	282810	(EPA/ML 200.8)	Chromium, dissolved, ICAP/MS	2	ug/l	2.0	1
	08/08/05 22:47	283768	(EPA 218.6)	Hexavalent chromium(Dissolved)	1.8	ug/l	0.10	1
	08/09/05 13:01	282813	(EPA/ML 200.8)	Copper, dissolved, ICAP/MS	ND	ug/l	2.0	1
	08/29/05 08:37	285047	(ML/SM 5310C)	Dissolved Organic Carbon	0.30	mg/l	0.30	1
	08/09/05 13:34	282308	(2510B/ SW9050)	Specific Conductance	1190	umho/cm	2.0	1
08/09/05	08/11/05 00:00	282734	(ML/EPA 548.1)	Endothall	ND	ug/l	20	4
	08/11/05 00:00	282675	(SM 4500C)	Fluoride	0.08	mg/l	0.050	1
	08/11/05 00:00	282726	(ML/EPA 200.7)	Iron, Dissolved, ICAP	ND	mg/l	0.020	1
	08/10/05 18:49		(ML/SM2340B)	Total Hardness as CaCO3 by ICP	344.	mg/l	3.0	1
	08/16/05 22:27		(SM2320B/E310.1)	Bicarb.Alkalinity as HCO3,calc	109.	mg/l	0.001	1
	08/17/05 12:13	283386	(EPA/ML 245.1)	Mercury, dissolved	ND	ug/l	0.20	1
	08/09/05 16:34	282385	(ML/EPA 200.7)	Potassium, Total, ICAP	1.8	mg/l	1.0	1
	08/16/05 22:47		(ML/SM2330B)	Langelier Index - 25 degree	0.51	None	0.0000	1
	08/09/05 13:30	282466	(SM5540C/E425.1)	Surfactants	ND	mg/l	0.050	1
	08/09/05 16:34	282389	(ML/EPA 200.7)	Magnesium, Total, ICAP	4.8	mg/l	0.10	1
	08/09/05 13:01	282811	(EPA/ML 200.8)	Manganese, dissolved, ICAP/MS	6.6	ug/l	2.0	1
	08/09/05 16:34	282392	(ML/EPA 200.7)	Sodium, Total, ICAP	83	mg/l	1.0	1
	08/09/05 00:00	284112	(EPA/ML 200.8)	Nickel, dissolved, ICAP/MS	ND	ug/l	5.0	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 17:00	282311	(ML/S2150B)	Odor	2	TON	1.0	1
	08/15/05 14:59		(SM2320B/E310.1)	Hydroxide as OH, Calculated	0.01	mg/l	0.001	1
	08/09/05 13:01	282807	(EPA/ML 200.8)	Lead, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/11/05 00:00	282674	(4500HB/ E 150)	PH (H1=past HT, not compliant)	7.8	Units	0.001	1
	08/08/05 00:00		(ML/EPA 150.1)	Field pH	7.5	Units	0.0000	1
	08/16/05 22:45		(ML/SM2330B)	pH of CaCO3 saturation(25C)	7.29	Units	0.10	1
	08/16/05 22:47		(ML/SM2330B)	pH of CaCO3 saturation(60C)	6.85	Units	0.10	1
	08/09/05 13:01	282804	(EPA/ML 200.8)	Antimony, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/23/05 00:00	284107	(EPA/ML 200.8)	Selenium, dissolved, ICAP/MS	ND	ug/l	5.0	1
	08/08/05 22:30	282253	(ML/EPA 300.0)	Sulfate	28	mg/l	2.5	5
08/09/05	08/09/05 12:00	282564	(SM 2540C)	Total Dissolved Solid (TDS)	800	mg/l	10	1
	08/08/05 00:00		(FIELD/SM2550B)	Source Temperature	23.3	DEGC	0.0000	1
	08/09/05 13:01	282806	(EPA/ML 200.8)	Thallium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 15:59	282492	(ML/EPA 180.1)	Turbidity	0.25	NTU	0.050	1
	08/24/05 13:43	284243	(ML/EPA 200.8)	Uranium, ICAP/MS	21	ug/l	1.0	1
	08/25/05 20:33		(EPA/ML 200.8)	Uranium by ICPMS as pCi/L	14.1	pCi/l	0.70	1
	08/09/05 13:01	282800	(EPA/ML 200.8)	Zinc, dissolved, ICAP/MS	ND	ug/l	5.0	1

525 Semivolatiles by GC/MS

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	2,4-Dinitrotoluene	ND	ug/l	0.10	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	alpha-Chlordane	ND	ug/l	0.050	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Diazinon (Qualitative)	ND	ug/l	0.10	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Acenaphthylene	ND	ug/l	0.10	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Alachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Aldrin	ND	ug/l	0.050	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Anthracene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Atrazine	ND	ug/l	0.050	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Benz(a)Anthracene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Benzo(a)pyrene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Benzo(b)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Benzo(g,h,i)Perylene	ND	ug/l	0.050	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Benzo(k)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Di(2-Ethylhexyl)phthalate	ND	ug/l	0.60	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Butylbenzylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Bromacil	ND	ug/l	0.20	1
08/18/05	09/01/05 12:33	285766	(ML/EPA 525.2)	Butachlor	ND	ug/l	0.050	1

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Layne Christensen
(continued)

Prepared	[illegible]	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Caffeine	ND	ug/l	0.050	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Chrysene	ND	ug/l	0.020	1
08/18/05	[illegible]01/05 12:33	285766	(ML/EPA 525.2)	Dibenz(a,h)Anthracene	ND	ug/l	0.050	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	Di-(2-Ethylhexyl)adipate	ND	ug/l	0.60	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Diethylphthalate	ND	ug/l	0.50	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Dieldrin	ND	ug/l	0.20	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Dimethylphthalate	ND	ug/l	0.50	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	Dimethoate	ND	ug/l	0.10	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	Di-n-Butylphthalate	ND	ug/l	1.0	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Endrin	ND	ug/l	0.10	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Fluoranthene	ND	ug/l	0.10	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Fluorene	ND	ug/l	0.050	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	gamma-Chlordane	ND	ug/l	0.050	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	Hexachlorobenzene	ND	ug/l	0.050	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Hexachlorocyclopentadiene	ND	ug/l	0.050	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Heptachlor	ND	ug/l	0.040	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Heptachlor Epoxide (isomer B)	ND	ug/l	0.020	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Indeno(1,2,3,c,d)Pyrene	ND	ug/l	0.050	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Isophorone	ND	ug/l	0.50	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Lindane	ND	ug/l	0.020	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Methoxychlor	ND	ug/l	0.10	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	Metribuzin	ND	ug/l	0.050	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	Molinate	ND	ug/l	0.10	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Metolachlor	ND	ug/l	0.050	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	trans-Nonachlor	ND	ug/l	0.050	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Pentachlorophenol	ND	ug/l	1.0	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Phenanthrene	ND	ug/l	0.020	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	Prometryn	ND	ug/l	0.50	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Propachlor	ND	ug/l	0.050	1
08/18/05	[illegible] 12:33	285766	(ML/EPA 525.2)	Pyrene	ND	ug/l	0.050	1
08/18/05	[illegible]/01/05 12:33	285766	(ML/EPA 525.2)	Simazine	ND	ug/l	0.050	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	Thiobencarb	ND	ug/l	0.20	1
08/18/05	[illegible]/05 12:33	285766	(ML/EPA 525.2)	Trifluralin	ND	ug/l	0.10	1
			(ML/EPA 525.2)	Perylene-d12(70-130)	88	% Rec		
			(ML/EPA 525.2)	1.3-dimethyl-2-nbenz(70-130)	105	% Rec		
			(ML/EPA 525.2)	Triphenylphosphate(70-130)	96	% Rec		

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(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
			Aldicarbs by 531.2					
	08/25/05 00:00	284485	(ML/EPA 531.2)	3-Hydroxycarbofuran	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Aldicarb (Temik)	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfone	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfoxide	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Baygon (Propoxur)	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Carbofuran (Furadan)	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Carbaryl	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Methiocarb	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Methomyl	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Oxamyl (Vydate)	ND	ug/l	0.50	1
			(ML/EPA 531.2)	BDMC(70-130)	101	% Rec		
			Diuron by method 532					
08/11/05	08/24/05 00:00	284321	(EPA 532)	Diuron	ND	ug/l	1.0	1
			(EPA 532)	Carbazole(70-130)	99	% Rec		
			(EPA 532)	Monuron(70-130)	106	% Rec		
			EDB and DBCP by GC-ECD					
08/16/05	08/17/05 01:09	283333	(ML/EPA 504.1)	Dibromochloropropane (DBCP)	ND	ug/l	0.010	1
08/16/05	08/17/05 01:09	283333	(ML/EPA 504.1)	Ethylene Dibromide (EDB)	ND	ug/l	0.010	1
			Gross Alpha Radiation					
	08/17/05 00:00	284048	(ML/EPA 900.0)	Alpha, Gross	7.6	pCi/l	2.0	1
	08/17/05 00:00	284048	(ML/EPA 900.0)	Alpha, Two Sigma Error	2.3	pCi/l	0.0000	1
	08/17/05 00:00	284048	(ML/EPA 900.0)	Alpha, Min Detectable Activity	2.00	pCi/l	0.0000	1
			Herbicides by 515.4					
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4,5-T	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4,5-TP (Silvex)	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4-D	ND	ug/l	0.10	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4-DB	ND	ug/l	2.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dichlorprop	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Acifluorfen	ND	ug/l	0.20	1

