This section provides an overview of the current conditions of the environmental resources potentially affected by the proposed action or the alternatives. Information for this discussion was gathered from several sources: the 2002 Environmental Assessment (EA Number 01-83), Mendota Pool Exchange Agreements (Reclamation 2002), the 1999 Water Management Plan for Westlands Water District (WWD 1999), the 2000 Deep Groundwater Report for Westlands Water District (WWD 2001), technical reports on previous projects (KDSA and LSCE 2000a and 2000b, LSCE and KDSA 2001, LSCE and KDSA 2002), and the draft EIR for a previously proposed project (Jones and Stokes 1995).

The Proposed Action involves pumping groundwater into a surface water body (the Mendota Pool), with subsequent delivery to irrigated farmland and wildlife habitat. Water pumped into the Mendota Pool would be exchanged with Reclamation for water from the SLR and SLC. Therefore, the potentially affected resources in the action vicinity include:

- Groundwater
- Surface water
- Sediment
- Biological resources
- Central Valley Project facilities
- Archaeological and cultural resources
- Land use
- Traffic
- Noise

The socioeconomic characteristics of the action area and populations that would be potentially affected are also discussed in this section.

3.1 AREA OF INTEREST

The area of interest for the evaluation of potential effects from the proposed action and alternatives is dependent on which primary environmental issue of concern is being addressed. The 1999 through 2002 monitoring programs have provided information with which to define the areas likely to be affected.

3.1.1 GROUNDWATER LEVELS AND SUBSIDENCE

The area of interest for evaluation of groundwater levels and subsidence was based on results of previous monitoring efforts and analyses. Based on existing data and modeling results, the groundwater level impacts from the proposed action during the pumping period are estimated to extend a maximum of 3.5 miles from the center of the MPG wells in FWD. This area represents the approximate center of the cone of depression created by MPG deep zone transfer pumping. For the purposes of this EIS, a conservative radius of 6 miles from the center of the cone of depression was selected as the area of interest for the proposed action, for both the normal and dry year pumping programs. This area of interest is shown on Figure 1-3. In wet years, when no transfer pumping would occur, there would be no water level impacts due to the proposed action. The area of interest for the evaluation of subsidence resulting from the Proposed Action coincides with that for groundwater levels, as it is the change in groundwater levels due to pumping that is the primary cause of subsidence. In this analysis, subsidence is evaluated at two locations: the Yearout Ranch and Fordel Extensometers, located east and west of the Fresno Slough (Figure 2-1).

Under either of the No Action alternatives, the area of interest for groundwater levels would include areas of WWD and SLWD where new production wells would be installed. These wells would be located on lands owned by MPG members (Figure 1-2). The new wells would probably pump from the aquifer beneath the Corcoran Clay. The cones of depression resulting from pumping 25,000 acre-feet of water from these wells would depend on their depths and distribution among the MPG lands in WWD and SLWD. Subsidence due to inelastic compaction in and below the Corcoran Clay resulting from this pumping is a major concern for the No Action alternatives. The area of interest for subsidence for this alternative would also depend on the depth and location of the new wells.

3.1.2 GROUNDWATER QUALITY

The area of interest for the evaluation of groundwater quality for the Proposed Action is smaller than that for groundwater levels because groundwater quality impacts are expected to be more localized in the vicinity of the MPG well field. Groundwater quality has been evaluated primarily near the Fresno Slough and the San Joaquin River in the central and western portion of the study area used for evaluation of groundwater level impacts. Groundwater quality has not been evaluated south of Whitesbridge Road because the nearest non-MPG production wells in this area are located south of the MWA. Groundwater quality has not been evaluated in the eastern portion of the study area (east of the Chowchilla Bypass) due to limited data and because no impacts due to the proposed action are anticipated in this area.