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(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Bentazon	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dalapon	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	3,5-Dichlorobenzoic acid	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Tot DCPA Mono&Diacid Degradate	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dicamba	ND	ug/l	0.080	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dinoseb	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Pentachlorophenol	ND	ug/l	0.040	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Picloram	ND	ug/l	0.10	1
			(ML/EPA 515.4)	4,4-Dibromobiphenyl(60-140)	104	% Rec		
			(ML/EPA 515.4)	2,4-DCPAA (70-130)	95	% Rec		

Pesticides by EPA 505

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	PCB 1016 Aroclor	ND	ug/l	0.070	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	PCB 1221 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	PCB 1232 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	PCB 1242 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	PCB 1248 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	PCB 1254 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	PCB 1260 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Alachlor (Alanex)	ND	ug/l	0.050	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Aldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Chlordane	ND	ug/l	0.10	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Dieldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Endrin	ND	ug/l	0.010	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Heptachlor	ND	ug/l	0.010	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Heptachlor Epoxide	ND	ug/l	0.010	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Lindane (gamma-BHC)	ND	ug/l	0.010	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Methoxychlor	ND	ug/l	0.050	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Total PCBs	ND	ug/l	0.070	1
08/10/05	08/10/05 21:41	283059	(ML/EPA 505)	Toxaphene	ND	ug/l	0.50	1

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1

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Laboratory Data Report #153978

Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Benzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 23:29	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/08/05 23:29	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1
			(EPA 524.2)	4-Bromofluorobenzene(70-130)	99	% Rec		
			(EPA 524.2)	1,2-Dichloroethane-d4(70-130)	110	% Rec		
			(EPA 524.2)	Toluene-d8(70-130)	93	% Rec		

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution

TRAVEL BLANK-ANALYZE (2508080246) Sampled on 08/08/05 00:00

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Benzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 01:42	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/09/05 01:42	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
			(EPA 524.2	) 1,2-Dichloroethane-d4(70-130)	117	% Rec		
			(EPA 524.2	) 4-Bromofluorobenzene(70-130)	99	% Rec		
			(EPA 524.2	) Toluene-d8(70-130)	91	% Rec		

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Laboratory Report

for

Layne Christensen
11001 Etiwanda Ave.

Fontana , CA 92337

Attention: Tony Morgan
Fax: (909) 390-6097

ACCREDITED IN ACCORDANCE WITH nelac 01114CA

LXG Linda Geddes
Project Manager

Report#: 153980
DRINKING

Laboratory certifies that the test results meet all **NELAC** requirements unless noted in the Comments section or the Case Narrative. Following the cover page are Comments,QC Report,QC Summary,Data Report,Hits Report, totaling 58 page[s].

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Laboratory
Hits Report
#153980

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08-aug-2005 19:43:23

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080249	**STRAND #4**				
08/17/05	Alpha, Gross		8.0	15	pCi/l	2.0
08/17/05	Alpha, Min Detectable Activity		2.00		pCi/l	
08/17/05	Alpha, Two Sigma Error		2.6		pCi/l	
08/16/05	Agressiveness Index-Calculated		12.35		Not Appl.	0.10
08/12/05	Alkalinity in CaCO3 units		95.9		mg/l	2.0
08/09/05	Barium, dissolved, ICAP/MS		130		ug/l	2.0
08/16/05	Bicarb.Alkalinity as HCO3,calc		117.		mg/l	0.001
08/17/05	Bromide		900		ug/l	25
08/09/05	Calcium, Total, ICAP		85		mg/l	1.0
08/16/05	Carbon Dioxide,Free(25C)-Calc.		2.42		mg/l	0.001
08/16/05	Carbonate as CO3, Calculated		0.604		mg/l	0.001
08/08/05	Chloride		140	250	mg/l	5.0
08/09/05	Chromium, dissolved, ICAP/MS		4.1		ug/l	2.0
08/08/05	Field pH		7.5		Units	
08/11/05	Fluoride		0.06	4	mg/l	0.050
08/08/05	Hexavalent chromium(Dissolved)		2.5		ug/l	0.10
08/15/05	Hydroxide as OH, Calculated		0.01		mg/l	0.001
08/16/05	Langelier Index - 25 degree		0.45		None	
08/09/05	Magnesium, Total, ICAP		3.2		mg/l	0.10
08/08/05	Odor		1	3	TON	1.0
08/11/05	PH (H1=past HT, not compliant)		7.9	6.5-8.5	Units	0.001
08/09/05	Potassium, Total, ICAP		1.4		mg/l	1.0
08/09/05	Sodium, Total, ICAP		52		mg/l	1.0
08/08/05	Source Temperature		23.5		Degrees C	
08/09/05	Specific Conductance		775		umho/cm	2.0
08/08/05	Sulfate		30	250	mg/l	2.5
08/09/05	Total Dissolved Solid (TDS)		510	500	mg/l	10
08/10/05	Total Hardness as CaCO3 by ICP		225.		mg/l	3.0
08/09/05	Turbidity		0.20	5	NTU	0.050
08/25/05	Uranium by ICPMS as pCi/L		13.4		pCi/l	0.70

SUMMARY OF POSITIVE DATA ONLY.

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Laboratory
Hits Report
#153980

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08-aug-2005 19:43:23

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080249	STRAND #4				
08/24/05	Uranium, ICAP/MS		20	30	ug/l	1.0
08/16/05	pH of CaCO3 saturation(25C)		7.45		Units	0.10
08/16/05	pH of CaCO3 saturation(60C)		7.00		Units	0.10
	2508080250	TRAVEL BLANK-ANALYZE				

SUMMARY OF POSITIVE DATA ONLY.

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Laboratory
Data Report
#153980

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08/08/05

STRAND #4 (2508080249) Sampled on 08/08/05 11:10

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 13:08	282802	(EPA/ML 200.8)	Silver, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/16/05 22:58		(ML/SM2330)	Agressiveness Index-Calculated	12.35	NA	0.10	1
	08/09/05 13:08	282808	(EPA/ML 200.8)	Aluminum, dissolved, ICAP/MS	ND	ug/l	25	1
	08/12/05 12:41	283063	(SM2320B/ 310.1)	Alkalinity in CaCO3 units	95.9	mg/l	2.0	1
	08/09/05 13:08	282801	(EPA/ML 200.8)	Arsenic, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 13:08	282805	(EPA/ML 200.8)	Barium, dissolved, ICAP/MS	130	ug/l	2.0	1
	08/09/05 13:08	282799	(EPA/ML 200.8)	Beryllium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/17/05 00:00	283494	(ML/EPA 300.0)	Bromide	900	ug/l	25	5
	08/09/05 16:21	282400	(ML/EPA 200.7)	Calcium, Total, ICAP	85	mg/l	1.0	1
	08/09/05 13:08	282803	(EPA/ML 200.8)	Cadmium, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/08/05 22:42	282244	(ML/EPA 300.0)	Chloride	140	mg/l	5.0	5
	08/16/05 22:44		(SM4500-CO2-D)	Carbon Dioxide,Free(25C)-Calc.	2.42	mg/l	0.001	1
	08/16/05 22:39		(SM2320B/E310.1)	Carbonate as CO3, Calculated	0.604	mg/l	0.001	1
	08/08/05 00:00	282313	(ML/S2120B)	Apparent Color	ND	ACU	3.0	1
	08/09/05 13:08	282810	(EPA/ML 200.8)	Chromium, dissolved, ICAP/MS	4.1	ug/l	2.0	1
	08/08/05 23:12	283768	(EPA 218.6)	Hexavalent chromium(Dissolved)	2.5	ug/l	0.10	1
	08/09/05 13:08	282813	(EPA/ML 200.8)	Copper, dissolved, ICAP/MS	ND	ug/l	2.0	1
	08/29/05 08:37	285047	(ML/SM 5310C)	Dissolved Organic Carbon	ND	mg/l	0.30	1
	08/09/05 13:34	282308	(2510B/ SW9050)	Specific Conductance	775	umho/cm	2.0	1
08/12/05	08/16/05 00:00	283673	(ML/EPA 548.1)	Endothall	ND	ug/l	20	4
	08/11/05 00:00	282675	(SM 4500C)	Fluoride	0.06	mg/l	0.050	1
	08/11/05 00:00	282726	(ML/EPA 200.7)	Iron, Dissolved, ICAP	ND	mg/l	0.020	1
	08/10/05 18:49		(ML/SM2340B)	Total Hardness as CaCO3 by ICP	225.	mg/l	3.0	1
	08/16/05 22:27		(SM2320B/E310.1)	Bicarb.Alkalinity as HCO3,calc	117.	mg/l	0.001	1
	08/17/05 12:13	283386	(EPA/ML 245.1)	Mercury, dissolved	ND	ug/l	0.20	1
	08/09/05 16:21	282385	(ML/EPA 200.7)	Potassium, Total, ICAP	1.4	mg/l	1.0	1
	08/16/05 22:47		(ML/SM2330B)	Langelier Index - 25 degree	0.45	None	0.0000	1
	08/09/05 13:30	282466	(SM5540C/E425.1)	Surfactants	ND	mg/l	0.050	1
	08/09/05 16:21	282389	(ML/EPA 200.7)	Magnesium, Total, ICAP	3.2	mg/l	0.10	1
	08/09/05 13:08	282811	(EPA/ML 200.8)	Manganese, dissolved, ICAP/MS	ND	ug/l	2.0	1
	08/09/05 16:21	282392	(ML/EPA 200.7)	Sodium, Total, ICAP	52	mg/l	1.0	1
	08/09/05 00:00	284112	(EPA/ML 200.8)	Nickel, dissolved, ICAP/MS	ND	ug/l	5.0	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 17:00	282311	(ML/S2150B)	Odor	1	TON	1.0	1
	08/15/05 14:59		(SM2320B/E310.1)	Hydroxide as OH, Calculated	0.01	mg/l	0.001	1
	08/09/05 13:08	282807	(EPA/ML 200.8)	Lead, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/11/05 00:00	282674	(4500HB/ E 150)	PH (H1=past HT, not compliant)	7.9	Units	0.001	1
	08/08/05 00:00		(ML/EPA 150.1)	Field pH	7.5	Units	0.0000	1
	08/16/05 22:45		(ML/SM2330B)	pH of CaCO3 saturation(25C)	7.45	Units	0.10	1
	08/16/05 22:47		(ML/SM2330B)	pH of CaCO3 saturation(60C)	7.00	Units	0.10	1
	08/09/05 13:08	282804	(EPA/ML 200.8)	Antimony, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/23/05 00:00	284107	(EPA/ML 200.8)	Selenium, dissolved, ICAP/MS	ND	ug/l	5.0	1
	08/08/05 22:42	282253	(ML/EPA 300.0)	Sulfate	30	mg/l	2.5	5
08/09/05	08/09/05 12:00	282564	(SM 2540C)	Total Dissolved Solid (TDS)	510	mg/l	10	1
	08/08/05 00:00		(FIELD/SM2550B)	Source Temperature	23.5	DEGC	0.0000	1
	08/09/05 13:08	282806	(EPA/ML 200.8)	Thallium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 15:59	282492	(ML/EPA 180.1)	Turbidity	0.20	NTU	0.050	1
	08/24/05 13:48	284243	(ML/EPA 200.8)	Uranium, ICAP/MS	20	ug/l	1.0	1
	08/25/05 20:33		(EPA/ML 200.8)	Uranium by ICPMS as pCi/L	13.4	pCi/l	0.70	1
	08/09/05 13:08	282800	(EPA/ML 200.8)	Zinc, dissolved, ICAP/MS	ND	ug/l	5.0	1