3.1.3 Surface Water Quality

The primary source of water for the Mendota Pool is the DMC. This proposed action has no effect on the quality of the water delivered to the Mendota Pool by the DMC. Therefore, the starting point for water quality evaluations is the quality of the water at Check 21 near the DMC terminus (Figure 1-1). The Proposed Action would introduce groundwater into the Mendota Pool, the majority of which would be introduced into the Fresno Slough branch. Surface water is currently removed from the Mendota Pool via irrigation canals and pipelines located in both the northern and southern portions of the Mendota Pool. However, any impacts on surface water quality will occur predominantly in the southern portion of the Mendota Pool, because groundwater would only be introduced into the Fresno Slough when flows in this branch of the Mendota Pool are to the south. Some effects may be observed in the northern portion of the Mendota Pool as a result of pumping from the wells in FWD. This EIS evaluates changes in surface water quality as they potentially affect the irrigation districts (i.e., JID, TID, Fresno Slough WD, and Mid-Valley WD) and wildlife refuges that receive water from the Mendota Pool. The irrigation districts in the southern portion of the Pool do not discharge agricultural return water back to the Mendota Pool or any other water body but let it infiltrate to groundwater.

Neither of the No Action alternatives would introduce groundwater into the Mendota Pool or other water bodies, so there is no area of interest for surface water quality associated with them.

3.1.4 Sediment Quality

Sediment quality is influenced by the native substrate of which the sediment is composed and by inputs from overlying surface water. Impacts to surface water quality in the Mendota Pool from the proposed action can, therefore, also impact sediment quality. The area of interest for impacts to sediment quality is the same as for surface water. The No Action Alternatives would not affect surface water quality or sediment quality. This EIS evaluates potential effects of sediment quality on aquatic organisms that may be present in the Mendota Pool.

3.1.5 Biological Resources

Biological resources are considered to be primarily influenced by changes in surface water or sediment quality. Therefore, the area of interest for the evaluation of impacts of the proposed action on biological resources is coincident with the areas that are affected by changes in surface water quality. This area includes the Mendota Pool, irrigation canals and bordering lands, irrigated fields, and the MWA. As noted for surface water quality, limiting MPG pumping to periods when flow is to the south in the Fresno Slough effectively precludes movement of MPG water from wells along the Fresno Slough into irrigation canals in the northern portion of the Mendota Pool. Because the primary route of exposure to biological resources is through surface water, this evaluation will focus primarily on species associated with the water in the Mendota Pool, irrigation canals, and irrigated (or flooded) fields.

The No Action alternatives would have different areas of interest. Neither option would result in changes to surface water quality or sediment quality. Installation of additional wells on lands farmed by MPG members in WWD and SLWD would maintain production on lands currently being farmed. Therefore, the area of interest would include MPG owned lands in SLWD, WWD, and adjacent areas.

3.1.6 Historic And Societal Resources

The area of interest for archaeological and cultural resources for the proposed action and the alternatives includes the Mendota Pool and the lands irrigated by the MPG. The area of interest for land use for the proposed action and the alternatives includes the lands irrigated by the MPG. The area of interest for traffic for the proposed action and the alternatives includes roads that provide access to the lands irrigated by the MPG. The area of interest for noise for the proposed action includes the areas near production wells owned and operated by the MPG. For the No Action alternative option that includes construction of new production wells, the area of interest would include areas near the new well locations during construction and subsequent operation, as well as the areas near the existing MPG wells.

3.2 Climate

Climate is the primary factor controlling water supply and water requirements throughout California. Most of California's water supply comes from precipitation in mountainous areas. Falling as rain or snow during the winter, it is held in reservoirs and as snowpack until needed during the growing season (Western Regional Climate Center [WRCC] 2002). Approximately 90 percent of California's water consumption is used for agriculture. Within the state, more than 70 percent of the streamflow is generated in the area north of Sacramento, while about 80 percent of the water demands occur south of this line. Thus, distribution of water is a major concern within California.

Typically, throughout California there are extended periods every summer with little or no precipitation. This is the normal and expected condition. Therefore, a shortage of irrigation water stored in reservoirs at the beginning of the season is serious because normal summer precipitation is not sufficient to meet agricultural requirements. Precipitation deficiencies become critical in the state when the normal winter water supply fails to materialize.