525 Semivolatiles by GC/MS

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	2,4-Dinitrotoluene	ND	ug/l	0.10	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	alpha-Chlordane	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Diazinon (Qualitative)	ND	ug/l	0.10	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Acenaphthylene	ND	ug/l	0.10	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Alachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Aldrin	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Anthracene	ND	ug/l	0.020	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Atrazine	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Benz(a)Anthracene	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Benzo(a)pyrene	ND	ug/l	0.020	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Benzo(b)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Benzo(g,h,i)Perylene	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Benzo(k)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Di(2-Ethylhexyl)phthalate	ND	ug/l	0.60	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Butylbenzylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Bromacil	ND	ug/l	0.20	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Butachlor	ND	ug/l	0.050	1

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Laboratory
Data Report
#153980

Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Caffeine	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Chrysene	ND	ug/l	0.020	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Dibenz(a,h)Anthracene	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Di-(2-Ethylhexyl)adipate	ND	ug/l	0.60	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Diethylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Dieldrin	ND	ug/l	0.20	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Dimethylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Dimethoate	ND	ug/l	0.10	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Di-n-Butylphthalate	ND	ug/l	1.0	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Endrin	ND	ug/l	0.10	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Fluoranthene	ND	ug/l	0.10	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Fluorene	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	gamma-Chlordane	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Hexachlorobenzene	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Hexachlorocyclopentadiene	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Heptachlor	ND	ug/l	0.040	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Heptachlor Epoxide (isomer B)	ND	ug/l	0.020	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Indeno(1,2,3,c,d)Pyrene	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Isophorone	ND	ug/l	0.50	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Lindane	ND	ug/l	0.020	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Methoxychlor	ND	ug/l	0.10	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Metribuzin	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Molinate	ND	ug/l	0.10	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Metolachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	trans-Nonachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Pentachlorophenol	ND	ug/l	1.0	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Phenanthrene	ND	ug/l	0.020	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Prometryn	ND	ug/l	0.50	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Propachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Pyrene	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Simazine	ND	ug/l	0.050	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Thiobencarb	ND	ug/l	0.20	1
08/18/05	09/01/05 13:18	285766	(ML/EPA 525.2)	Trifluralin	ND	ug/l	0.10	1
			(ML/EPA 525.2)	Perylene-d12(70-130)	89	% Rec		
			(ML/EPA 525.2)	1,3-dimethyl-2-nbenz(70-130)	100	% Rec		
			(ML/EPA 525.2)	Triphenylphosphate(70-130)	90	% Rec		

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
			Aldicarbs by 531.2					
	08/25/05 00:00	284485	(ML/EPA 531.2)	3-Hydroxycarbofuran	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Aldicarb (Temik)	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfone	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfoxide	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Baygon (Propoxur)	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Carbofuran (Furadan)	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Carbaryl	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Methiocarb	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Methomyl	ND	ug/l	0.50	1
	08/25/05 00:00	284485	(ML/EPA 531.2)	Oxamyl (Vydate)	ND	ug/l	0.50	1
			(ML/EPA 531.2)	BDMC(70-130)	104	% Rec		
			Diuron by method 532					
08/11/05	08/24/05 00:00	284321	(EPA 532)	Diuron	ND	ug/l	1.0	1
			(EPA 532)	Carbazole(70-130)	91	% Rec		
			(EPA 532)	Monuron(70-130)	107	% Rec		
			EDB and DBCP by GC-ECD					
08/17/05	08/17/05 09:54	283599	(ML/EPA 504.1)	Dibromochloropropane (DBCP)	ND	ug/l	0.010	1
08/17/05	08/17/05 09:54	283599	(ML/EPA 504.1)	Ethylene Dibromide (EDB)	ND	ug/l	0.010	1
			Gross Alpha Radiation					
	08/17/05 00:00	284048	(ML/EPA 900.0)	Alpha, Gross	8.0	pCi/l	2.0	1
	08/17/05 00:00	284048	(ML/EPA 900.0)	Alpha, Two Sigma Error	1.6	pCi/l	0.0000	1
	08/17/05 00:00	284048	(ML/EPA 900.0)	Alpha, Min Detectable Activity	1.00	pCi/l	0.0000	1
			Herbicides by 515.4					
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4,5-T	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4,5-TP (Silvex)	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4-D	ND	ug/l	0.10	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	2,4-DB	ND	ug/l	2.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dichlorprop	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Acifluorfen	ND	ug/l	0.20	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Bentazon	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dalapon	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	3,5-Dichlorobenzoic acid	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Tot DCPA Mono&Diacid Degradate	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dicamba	ND	ug/l	0.080	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dinoseb	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Pentachlorophenol	ND	ug/l	0.040	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Picloram	ND	ug/l	0.10	1
			(ML/EPA 515.4)	4,4-Dibrombiphenyl(60-140)	108	% Rec		
			(ML/EPA 515.4)	2,4-DCPAA (70-130)	91	% Rec		

Pesticides by EPA 505

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	PCB 1016 Aroclor	ND	ug/l	0.070	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	PCB 1221 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	PCB 1232 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	PCB 1242 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	PCB 1248 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	PCB 1254 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	PCB 1260 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Alachlor (Alanex)	ND	ug/l	0.050	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Aldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Chlordane	ND	ug/l	0.10	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Dieldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Endrin	ND	ug/l	0.010	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Heptachlor	ND	ug/l	0.010	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Heptachlor Epoxide	ND	ug/l	0.010	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Lindane (gamma-BHC)	ND	ug/l	0.010	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Methoxychlor	ND	ug/l	0.050	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Total PCBs	ND	ug/l	0.070	1
08/10/05	08/10/05 23:09	283059	(ML/EPA 505)	Toxaphene	ND	ug/l	0.50	1

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Benzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1

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750 Royal Oaks Drive
Suite 100
Monrovia, California 91016-3629
Tel: 626 568 6400
Fax: 626 568 6324
1 800 566 LABS (1 800 566 5227)

Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 23:56	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/08/05 23:56	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1
			(EPA 524.2)	4-Bromofluorobenzene(70-130)	102	% Rec		
			(EPA 524.2)	Toluene-d8(70-130)	94	% Rec		
			(EPA 524.2)	1,2-Dichloroethane-d4(70-130)	111	% Rec		

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Layne Christensen
(continued)

TRAVEL BLANK-ANALYZE (2508080250) Sampled on 08/08/05 00:00

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Benzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 02:09	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/09/05 02:09	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
			(EPA 524.2	) 4-Bromofluorobenzene(70-130)	99	% Rec		
			(EPA 524.2	) 1,2-Dichloroethane-d4(70-130)	119	% Rec		
			(EPA 524.2	) Toluene-d8(70-130)	93	% Rec		

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Laboratory Report

for

Layne Christensen
11001 Etiwanda Ave.