The California Department of Water Resources classifies water year types based on runoff and storage in the Sacramento and San Joaquin Valleys. Data on water year types are available from 1901 to 2001 for the San Joaquin Valley and from 1906 to 2001 for the Sacramento Valley. Within each valley, an index is calculated based on four major tributaries (DWR 2002a). The classification of a particular year is relative to other years in the same drainage.

The hydrologic year classifications of the Sacramento and San Joaquin River Basins are highly correlated between the two basins (r = 0.89). Each basin is characterized by approximately 35 percent wet years and 30 to 34 percent dry or critical years (Figure3-1). The San Joaquin Basin has had a slightly greater percentage of above normal years and more critical years than the Sacramento Basin. Although the two basins are very similar, the Sacramento River Basin index is used for water supply allocations to WWD, as the majority of the water storage is derived from the northern portion of the State.

The long growing season characteristic of most of the valley areas where agriculture is concentrated is an important factor in the production picture. The long dry period during the summer facilitates the planting, cultivation, and harvest of many crops; isolated late spring, summer, or early fall rains sometimes result in more damage than benefit to crops. In general, the distribution of temperature and precipitation is highly favorable for most agricultural enterprises as long as sufficient irrigation water is available (WRCC 2002).

Regional climate data were obtained from the WRCC and DWR for the Five Points weather station. The Five Points station is located approximately 25 to 30 miles south-southwest of Mendota (Figure 1-1). Annual precipitation at the Five Points weather station averages about 6.6 inches, the majority of which falls during the months of December through March (Table 3-1). Historically, total annual precipitation has varied from 2.9 inches to 14.6 inches per year. Average monthly maximum temperatures range from 55°F to 97°F, and average monthly minimum temperatures range from 36°F to 62°F. Summer maximum temperatures frequently exceed 100°F, and winter temperatures occasionally fall below freezing (WRCC 2002). With a mean annual temperature of 62°F, the area has an average frost-free growing season of 280 days (WWD 1999).

Evapotranspiration in the vicinity of the proposed action is among the highest in California. DWR provides reference evaporation (ET_0) rates for over 100 sites as part of the California Irrigation Management Information System (CIMIS). The ET_0 is based on the evapotranspiration of turf grass and is used to estimate evapotranspiration rates for major crops. For the CIMIS stations closest to the Mendota Pool, the ET_0 averages 55.4 inches per year at the Firebaugh station and 58.8 inches per year at the WWD station near Tranquillity (DWR 2002b).

3.3 SURFACE WATER

The following discussion of surface water resources addresses the major components of the water storage and delivery system in the action area, the volumes of water moving into and out of the Mendota Pool, and the water quality of the Mendota Pool and adjoining canals.

3.3.1 SURFACE WATER DELIVERY AND DISTRIBUTION

Reclamation has contracts to deliver approximately 1.9 million acre-feet of water per year to users on the western side of the Central Valley. WWD's contract with Reclamation is for a maximum of 1,008,000 acre-feet per year, or approximately 53 percent of the total contracted amount. WWD began receiving CVP water in 1968 when the SLC was completed. WWD also has a contract for 250,000 acre-feet per year of litigation settlement water from the resolution of the Barcellos lawsuit. In most years, however, these deliveries are reduced to a fraction of the maximum contracted amounts because of drought conditions and, more recently, the federal ESA, the CVPIA, Central Valley Water Quality Control Plan, and other environmental concerns in and upstream of the Delta.

Surface water features in the southern Central Valley include Millerton Reservoir, SLR, the SLC, the DMC, the Mendota Pool, the San Joaquin River, Fresno Slough, James Bypass, Kings River, and Chowchilla Bypass (Figure 1-1). The SLR, DMC, SLC, San Joaquin River, Mendota Pool, and the WWD distribution system are key components of the proposed action.

3.3.1.1 San Luis Reservoir

The SLR is an off-stream storage reservoir with a gross storage capacity of 2,039,000 acre-feet (DWR 2002). The federal (i.e., CVP) portion of the storage capacity is 971,000 acre-feet. The reservoir receives exports of Delta water from the CVP and SWP systems. The SLR increases the operational flexibility of the CVP and SWP pumping plants, which are restricted from pumping during certain periods because of fishery and water quality concerns. During winter and early spring, water is pumped to the SLR from the DMC for storage and later release during the irrigation season. During the principal irrigation months, water at the O'Neill Forebay is diverted directly to the DMC and SLC without being pumped into the reservoir. Reclamation monitors water quality in the O'Neill Forebay (Check 13) on a monthly basis (B. Moore 2001, pers. comm.). Water from the MPG wells cannot be pumped directly to the SLR for storage.

Storage in the SLR shows a seasonal pattern corresponding to filling during the winter and release for use during the summer months. Typically, federal storage in SLR reaches its maximum in March-April of each year (Figure 3-2) (DWR 2002d). Minimum storage generally occurs in August. Between 1981 and 2002, the median available federal storage in SLR in March-April was 15,900 acre-feet. Prior to 1991, available federal storage was highly variable, since then available storage has been more uniform. Between December 2000 and March 2001, federal storage exceeded its available capacity by up to 78,800 acre feet. However, available federal storage in the reservoir has been at least 4,150 acre-feet in all other years.

3.3.1.2 San Luis Canal (California Aqueduct)

The SLC is the joint state-federal portion of the California aqueduct that extends from the O'Neill Forebay to the southern end of the San Joaquin Valley. The SLC is used to transport water to the west side of the San Joaquin Valley for use by CVP and SWP contractors (Interior 1999). SLWD and WWD divert water from the SLC for irrigation. The capacity of the Dos Amigos Pumping Plant, located downstream of the SLR, is 15,450 cfs. The federal share of the plant capacity is approximately 7,357 cfs, or approximately 14,600 acre-feet per day (Kiteck 2002).

Monthly average flows in the federal portion of the SLC between 1981 and 2002 are shown in Figure 3-3. The maximum federal flow observed in this period was 5,272 cfs; the median flow was 1,337 cfs. Maximum federal flows in the SLC generally occur in June to August. Typically, flows during the peak irrigation season (May to August) average 2,920 cfs, or approximately 40 percent of the maximum capacity. Available federal capacity in the SLC ranges from 2,085 to 7,357 cfs as a monthly average, with a median value of 6,020 cfs.

3.3.1.3 Delta-Mendota Canal

The DMC is a CVP facility that conveys water from the Delta to the Mendota Pool and is the primary source of water to the Mendota Pool. Water from the Delta is diverted at the CVP Tracy Pumping Plant and conveyed 117 miles south to the Mendota Pool (Jones and Stokes 1995). The original design capacity of the DMC is 4,600 cfs at the Delta and 4,200 cfs at O'Neill Forebay (Check 13), decreasing to 3,200 cfs at the DMC terminus at the Mendota Pool. Current actual capacities are 4,600 cfs, 4,150 cfs, and 2,950 cfs, respectively.

Upstream of Check 13, the water in the DMC is used as both a domestic water source and for irrigation. At Check 13, water for domestic uses and irrigation is diverted to the SLR or SLC. Water that flows in the DMC downstream of Check 13 is used for agricultural purposes only. Water in the DMC is used to irrigate lands along the west side of the San Joaquin Valley and to replace some of the riparian diversions from the San Joaquin River that have been eliminated since the construction of Friant Dam (Millerton Reservoir). Some of the water delivered to WWD is conveyed to the Mendota Pool via the DMC, but WWD does not divert water from the DMC directly. WWD receives water from the Pool via Laterals 6 and 7.