Fontana , CA 92337

Attention: Tony Morgan
Fax: (909) 390-6097

ACCREDITED IN ACCORDANCE WITH nelac 01114CA

LXG Linda Geddes
Project Manager

Report#: 153967
DRINKING

Laboratory certifies that the test results meet all **NELAC** requirements unless noted in the Comments section or the Case Narrative. Following the cover page are Comments,QC Report,QC Summary,Data Report,Hits Report, totaling 58 page[s].

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Laboratory Hits Report #153967

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08-aug-2005 18:16:58

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080220	**STRAND #6**				
08/15/05	Alpha, Gross		22	15	pCi/l	2.0
08/15/05	Alpha, Min Detectable Activity		2.00		pCi/l	
08/15/05	Alpha, Two Sigma Error		4.3		pCi/l	
08/16/05	Agressiveness Index-Calculated		12.43		Not Appl.	0.10
08/12/05	Alkalinity in CaCO3 units		157		mg/l	2.0
08/09/05	Barium, dissolved, ICAP/MS		100		ug/l	2.0
08/16/05	Bicarb.Alkalinity as HCO3,calc		191.		mg/l	0.001
08/17/05	Bromide		420		ug/l	10
08/09/05	Calcium, Total, ICAP		78		mg/l	1.0
08/16/05	Carbon Dioxide,Free(25C)-Calc.		4.96		mg/l	0.001
08/16/05	Carbonate as CO3, Calculated		0.783		mg/l	0.001
08/08/05	Chloride		200	250	mg/l	5.0
08/09/05	Copper, dissolved, ICAP/MS		5.6		ug/l	2.0
08/29/05	Dissolved Organic Carbon		0.37		mg/l	0.30
08/08/05	Field pH		7.3		Units	
08/11/05	Fluoride		0.05	4	mg/l	0.050
08/08/05	Hexavalent chromium(Dissolved)		1.3		ug/l	0.10
08/15/05	Hydroxide as OH, Calculated		0.01		mg/l	0.001
08/16/05	Langelier Index - 25 degree		0.53		None	
08/09/05	Lead, dissolved, ICAP/MS		1.5		ug/l	0.50
08/09/05	Magnesium, Total, ICAP		4.3		mg/l	0.10
08/08/05	Odor		1	3	TON	1.0
08/11/05	PH (H1=past HT, not compliant)		7.8	6.5-8.5	Units	0.001
08/09/05	Potassium, Total, ICAP		1.3		mg/l	1.0
08/09/05	Sodium, Total, ICAP		49		mg/l	1.0
08/08/05	Source Temperature		23.3		Degrees C	
08/09/05	Specific Conductance		683		umho/cm	2.0
08/08/05	Sulfate		82	250	mg/l	2.5
08/09/05	Total Dissolved Solid (TDS)		410	500	mg/l	10
08/10/05	Total Hardness as CaCO3 by ICP		212.		mg/l	3.0

SUMMARY OF POSITIVE DATA ONLY.

Laboratory
Hits Report
#153967

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Samples Received
08-aug-2005 18:16:58

Analyzed	Sample#	Sample ID	Result	Federal MCL	UNITS	MRL
	2508080220	STRAND #6				
08/09/05	Turbidity		0.35	5	NTU	0.050
08/25/05	Uranium by ICPMS as pCi/L		27.5		pCi/l	0.70
08/24/05	Uranium, ICAP/MS		41	30	ug/l	1.0
08/09/05	Zinc, dissolved, ICAP/MS		5.2		ug/l	5.0
08/16/05	pH of CaCO3 saturation(25C)		7.27		Units	0.10
08/16/05	pH of CaCO3 saturation(60C)		6.83		Units	0.10
	2508080224	TRAVEL BLANK-ANALYZE				

SUMMARY OF POSITIVE DATA ONLY.

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Laboratory
Data Report
#153967

Layne Christensen
Tony Morgan
11001 Etiwanda Ave.
Fontana , CA 92337

Samples Received
08/08/05

STRAND #6 (2508080220) Sampled on 08/08/05 10:25

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 12:46	282802	(EPA/ML 200.8)	Silver, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/16/05 22:58		(ML/SM2330)	Agressiveness Index-Calculated	12.43	NA	0.10	1
	08/09/05 12:46	282808	(EPA/ML 200.8)	Aluminum, dissolved, ICAP/MS	ND	ug/l	25	1
	08/12/05 12:41	283063	(SM2320B/ 310.1)	Alkalinity in CaCO3 units	157	mg/l	2.0	1
	08/09/05 12:46	282801	(EPA/ML 200.8)	Arsenic, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 12:46	282805	(EPA/ML 200.8)	Barium, dissolved, ICAP/MS	100	ug/l	2.0	1
	08/09/05 12:46	282799	(EPA/ML 200.8)	Beryllium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/17/05 00:00	283494	(ML/EPA 300.0)	Bromide	420	ug/l	10	2
	08/09/05 16:25	282400	(ML/EPA 200.7)	Calcium, Total, ICAP	78	mg/l	1.0	1
	08/09/05 12:46	282803	(EPA/ML 200.8)	Cadmium, dissolved, ICAP/MS	ND	ug/l	0.50	1
	08/08/05 22:54	282244	(ML/EPA 300.0)	Chloride	200	mg/l	5.0	5
	08/16/05 22:44		(SM4500-CO2-D)	Carbon Dioxide,Free(25C)-Calc.	4.96	mg/l	0.001	1
	08/16/05 22:39		(SM2320B/E310.1)	Carbonate as CO3, Calculated	0.783	mg/l	0.001	1
	08/08/05 00:00	282313	(ML/S2120B)	Apparent Color	ND	ACU	3.0	1
	08/09/05 12:46	282810	(EPA/ML 200.8)	Chromium, dissolved, ICAP/MS	ND	ug/l	2.0	1
	08/08/05 22:55	283768	(EPA 218.6)	Hexavalent chromium(Dissolved)	1.3	ug/l	0.10	1
	08/09/05 12:46	282813	(EPA/ML 200.8)	Copper, dissolved, ICAP/MS	5.6	ug/l	2.0	1
	08/29/05 08:37	285047	(ML/SM 5310C)	Dissolved Organic Carbon	0.37	mg/l	0.30	1
	08/09/05 13:34	282308	(2510B/ SW9050)	Specific Conductance	683	umho/cm	2.0	1
08/09/05	08/11/05 00:00	282734	(ML/EPA 548.1)	Endothall	ND	ug/l	20	4
	08/11/05 00:00	282675	(SM 4500C)	Fluoride	0.05	mg/l	0.050	1
	08/11/05 00:00	282726	(ML/EPA 200.7)	Iron, Dissolved, ICAP	ND	mg/l	0.020	1
	08/10/05 18:49		(ML/SM2340B)	Total Hardness as CaCO3 by ICP	212.	mg/l	3.0	1
	08/16/05 22:27		(SM2320B/E310.1)	Bicarb.Alkalinity as HCO3,calc	191.	mg/l	0.001	1
	08/17/05 12:13	283386	(EPA/ML 245.1)	Mercury, dissolved	ND	ug/l	0.20	1
	08/09/05 16:25	282385	(ML/EPA 200.7)	Potassium, Total, ICAP	1.3	mg/l	1.0	1
	08/16/05 22:47		(ML/SM2330B)	Langelier Index - 25 degree	0.53	None	0.0000	1
	08/09/05 13:30	282466	(SM5540C/E425.1)	Surfactants	ND	mg/l	0.050	1
	08/09/05 16:25	282389	(ML/EPA 200.7)	Magnesium, Total, ICAP	4.3	mg/l	0.10	1
	08/09/05 12:46	282811	(EPA/ML 200.8)	Manganese, dissolved, ICAP/MS	ND	ug/l	2.0	1
	08/09/05 16:25	282392	(ML/EPA 200.7)	Sodium, Total, ICAP	49	mg/l	1.0	1
	08/09/05 00:00	284112	(EPA/ML 200.8)	Nickel, dissolved, ICAP/MS	ND	ug/l	5.0	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/08/05 17:00	282311	(ML/S2150B)	Odor	1	TON	1.0	1
	08/15/05 14:59		(SM2320B/E310.1)	Hydroxide as OH, Calculated	0.01	mg/l	0.001	1
	08/09/05 12:46	282807	(EPA/ML 200.8)	Lead, dissolved, ICAP/MS	1.5	ug/l	0.50	1
	08/11/05 00:00	282674	(4500HB/ E 150)	PH (H1=past HT, not compliant)	7.8	Units	0.001	1
	08/08/05 00:00		(ML/EPA 150.1)	Field pH	7.3	Units	0.0000	1
	08/16/05 22:45		(ML/SM2330B)	pH of CaCO3 saturation(25C)	7.27	Units	0.10	1
	08/16/05 22:47		(ML/SM2330B)	pH of CaCO3 saturation(60C)	6.83	Units	0.10	1
	08/09/05 12:46	282804	(EPA/ML 200.8)	Antimony, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/23/05 00:00	284107	(EPA/ML 200.8)	Selenium, dissolved, ICAP/MS	ND	ug/l	5.0	1
	08/08/05 22:54	282253	(ML/EPA 300.0)	Sulfate	82	mg/l	2.5	5
08/09/05	08/09/05 12:00	282564	(SM 2540C)	Total Dissolved Solid (TDS)	410	mg/l	10	1
	08/08/05 00:00		(FIELD/SM2550B)	Source Temperature	23.3	DEGC	0.0000	1
	08/09/05 12:46	282806	(EPA/ML 200.8)	Thallium, dissolved, ICAP/MS	ND	ug/l	1.0	1
	08/09/05 15:59	282492	(ML/EPA 180.1)	Turbidity	0.35	NTU	0.050	1
	08/24/05 13:39	284243	(ML/EPA 200.8)	Uranium, ICAP/MS	41	ug/l	1.0	1
	08/25/05 20:33		(EPA/ML 200.8)	Uranium by ICPMS as pCi/L	27.5	pCi/l	0.70	1
	08/09/05 12:46	282800	(EPA/ML 200.8)	Zinc, dissolved, ICAP/MS	5.2	ug/l	5.0	1