3.3.1.4 San Joaquin River

The majority of flow in the San Joaquin River upstream of the Mendota Pool is diverted out of the San Joaquin River at the Friant Dam (Millerton Reservoir) (Figure 1-1). Construction and operation of Friant Dam and Millerton Reservoir in 1944 as part of the CVP and water diversions to the Friant-Kern and Madera Canal distribution systems essentially depleted flows in the San Joaquin River between Friant Dam and Mendota Pool. In general, the San Joaquin River is dry downstream of Gravelly Ford during most years, except during periods of heavy snowmelt and flood releases. Typically, releases from Friant Dam are only sufficient to provide minimal irrigation water supplies. Starting in 1999, additional water has been released intermittently from Friant Dam and discharged into the San Joaquin River in an effort to restore upstream riparian areas (Central Valley Regional Water Quality Control Board 2002). Water diversions for agricultural production throughout the valley, reduced natural streamflows, and discharges of subsurface agricultural drainage, municipal and industrial runoff, and surface return flows have had a major impact on San Joaquin River water quality below Friant Dam. Water quality ranges from good to poor depending on water conditions and the volume of drainage water. The river reach immediately below the Mendota Pool flows year round because of releases from the Mendota Dam to meet water rights of the SLCC, one of the

Exchange Contractors, at the Arroyo Canal (Jones and Stokes 1995). Downstream of the Arroyo Canal to Bear Creek, the San Joaquin River is dry throughout the summer months.

Below the confluence with Bear Creek at Lander Avenue, elevated concentrations of salt and trace elements such as boron and selenium have been reported in samples from the San Joaquin River. Drainage from the Grasslands Watershed, FCWD, CCID, CCC, and SLCC enters the San Joaquin River below Bear Creek. The lower San Joaquin River watershed downstream of Mendota Dam to Airport Way Bridge near Vernalis (130 river miles) is listed as an impaired waterway under Section 303(d) of the Clean Water Act for salinity and boron, as well as other constituents. Water quality criteria for salinity (as EC) and boron at the Airport Way Bridge have been established. The portion of the San Joaquin River from Salt Slough to the Airport Way Bridge (50 river miles) is listed as an impaired waterway under Section 303(d) of the Clean Water Act for selenium.

3.3.1.5 Mendota Pool

The Mendota Dam is a nonfederal facility owned and operated by the CCID. The dam is located downstream of the confluence of the San Joaquin River and Fresno Slough and forms the Mendota Pool (Figure 2-1). The Mendota Pool is generally considered to extend to the south past the MWA to the terminus of the James Bypass. In the San Joaquin River branch, the Mendota Pool extends almost to San Mateo Avenue. The Mendota Pool is generally less than 10 feet deep and averages about 400 feet wide. The total capacity of the Mendota Pool is about 8,500 acre-feet (J. Martin 2001, pers. comm.).

The SLDMWA manages the Mendota Pool and maintains the water level in the Mendota Pool so that its contractors and prior water right diverters may redivert water imported via the DMC. Reclamation has contracts to deliver 936,631 acre-feet per year of water through the Mendota Pool. This water is diverted to the users by canals, pumping plants, and downstream releases to the San Joaquin River. Up to 840,000 acre-feet per year are used to replace San Joaquin River water that is diverted at Friant Dam. Reclamation also delivers water through the Mendota Pool to satisfy the prior rights of JID (45,000 acre-feet per year), TID (34,000 acre-feet per year), and the MWA (30,000 acre-feet per year), as well as a portion of the water contract for WWD (Jones and Stokes 1995). WWD can take up to 50,000 acre-feet of provisional CVP water per year from the Mendota Pool.

Most of the diversions from the Mendota Pool occur in the northern portion of the Fresno Slough branch north of Transect A-A’ (Figure 3-4) by the SJREC. Transect A-A’ is an artificial dividing line located east of the Firebaugh Intake

Canal. This transect location is between the SJREC intake canals and the outlets of the northernmost MPG wells along the Fresno Slough. Flow direction in the Slough was monitored at this location in 1999. The Mendota Pool is drained approximately every other year by CCID to allow maintenance on Mendota Dam. The Mendota Pool was drained by CCID from late November 1999 until January 2000 and from late November 2001 until January 2002.

In order to clarify discussions of surface water in the Mendota Pool and groundwater near the Mendota Pool, it is necessary to define distinct areas. The following definitions take into account the surface water sampling stations and the locations of both MPG and non-MPG wells in the region. The Mendota Pool and lands near the Mendota Pool and the San Joaquin River discussed in this report are grouped into the following areas:

1. San Joaquin River branch of the Mendota Pool – This area encompasses the San Joaquin River from the eastern portion of the Mendota Pool (west of San Mateo Ave.) to its confluence with the Fresno Slough near Mendota Dam. This region includes the Columbia Canal surface water sampling station and the MPG wells in FWD, which pump into this branch of the Mendota Pool.

2. Northern Fresno Slough – This area extends from Mendota Dam south to the center of the MPG well field along the Fresno Slough (just north of Etchegoinberry). This includes the Dam, the DMC, the CCID Main and Outside Canals, and the Firebaugh Intake Canal. It also includes the northern portion of the MPG well field.

3. Central Fresno Slough – This extends from Etchegoinberry south to the northern boundary of the Five Star and Coelho West well fields adjacent to Whitesbridge Road (Highway 180). This area includes the southern portion of the MPG well field along the Fresno Slough. It also includes the Mendota Biomass production well.

4. Southern Fresno Slough – This encompasses all areas south of Whitesbridge Road and includes the MWA, Laterals 6 and 7, and the James Bypass. The Five Star and Coelho West wells located immediately north of Whitesbridge Road are also included in this region.

5. West of Fresno Slough – This area encompasses those lands that lie south of Bass Avenue and west of the MPG wells along the Slough. It includes the USGS well clusters, the Hansen Farms well, and the Meyers Farming monitoring wells S-1 to S-3.

6. East of Fresno Slough – This area encompasses those lands that lie south or west of FWD, and east of the Fresno Slough. The Spreckels Sugar Co., BB Limited, and new City of Mendota wells lie in this area.

7. North of Mendota – This area includes lands that are situated north of Bass Avenue (at the northern edge of the City of Mendota) and west of the Fresno Slough and the San Joaquin River. The older City of Mendota, CCID, and Locke Ranch wells lie in this area.

8. North of San Joaquin River – This area is bounded on the south by the San Joaquin River branch of the Mendota Pool, on the west by the San Joaquin River downstream of Mendota Dam, and on the east by the Chowchilla Bypass. This area includes the NLF and CCC wells in Madera County.

9. East of Chowchilla Bypass – This area encompasses the eastern portion of the study area in both Madera and Fresno Counties. It includes portions of Aliso and Gravelly Ford Water Districts as well as undistricted areas.

3.3.1.6 WWD Distribution System

Since 1972, WWD has implemented water conservation practices. These practices have included:

- Preparation of a "Irrigation Management Handbook" that contains information on soil and crop characteristics, irrigation scheduling, and water use planning;
- Preparation of a "Water Conservation Plan;"
- Preparation of an "Irrigation Guide" that provides information on crop water use on a weekly basis;
- Distribution of water via a pipeline based system to minimize evaporative and seepage losses;
- Metering of all water intakes and deliveries;
- Establishment of a "Groundwater Management Plan;"
- Improved irrigation systems;
- Development of tailwater reuse systems; and

- Provision of low-interest loans to facilitate improvements in irrigation systems.

WWD supplies CVP water to farmers in the district through a 1,034-mile system of underground pipes varying from 10 inches to 96 inches in diameter. WWD maintains all conveyance facilities and equipment. Conveyance losses are small because of the closed system and intensive preventive maintenance. All water deliveries are measured by meters at the SLC and the Mendota Pool, at each diversion lateral, and at each field outlet. All meters are tested at least once every four years. Water is delivered to farmers based on water orders placed the previous day. At the scheduled time, a farmer opens the valve at the delivery point to obtain the approved flow (Jones and Stokes 1995).

The overall irrigation efficiency in WWD is estimated to be 83 percent (WWD 2001), which is one of the highest in the nation. Farmers are surveyed annually to determine the types of on-farm irrigation systems used. The available data through 2000 indicate that less than one-third of the district is irrigated by surface systems (furrows 28 percent and border strips 2 percent). The remaining farms use pressure systems (sprinklers 14 percent and drip irrigation 13 percent) or a combination of pressure and surface systems (sprinkler/furrow 43 percent) (WWD 2001). Currently, 29 percent of the surface-irrigated fields use tailwater (surface runoff) recovery and reuse systems (J. Robb, 2001, pers. comm.). Throughout WWD, no water is allowed to leave the water user's fields.