525 Semivolatiles by GC/MS

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	2,4-Dinitrotoluene	ND	ug/l	0.10	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	alpha-Chlordane	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Diazinon (Qualitative)	ND	ug/l	0.10	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Acenaphthylene	ND	ug/l	0.10	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Alachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Aldrin	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Anthracene	ND	ug/l	0.020	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Atrazine	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Benz(a)Anthracene	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Benzo(a)pyrene	ND	ug/l	0.020	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Benzo(b)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Benzo(g,h,i)Perylene	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Benzo(k)Fluoranthene	ND	ug/l	0.020	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Di(2-Ethylhexyl)phthalate	ND	ug/l	0.60	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Butylbenzylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Bromacil	ND	ug/l	0.20	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Butachlor	ND	ug/l	0.050	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Caffeine	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Chrysene	ND	ug/l	0.020	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Dibenz(a,h)Anthracene	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Di-(2-Ethylhexyl)adipate	ND	ug/l	0.60	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Diethylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Dieldrin	ND	ug/l	0.20	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Dimethylphthalate	ND	ug/l	0.50	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Dimethoate	ND	ug/l	0.10	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Di-n-Butylphthalate	ND	ug/l	1.0	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Endrin	ND	ug/l	0.10	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Fluoranthene	ND	ug/l	0.10	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Fluorene	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	gamma-Chlordane	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Hexachlorobenzene	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Hexachlorocyclopentadiene	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Heptachlor	ND	ug/l	0.040	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Heptachlor Epoxide (isomer B)	ND	ug/l	0.020	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Indeno(1,2,3,c,d)Pyrene	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Isophorone	ND	ug/l	0.50	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Lindane	ND	ug/l	0.020	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Methoxychlor	ND	ug/l	0.10	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Metribuzin	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Molinate	ND	ug/l	0.10	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Metolachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	trans-Nonachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Pentachlorophenol	ND	ug/l	1.0	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Phenanthrene	ND	ug/l	0.020	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Prometryn	ND	ug/l	0.50	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Propachlor	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Pyrene	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Simazine	ND	ug/l	0.050	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Thiobencarb	ND	ug/l	0.20	1
08/18/05	09/01/05 11:48	285766	(ML/EPA 525.2)	Trifluralin	ND	ug/l	0.10	1
			(ML/EPA 525.2)	Perylene-d12(70-130)	89	% Rec		
			(ML/EPA 525.2)	1,3-dimethyl-2-nbenz(70-130)	100	% Rec		
			(ML/EPA 525.2)	Triphenylphosphate(70-130)	93	% Rec		

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
			Aldicarbs by 531.2					
	08/24/05 00:00	284485	(ML/EPA 531.2)	3-Hydroxycarbofuran	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Aldicarb (Temik)	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfone	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Aldicarb sulfoxide	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Baygon (Propoxur)	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Carbofuran (Furadan)	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Carbaryl	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Methiocarb	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Methomyl	ND	ug/l	0.50	1
	08/24/05 00:00	284485	(ML/EPA 531.2)	Oxamyl (Vydate)	ND	ug/l	0.50	1
			(ML/EPA 531.2)	BDMC(70-130)	102	% Rec		
			Diuron by method 532					
08/11/05	08/24/05 00:00	284321	(EPA 532)	Diuron	ND	ug/l	1.0	1
			(EPA 532)	Carbazole(70-130)	95	% Rec		
			(EPA 532)	Monuron(70-130)	106	% Rec		
			EDB and DBCP by GC-ECD					
08/16/05	08/17/05 00:11	283333	(ML/EPA 504.1)	Dibromochloropropane (DBCP)	ND	ug/l	0.010	1
08/16/05	08/17/05 00:11	283333	(ML/EPA 504.1)	Ethylene Dibromide (EDB)	ND	ug/l	0.010	1
			Gross Alpha Radiation					
	08/15/05 00:00	283971	(ML/EPA 900.0)	Alpha, Gross	22	pCi/l	2.0	1
	08/15/05 00:00	283971	(ML/EPA 900.0)	Alpha, Two Sigma Error	4.3	pCi/l	0.0000	1
	08/15/05 00:00	283971	(ML/EPA 900.0)	Alpha, Min Detectable Activity	2.00	pCi/l	0.0000	1
			Herbicides by 515.4					
08/10/05	08/11/05 00:00	283006	(ML/EPA 515.4)	2,4,5-T	ND	ug/l	0.20	1
08/10/05	08/11/05 00:00	283006	(ML/EPA 515.4)	2,4,5-TP (Silvex)	ND	ug/l	0.20	1
08/10/05	08/11/05 00:00	283006	(ML/EPA 515.4)	2,4-D	ND	ug/l	0.10	1
08/10/05	08/11/05 00:00	283006	(ML/EPA 515.4)	2,4-DB	ND	ug/l	2.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dichlorprop	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Acifluorfen	ND	ug/l	0.20	1

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(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Bentazon	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dalapon	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	3,5-Dichlorobenzoic acid	ND	ug/l	0.50	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Tot DCPA Mono&Diacid Degradate	ND	ug/l	1.0	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dicamba	ND	ug/l	0.080	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Dinoseb	ND	ug/l	0.20	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Pentachlorophenol	ND	ug/l	0.040	1
08/10/05	08/12/05 00:00	283006	(ML/EPA 515.4)	Picloram	ND	ug/l	0.10	1
			(ML/EPA 515.4)	2,4-DCPAA (70-130)	100	% Rec		
			(ML/EPA 515.4)	4,4-Dibrombiphenyl(60-140)	101	% Rec		

Pesticides by EPA 505

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	PCB 1016 Aroclor	ND	ug/l	0.070	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	PCB 1221 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	PCB 1232 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	PCB 1242 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	PCB 1248 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	PCB 1254 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	PCB 1260 Aroclor	ND	ug/l	0.10	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Alachlor (Alanex)	ND	ug/l	0.050	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Aldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Chlordane	ND	ug/l	0.10	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Dieldrin	ND	ug/l	0.010	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Endrin	ND	ug/l	0.010	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Heptachlor	ND	ug/l	0.010	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Heptachlor Epoxide	ND	ug/l	0.010	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Lindane (gamma-BHC)	ND	ug/l	0.010	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Methoxychlor	ND	ug/l	0.050	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Total PCBs	ND	ug/l	0.070	1
08/10/05	08/10/05 17:17	283059	(ML/EPA 505)	Toxaphene	ND	ug/l	0.50	1

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1

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(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Benzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 00:22	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/09/05 00:22	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1
			(EPA 524.2)	Toluene-d8(70-130)	95	% Rec		
			(EPA 524.2)	4-Bromofluorobenzene(70-130)	103	% Rec		
			(EPA 524.2)	1,2-Dichloroethane-d4(70-130)	121	% Rec		

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Layne Christensen
(continued)

TRAVEL BLANK-ANALYZE (2508080224)   Sampled on 08/08/05 00:00

Regulated VOCs plus Lists 1&3

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,1,1,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,1,1-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,1,2,2-Tetrachloroethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,1,2-Trichloroethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,1-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,1-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,1-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,2,3-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,2,3-Trichloropropane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,2,4-Trichlorobenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,2,4-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,2-Dichloroethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,3,5-Trimethylbenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	1,3-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	p-Dichlorobenzene (1,4-DCB)	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	2,2-Dichloropropane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	2-Butanone (MEK)	ND	ug/l	5.0	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	o-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	p-Chlorotoluene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	4-Methyl-2-Pentanone (MIBK)	ND	ug/l	5.0	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Benzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Bromobenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Bromomethane (Methyl Bromide)	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Bromoethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	cis-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Chlorobenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Carbon Tetrachloride	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	cis-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Bromoform	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Chloroform (Trichloromethane)	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Bromochloromethane	ND	ug/l	0.50	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
	08/09/05 02:35	282541	(ML/EPA 524.2)	Chloroethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Chloromethane(Methyl Chloride)	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Chlorodibromomethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Dibromomethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Bromodichloromethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Dichloromethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Di-isopropyl ether	ND	ug/l	3.0	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Ethyl benzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Dichlorodifluoromethane	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Fluorotrichloromethane-Freon11	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Hexachlorobutadiene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Isopropylbenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	m-Dichlorobenzene (1,3-DCB)	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	m,p-Xylenes	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Methyl Tert-butyl ether (MTBE)	ND	ug/l	1.0	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Naphthalene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	n-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	n-Propylbenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	o-Xylene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	o-Dichlorobenzene (1,2-DCB)	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Tetrachloroethylene (PCE)	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	p-Isopropyltoluene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	sec-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Styrene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	trans-1,2-Dichloroethylene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	tert-amyl Methyl Ether	ND	ug/l	3.0	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	tert-Butyl Ethyl Ether	ND	ug/l	3.0	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	tert-Butylbenzene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Trichloroethylene (TCE)	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Trichlorotrifluoroethane(Freon	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	trans-1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Toluene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Total 1,3-Dichloropropene	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Total THM	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Total xylenes	ND	ug/l	0.50	1
	08/09/05 02:35	282541	(ML/EPA 524.2)	Vinyl chloride (VC)	ND	ug/l	0.30	1

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Layne Christensen
(continued)

Prepared	Analyzed	QC Ref#	Method	Analyte	Result	Units	MRL	Dilution
			(EPA 524.2	) 4-Bromofluorobenzene(70-130)	101	% Rec		
			(EPA 524.2	) Toluene-d8(70-130)	95	% Rec		
			(EPA 524.2	) 1,2-Dichloroethane-d4(70-130)	120	% Rec		

Appendix I
Wildermuth Environmental Credentials

WILDERMUTH™
ENVIRONMENTAL INC.

Wildermuth Environmental Inc. (WEI) is a specialized water resources consulting firm dedicated to creating visionary yet practical solutions to the complex water problems facing California municipalities, governmental agencies, and private companies.

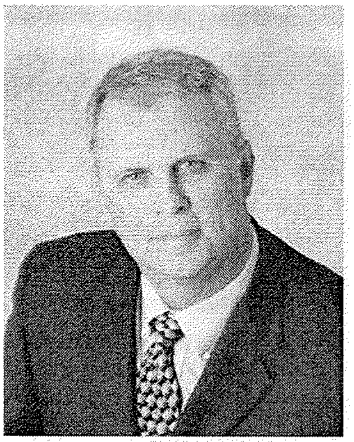
Founded in 1990, WEI has built a solid reputation as a trusted partner to water districts, municipalities, dischargers, regulators, and others in the water community by providing sage water resources consulting and innovative solutions with a focus on a sustainable resource utilization.

WEI is unmatched in its ability to design and implement holistic, sustainable solutions that fuse the needs of clients, the environment, and surrounding communities. The forward-thinking scientists and environmental engineers at WEI identify problems precisely, and solve them through a methodical process that weighs political, legal, and technical considerations while building consensus for ideas and solutions. The cornerstone of the firm's relationships with employees, clients, regulatory agencies, and business partners is its pledge to perform every service, every engagement, and every project with integrity. In essence, WEI serves as extended staff to its clients, which is reflected in the firm's commitment to excellence, professionalism, and responsibility.

After leading the water resources groups of two large consulting companies, Mark Wildermuth discovered that his 14 years of water engineering experience highly coveted by agencies and companies in need of strategic guidance for water resource problems. He spent the first half of his career working for large companies where their bottom line was more important than their clients needs and often more important than developing long-term sustainable solutions. It was during this time that he developed a unique outlook and distinct method for how water resources consulting should be approached.

In 1990, Mark broke out on his own and founded WEI. Since that time many like-minded engineers and scientists with similar values have joined WEI. Today, WEI has a staff of 25 employees and continues to grow. Since the launch, the company has adhered to a singular vision: to participate in significant and positive ways to the solution of important environmental problems and to support important environmental decision processes."

WEI is known for accurately identifying water resource issues, and, through the application of science and mediation, developing solutions that place equal value on fusing the needs of clients, preserving environmental integrity and supporting surrounding communities. This holistic "big picture" approach has set WEI apart from competitors, who largely focus on short-term technical solutions.



Assignment

Principal Engineer / President

Education

M.S., Systems Engineering, University of California, Los Angeles, 1976

B.S., Engineering, University of California, Los Angeles, 1975

Registrations

Professional Civil Engineer, California C32331

Mark J. Wildermuth, PE
Principal Engineer / President

Summary

Mr. Wildermuth has 31 years of experience in water resources engineering and planning including: surface and groundwater hydrology and hydraulics; water resources planning; surface water and groundwater computer simulation modeling; water rights; surface water and groundwater quality; flood plain management; municipal recycled water discharge impacts in receiving waters; and water supply and flood control facility design. He has also developed extensive expertise in the development of water resources management plans for groundwater basins and watersheds in southern California, and has provided expert witness and opinions for litigation support and mediation in several important issues.

His past experience has included responsible positions at major environmental consulting firms including James M. Montgomery, Consulting Engineers, Inc., where he was a principal engineer from 1987 to 1990; and Camp Dresser and McKee, Inc., 1980 to 1987. Mr. Wildermuth began his own company in 1990 to focus specifically on water resources management studies and the application of state-of-the-art technology to water resources projects. The company has now grown to 20 professionals and became incorporated as WEI in 1998. Mr. Wildermuth received a B.S. in Engineering from the University of California at Los Angeles in 1975, and a M.S. in Water Resources Engineering from University of California at Los Angeles in 1976. He is a registered professional civil engineer in the State of California, and a member of the National Ground Water Association, American Water Resources Association, and Groundwater Resources Association of California.

Selected Project Experience

Wildermuth Environmental, Inc., Lake Forest, CA – 1990 / Current

Optimum Basin Management Program (OBMP), Chino Basin Watermaster

Mr. Wildermuth was the project manager and lead technical analyst to provide as-needed engineering services to the Chino Basin Watermaster. Activities included review of water rights applications, storage losses from over-year groundwater storage accounts, groundwater monitoring, estimating salt offset credits, estimating replenishment volumes required for proposed groundwater

Mark J. Wildermuth, PE, cont'd

treatment project(s), coordination with San Bernardino County Flood Control District and Conservation District regarding recharge, coordination with Metropolitan Water District regarding water rates and seasonal storage service.

Mr. Wildermuth was the project manager to develop the scope of work and to implement that scope of work for the Chino Basin OBMP. The San Bernardino Court ordered the development of the OBMP. Mr. Wildermuth developed the process used to develop the OBMP scope of work and authored the engineering and institutional scopes of work. WEI, under the direction of Mr. Wildermuth, completed the engineering studies and developed the resulting management plan. The engineering scope of work included the problem definition, development of goals, developing and analyzing management components, integration of management components, financial analysis and development of an implementation strategy.

Optimum Basin Management Program Implementation, Chino Basin Watermaster
Mr. Wildermuth is the WEI project manager for WEI involvement in the OBMP Implementation. WEI efforts include running a large-scale surface water discharge and water quality monitoring (20 stations), groundwater level and water quality (600 wells), groundwater recharge, InSAR, and extensometer monitoring programs. WEI is also providing oversight to well siting and related impact analysis for new desalter wells.

Chino Basin Dry-Year Yield Program, Chino Basin Watermaster
Mr. Wildermuth is the WEI project manager for WEI involvement in the development of the Chino Basin Dry-Year Yield (DYY) Program. WEI is role is to assist the Watermaster and Inland Empire Utilities Agency in the development of the 100,000 acre-ft DYY program. WEI completed a thorough reassessment of the hydrogeologic conditions in the Chino Basin. WEI assisted other consultants with facility planning including well siting, water quality evaluations, and specialized mapping. WEI developed and applied a sophisticated set of surface and ground water models to evaluate the DYY impacts on groundwater levels, contaminant plume movement, and surface and ground water interaction in the southern part of the basin. Currently, WEI is expanding this analysis to investigate groundwater storage programs of up to 500,000 acre-ft.

Groundwater Quality Monitoring Program, Chino Basin Watermaster
Mr. Wildermuth conducted a groundwater quality-monitoring program for the Chino Basin Watermaster involving the collection of about 70 water samples in the field and about 200 samples from cooperating agencies. This project started in 1990 and was continued through 1996. Subsequently WEI has expanded this program to about 600 wells as part of the Chino Basin OBMP

Analyses of recharge & Recharge Facilities, Chino Basin Water Conservation District
Mr. Wildermuth conducted studies to determine the annual average recharge at stormwater recharge facilities owned by the Chino Basin Water Conservation District. Daily flow simulation models were developed and applied for a period of forty one years. The results of this study are being used to improve operations and maintenance schedules at the existing facilities.