3.3.1.7 Mendota Pool Water Budget

Water quality conditions in the Mendota Pool are the result of the quantity and quality of the various inflows and outflows of water from the delta (via the DMC) and intermittent inputs from the San Joaquin River, Fresno Slough, James Bypass, Panoche Creek, and seasonal groundwater pumping to the Mendota Pool. The major inflows and outflows considered in the water budget are shown in Figure 3-4. Inputs to the Mendota Pool shown in this figure include the DMC, the San Joaquin River, and the MPG wells.

Water budgets for 1997 through 2000 for the northern and southern portions of the Mendota Pool were prepared as part of the Phase I study report and the 2000 Annual Report (KDSA and LSCE 2000a, LSCE and KDSA 2001). A similar water budget for 2001 for the southern portion of the Mendota Pool was prepared as part of the 2001 Annual Report (LSCE and KDSA, 2002). Water budgets for the 1997 through 2001 irrigation seasons (May to September) are summarized in Table 3-2. The primary input in the southern portion of the Fresno Slough during wet years such as 1998 is the James Bypass, which shunts water from the Kings River to the southern end of

Fresno Slough. The dominant water inputs to the Mendota Pool during the rest of 1997 through 2001 came from the DMC, which accounted for over 80 percent of the total inflows. The primary outflows in the southern portion of the Mendota Pool are diversions by JID and TID, the MWA, and WWD (via Lateral 6 and 7). Seepage was estimated from measurements made over a 2-day period in November 1999 and is assumed constant.

Flows through the Mendota Pool show clear seasonal trends and are much larger during the summer months (except during periods of flood flows), although the timing and magnitude of the flows vary between years (Figure 3-5). The seasonal pattern is particularly evident in the northern portion of the Mendota Pool. Inflows to the northern Mendota Pool generally peak at approximately 3,000 cfs during the June-September time period. Measured outflows from the northern Mendota Pool were generally less than the inflows, with the exception of winter 1997 and spring 1998 when flood flows from the James Bypass into the southern Mendota Pool caused a northward flow in the Fresno Slough branch of the Mendota Pool. However, during most of the year, measured outflows from the southern Mendota Pool were generally greater than inflows. This pattern results in a net flow to the south in the Fresno Slough branch of the Mendota Pool for most of the year. Flow direction and magnitude across Transect A-A' is shown in Figure 3-5 for 1999 through 2001. During this period, only ten short-term flow reversals (i.e., northerly flow events) were identified. The north flow events in November-December 1999 and November-December 2001 were due to deliberate draining of the Mendota Pool to allow the dam to be inspected.

During MPG pumping events, inflows from the MPG wells generally comprised less than 10 percent of the total inflows to the Mendota Pool. In 1999 and 2000, the MPG contribution averaged 1 percent of the total inflow during the spring, 4 percent during the summer, and 2 percent in the fall.

3.3.2 Surface Water Quality

The MPG, in conjunction with NLF and the SJREC, has monitored water quality at twelve locations in the Mendota Pool, DMC, and canals that divert water from the Mendota Pool (Figure 3-6) during the MPG pumping periods from 1999 through 2002. Surface water quality data obtained from the 2001 monitoring program and 2002 monitoring data through September 2002 are summarized in Table 3-3 for the primary parameters of concern. The sampling locations are generally listed in geographical order from northeast to south and are grouped according to geographic region (San Joaquin River Arm, Northern Fresno Slough, Central Fresno Slough, and Southern Fresno Slough). Primary constituents of concern are salinity (as EC and/or TDS), arsenic, boron, molybdenum, and selenium because of their potentially harmful effects on plants and wildlife. Samples were also analyzed for selected additional trace elements and general minerals. The surface water monitoring program is described in Appendix B. Complete surface water quality results for 1999 through 2001 are summarized in Appendix C. Where a chemical constituent was not detected in a sample, the value is shown as less than the analytical reporting limit (e.g., <0.4 μg/L).