Mr. Wildermuth developed a monitoring program to determine changes in percolation rates and subsequent maintenance practices to restore maximum percolation rates. One of the key components of the monitoring program was the installation of digital water level sensors with integral data loggers to measure basin water levels every ten minutes. Wildermuth Environmental developed the analytical methods and software to convert these observations into estimates of basin inflow, outlet discharge, evaporation losses, and basin recharge.

Recharge Master Plan, Chino Basin Water Conservation District, Chino Basin Watermaster, San Bernardino County Flood Control District

Mr. Wildermuth was the project manager and lead technical analyst for the recharge master plan for the Chino Basin. The objectives of the master plan were to develop a plan of recharge to meet future groundwater replenishment requirements utilizing stormwater, recycled water, and imported water; and to evaluate the change in groundwater recharge caused by the construction of flood control improvements for San Sevaine Creek and East Etiwanda Creek. This study utilized a daily runoff model to estimate the magnitude and temporal distribution of stormwater recharge.

Recycled water and imported water will be recharged in periods with minimum conflict with stormwater recharge. New facilities and modifications to existing facilities were recommended. A second phase of the recharge master plan was completed as part of the Chino Basin OBMP where WEI collaborated with the Black and Veatch Corporation. Subsequently, the Chino Basin Watermaster, Inland Empire Utilities Agency, the Chino Basin Water Conservation District are converting 19 flood retention basin to spreading basins and are building two new recharge facilities. The total cost of the recharge improvements are approximately $45 million.

Nitrogen / Total Dissolved Solids (N/TDS) Task Force, Santa Ana Watershed Project Authority

Mr. Wildermuth was the architect and co-project leader for a multi-phase comprehensive evaluation of the fate of nitrogen and TDS in the Santa Ana Watershed. In this investigation, the basin plan objectives for TDS and nitrogen were reset based on the best available data and scientific methods, and new procedures were developed to assess the availability of assimilative capacity.

Phase one involved development of procedures for evaluation of TDS and nitrogen impacts from recycling projects in the Santa Ana watershed, a massive data collection and validation effort, watershed characterization, and an initial assessment of TDS and nitrogen loads to surface water and groundwater from municipal recycled water treatment plants and non-point sources. Phase 2A of this project involved: delineating new basin/management zone boundaries; development of groundwater storage estimates in each management unit; estimating TDS and nitrogen statistics at wells; computing volume weighted TDS and nitrate concentration for the new basin/management zones; and completing a new wasteload allocation analysis for the Santa Ana River and selected tributaries.

Phase 2B of the project involved the development and implementation of a sophisticated modeling system to evaluate the current wasteload allocation for TDS and total inorganic nitrogen for municipal recycled water plants that discharge to the Santa Ana River and its tributaries. A daily stream flow simulation model was used to estimate the TDS and TIN concentration in the Santa Ana River and its tributaries in response to recycled water discharge, stormwater runoff, non-tributary discharges, and groundwater interaction.

Tom McCarthy, PE, PG
Associate Engineer 1

Assignment
Associate Engineer 1

Education
M.S., Civil and Environmental Engineering, University of California, Los Angeles, 1998

B.S., Geological Sciences, University of Oregon, 1996

Registrations
Professional Civil Engineer, California C67516

Professional Geologist, California, No. 8207

Additional Training & Certifications
American Red Cross CPR & First Aid Training

Summary

Mr. McCarthy is an Associate Engineer at Wildermuth Environmental, Inc. He has over 10 years of professional experience working with private consulting firms and public agencies. His expertise includes water resources engineering, water resources planning, numerical modeling, and data management. The bulk of Mr. McCarthy's experience has been concentrated in the area of water resources engineering and planning, specifically with the optimization of well field operations considering constraints such as surface water interaction, ecologic conditions, and or legal constraints. Mr. McCarthy has worked also with decision, hydraulic, sewer, groundwater, ecologic, and reverse osmosis system models. Mr. McCarthy has completed several groundwater modeling projects as the project manager or lead groundwater modeler.

Mr. McCarthy received a B.S. in Geological Sciences from the University of Oregon in 1996, and an M.S. in Civil and Environmental Engineering, with an emphasis on water resources, from the University of California, Los Angeles, in 1998. His professional experience includes employment as a geologic technician for Leighton and Associates 1995 to 1996; a geologist for the United States Geological Survey in 1997 as a National Association of Geoscience Teachers appointee; and a Senior Engineer with MWH Americas, Inc., from 1998 to 2005.

At MWH Americas, Mr. McCarthy was responsible for four well field modeling projects in the Owens Valley. These projects included the development of MODFLOW models based on researched conceptual models. The calibrated numerical models were used to determine optimal extraction within existing constraints, e.g. vegetation impacts.

Mr. McCarthy was also an Associate Engineer from 2005 to 2006 with Mammoth Community Water District. Mr. McCarthy is a registered professional civil engineer, as well as a registered professional geologist, both within the State of California. Mr. McCarthy has served on the Board of Directors of the Meadow Creek Mutual Water Company. He is a member of the American Society of Civil Engineers, American Water Works Association, and the American Geophysical Union. Selected project experience continues on the following pages:

Tom McCarthy, PE, PG, cont'd

Wildermuth Environmental, Inc., Lake Forest, CA – 2006 - Current

Chino Basin Groundwater Model Recalibration, Chino Basin Watermaster, Rancho Cucamonga, CA

Project Manager: Mr. McCarthy currently serves as the project manger updating the existing Chino Basin MODFLOW groundwater flow model. This project involves updating the numerical model with recent revisions to the conceptual model and data processing of historic data prior to the previous model calibration period. The model domain encompasses approximately 220-square miles. The updated model will have a longer calibration period than the previous model and allow for longer planning alternative testing. The model is in the process of being recalibrated, with the finished model ready for planning use summer of 2007.

Fee Determination, Beaumont Basin Watermaster, Beaumont, CA

Project Manager: Based on Beaumont Watermaster member agency water supply plans, a salt mitigation fee is being determined to potentially allocate costs for basin groundwater desalting. Wildermuth Environmental is tasked with developing a reaction model to estimate basin water quality dynamics over time and establish a salt credit and debit system to allocate desalter costs. Wildermuth Environmental is also tasked with developing salt management alternatives and costs to manage the need for and timing of a desalter.

Mammoth Community Water District, Mammoth, CA – 2005 - 2006

Mammoth Community Water Basin Hydrologic Analysis/Numerical Groundwater Model Development, Mammoth Community Water District

Project Manager: Mr. McCarthy served as the project manager to establish a conceptual model for the Mammoth Basin for conversion to a numerical model. This project consisted of reference gathering, cross-section generation, monitoring well cuttings review, model layer determination and the initial stages of the water budget summarization.

Water and Wastewater Modeling for Capital Improvement Plan Determination, Mammoth Community Water District

Project Manager: Mr. McCarthy served as the project manager for the water and wastewater system modeling, capital improvement plan updating, Mr. McCarthy directed the determination of new projects required to serve new connections, the financial analysis to determine the appropriate and fair fees for the new connections, and the conversion from a land use based system (EDU) to a meter size based (MEU) system.

MWH Americas, Inc. (Consultant) – 2005 - 2006 (Water Systems)

Los Angeles Dept. of Water & Power Irrigation Reduction Incentive Program EIR, Los Angeles Dept. of Water & Power

Project Engineer: The intent of the project was to provide incentives to agricultural water users to use less water. As a consultant to MWH Americas, Mr. McCarthy evaluated the effects of using less water for irrigation on groundwater levels. Using a MODFLOW model and an analytical model, Mr. McCarthy evaluated different irrigation operations for varying vegetation communities.

MWH Americas, Inc. Pasadena, San Diego, & Bishop, CA – 1998 - 2005

Bishop Area Management Study, Los Angeles Dept. of Water & Power

Project Manager: Mr. McCarthy initiated this project as the Task Manger leading a team in developing a conceptual and numerical model for well field management optimization. This project served as an extension of the existing Laws Well Field conceptual and numerical models previously developed. The numerical model (MODFLOW) was based on an existing USGS groundwater model at a much more coarse scale. The goal of the project was to determine management practices based on climate trends, water needs, private pumping, legal constraints, and overall vegetation conditions.

Lower Owens River Final EIR, Los Angeles Dept. of Water & Power
Engineer: Mr. McCarthy assisted with the finalization of the Lower Owens River Restoration Project Environmental Impact Report for the Los Angeles Department of Water and Power. Assistance consisted of, but was not limited to researching vegetation and groundwater questions presented by the public, obtaining permits for the California State Land Commission, Bureau of Land Management, and the California Department of Transportation.

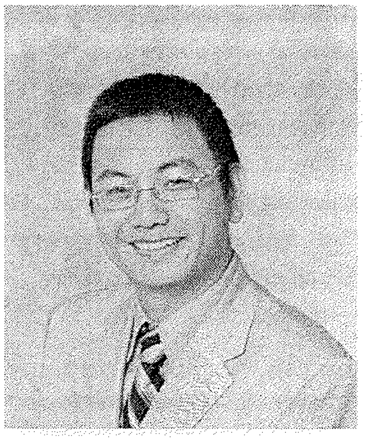
LA-Inyo Cooperative Deep Well Study and Analysis, Los Angeles Department of Water and Power
Project Engineer: Mr. McCarthy served as the Project Engineer for deep well pumping test within the Taboose Aberdeen Well Field and analysis of these resulting data. Mr. McCarthy compiled the specifications for the year long pump test and data collection requirements. Following the year long pump test and data collection effort by LADWP, Mr. McCarthy worked with all parties on the study to estimate drawdown in the shallow aquifer due to deep well pumping and document the effects for incorporation into management policy.

Taboose-Thibaut Well Field Management Study, Los Angeles Department of Water and Power
Project Manager: Mr. McCarthy was the Task Manger leading a team in developing a conceptual and numerical model for well field management optimization. The numerical model (MODFLOW) was based on an existing USGS groundwater model at a much more coarse scale. The model for this specific region was re-built at a more fine scale. The ultimate goal of the project was to determine management practices based on climate trends, water needs, and overall vegetation conditions.

Laredo Pre-Verification Study, City of Laredo, Texas
Engineer: This study was conducted to determine alternative drinking water sources for the City of Laredo, Texas. Using data obtained from video logs and aquifer performance testing.

Mr. McCarthy conducted an analysis of a potential well field for the City of Laredo second drinking water source. The modeling was completed using MODFLOW and analytical spreadsheet methods to determine response to pumping, other variable conditions, pipeline alignments, and rough cost estimations. This modeling and following analysis provided the City of Laredo with preliminary aquifer pump rates and sustainability estimates.

Confining Layer Study, Los Angeles Department of Water and Power
Project Manager: Mr. McCarthy completed a geostatistical analysis with pump test data and categorized hydrogeologic parameter data sets. From the geostatistical results, numerous maps were created that mapped the areas of confinement within the Owens Valley. Mr. McCarthy also maintained numerous project management responsibilities including managing sub consultants, budgets, and project schedules.



Wenbin Wang, PhD
Senior Scientist / Hydrogeologist

Assignment

Senior Scientist/Hydrogeologist

Education

Ph.D., Hydrology, Mathematics, University of Arizona, Tucson, 2002

M.S., Hydrogeology, University of Technology (CDUT), China, 1989

B.S., Hydrogeology, Chengdu University of Technology, China, 1984

Additional Training & Certifications

CPR & First Aid Training

Summary

Dr. Wang has more than 15 years of professional experience in the hydrogeologic field. His technical expertise includes numerical modeling of multiphase flow and contaminant transport in saturated and unsaturated porous and fractured medium, developing flow and transport codes and design of window-based software, estimation of hydraulic parameters via direct and indirect methods, application of statistics, geostatistics and stochastic methods in hydrogeology, sensitivity and error analysis, and site characterization.

Dr. Wang received a B.A. and a M.S. in hydrogeology from the Chengdu University of Technology in 1984 and 1989, and a Ph.D. in subsurface hydrology from the Department of Hydrology and Water Resources at the University of Arizona in 2002. His experience includes work as a hydrogeologist in China Geological Survey, Lecturer and Associate Professor at Chengdu University of Technology, and Project Hydrogeologist at an Arizona-based water management consulting company.

Dr. Wang is well-versed in various modeling software including TOUGH2/ITOUGH2, MODFLOW, PEST, MT3D, GW Vistas, PATH3D, MODPATH, FLOWPATH, HYDRUS-1D/2D, UNSAT, HEC, ROSETTA, AQTESOLV, PHREEQC, and MINTEQ.

He is a member of the America Geophysical Union (AGU) and Soil Science Society of America (SSSA). He is also a member of Groundwater Resources Association of California (GRA) and National Groundwater Association (NGWA).

Selected Project Experience

Wildermuth Environmental, Inc.

Subsidence Study of Chino Basin, 2005-2006.
Senior Scientist: Dr. Wang developed subsidence conceptual model and numerical model in Chino Basin, Conducted pumping test analysis and simulation of flow under different water extraction scenarios, determination of optimum water extraction scenario.

Ontario Contamination Simulation and Remediation, 2005-2006
Senior Scientist: Dr. Wang conducted simulation of contamination plume movement in Chino Basin, and finally determined the optimum remediation scenario.

Wenbin Wang, PhD, cont'd

Contaminant Source Investigation in Groundwater, Confidential Client, 2004-2005
Senior Scientist: **Dr. Wang** developed hydrogeological conceptual models for unsaturated and saturated zone, conducted simulations of flow and transport in the unsaturated zone of the San Bernardino Basin. Dr. Wang calibrated the flow and transport model paramaters, performed uncertainty analyses by using stochastic–Monte Carlo simulation, and settled conclusively the contaminant source.

Support on Title 22 Engineering Report, Chino Basin, 2005-2006
Senior Scientist: Dr. Wang conducted simulation of input/recycle water movement in Chino Basin, and finally determined the optimum scenario of distributing the amount of input/recycle water in various recharge basins in Chino Basin.

Engineering Support of RIX Expansion, 2005-2006
Senior Scientist: Dr. Wang estimated unsaturated and saturated hydraulic properties in the RIX site, Characterized site hydrogeology and developed conceptual models, conducted unsaturated and saturated flow model under the condition of Rapid Infiltration and Extraction operation, and finally provided the optimum scenario of infiltration and extraction.

Groundwater Simulation of Beaumont Basin, Riverside, 2005-2006
Senior Scientist: Dr. Wang was responsible for the development of a high resolution regional groundwater model for the Beaumont Basin. Dr. Wang developed a hydrogeological conceptual model for this complex heterogeneous anisotropic multilayer media with various horizontal barriers. Combined with the unsaturated flow model result, the developed numerical flow model was then calibrated by using PEST against the observation data of water level during the period of 1927-2005. Dr. Wang also developed a nitrate transport model for Beaumont Basin and used the flow-transport model to predict the water level variations and manage the water resources under future optimum basin management.

During the development of this flow-transport model, all the related inputs and their variations, such as rainfall, return flow related the land use, septic tank inflow, side boundary inflow, front-mountain inflow, stream percolation, artificial recharge, evapotranspiration, buffer action of thick unsaturated zone, etc. were taken into account. The model also took both anisotropic heterogeneity and parameter zonation into account.

China Airport Contamination Simulation and Remediation, 2006
Senior Scientist: Dr. Wang developed transport models and conducted flow and transport (PCE/TCE) simulations of existing contamination plume movements nearby Chino Airport, and finally determined the optimum remediation scenario.

Groundwater Simulation of Arlington Basin, Riverside, 2006-2007
Senior Scientist: Dr. Wang was responsible for the development of a high resolution regional groundwater model for the Arlington Basin. The developed flow model was calibrated by using parallel PEST in 24-processor computers against the observation data of water level during the period of 1966-2004. The developed model had heterogeneous anisotropic functions.

Water Management Consultants, Tucson, Arizona, 2002 to 2004
Hydrogeologist/Modeler: Dr. Wang conducted forward and inverse modeling of flow and transport in heterogeneous, unsaturated/saturated porous/fracture media and geostatistical analyses and

simulations using geophysical data. Performed the design and analyses for pumping/slug and tracer tests.

Responsible for computing and maintaining very large geophysical databases, computing 3-dimensional ERT, as well as software design, including the development of U-Win software, and programming for flow and solute transport and hydrogeochemical analysis. Performed hydraulic parameter estimation and site characterizations and developed heap leaching technology, including a geophysical monitoring system.

University of Arizona, Department of Hydrology and Water Resources, Arizona – 1997 to 2002

Research Associate/Assistant ship: Conducted testing of groundwater flow and transport models and uncertainty analyses related to hydrogeological conceptualization, modeling, and predictions. Applied various parameter estimation approaches to interpret and evaluate hydrogeologic data from this Maricopa site. Designed the conceptualization and modeling flow and transport and developed various codes for flow and transport. Responsible for the GIS to Maricopa area, site characterization and the pedotransfer function analysis and the Bayesian update coding and computations. Conducted geostatistical analysis of hydraulic parameters and pedological data, and geostatistical simulation.

Dr. Wang performed forward and inverse numerical modeling of multiphase flow and transport in heterogeneous, unsaturated and saturated porous media. He also performed sensitivity and error analysis and field experiment design, as well as uncertainty analysis of flow and solute transport modeling results.

Chengdu University of Technology (CDUT), Department of Hydrogeology and Engineering Geology, China. Lecturer from 1989 to 1994, Associate Professor from 1994 to 1996

At the Chengdu University, Mr. Dr. Wang lectured on hydrogeology and hydrogeochemistry. In addition, he completed various research projects, which included site characterizations of hydrogeology and geology, paleohydrogeological analysis, reservoir analysis, fluid flow and transport modeling, and hydrogeochemistry complex programming and computation

Chengdu University of Technology (CDUT), Department of Hydrogeology and Engineering Geology, China – 1986 to 1989

Research Assistant: Performed modeling of groundwater flow in fractured karst medium and model parameter identification

China Geological Survey, China – 1984 to 1986

Hydrogeologist: Conducted geological and hydrogeological investigations and mappings, as well as conducting pumping test, soil, and water sampling.

ESA