Surface water quality criteria or guidelines were identified for water quality constituents of concern. Criteria were identified for arsenic, boron, molybdenum, selenium, TDS, and EC. Beneficial uses of surface water for which criteria or guidelines were identified include irrigation water, drinking water, wildlife refuge habitat, and aquatic life. For surface water, the following documents were reviewed:

- The Fourth Edition of the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins (CVRWQCB 1998)
- The Second Edition of the Water Quality Control Plan (Basin Plan) for the Tulare Lake Basin (CVRWQCB 1995)
- The U.S. EPA National Recommended Ambient Water Quality Criteria (AWQC) for freshwater aquatic life protection as reported in Marshack (2000)
- The preliminary draft water quality criteria for refuge water supplies developed by the Central Valley RWQCB (1995)
- Selenium ecological risk guidance provided by Reclamation in "Appendix E2 of the Draft Grassland Bypass Project Environmental Impact Statement and Environmental Impact Report Volume II" (Reclamation 2000)
- The FAO Irrigation and Drainage Paper No. 29, "Water Quality for Agriculture" (Ayers and Westcot 1985)

The criteria listed in Table 3-4 represent the most conservative (lowest) values reported in the reviewed documents, and care was taken to select those criteria that are most appropriate for the Mendota Pool area.

The following sections discuss the 2001 and available 2002 surface water quality data for arsenic, boron, molybdenum, selenium, and salinity (Table 3-3). Other water quality parameters, including chloride and sulfate, are closely related to salinity and would be expected to behave similarly to salinity; these are not evaluated further in this EIS.

3.3.2.1 Arsenic

The MPG began to analyze Mendota Pool surface water samples for arsenic in 2001, at the request of CDFG, primarily in the southern portion of Fresno Slough. At least one sample from each station was analyzed for arsenic (Table 3-3). The detection limit was 2 μg/L, except for the July 2001 samples, which were analyzed with a detection limit of 3 μg/L. Arsenic was tested for the first time at the Columbia Canal intake (on the San Joaquin River Arm of the Pool) in June 2002 and was detected at 3 μg/L.

Sampling stations in the Northern Fresno Slough include the Mendota Dam, CCID Main Canal, Mowry Bridge, DMC Check 21, CCID Outside Canal, Firebaugh Intake Canal, and West of Fordel. Arsenic was detected at or near the reporting limit in 7 of 22 samples tested in the Northern Fresno Slough. Arsenic was detected at least once at all stations except the CCID Outside Canal. Of the seven detects, five were in samples collected in June 2002.

Etchegoinberry is the only station in the central Fresno Slough. Arsenic was not detected in a sample collected in November 2001 but was detected at 3 μg/L in June 2002.

In the Southern Fresno Slough, data are available for MWA, Lateral 6&7, and JID (Booster Plant) stations. Of the twenty-two samples tested from these three stations, arsenic was detected in twelve samples. Detected levels were generally 4 μg/L or less, with one sample (5/30/2001) at the JID station containing 10 μg/L. Other arsenic concentrations at this station in 2001 and 2002 ranged from <2 to 3 μg/L. Therefore, the value of 10 μg/L is considered anomalous.

Of the beneficial uses identified for surface water, the lowest benchmark for arsenic is 10 μg/L (aquatic life protection, Table 3-3). CDFG recommends a target level of 5 μg/L arsenic in water supplied to the MWA, with a toxicity level of 10 μg/L. Arsenic concentrations in surface water were less than 5 μg/L in all but one sample collected in the Mendota Pool in 2001 and 2002.

3.3.2.2 Boron

Water samples have been analyzed for boron since 1999 at most surface water sampling stations. Water from the DMC is the primary source of trace elements such as boron in the Pool. Appendix C includes all available boron data for surface water stations in the Pool. Table 3-3 includes available data from 2001 and 2002, which are discussed in this section. Three samples were collected at the Columbia Canal station in the San Joaquin River arm of the

Mendota Pool in 2001 and 2002. Boron concentrations ranged from 0.16 to 0.2 mg/L in the three samples.

In the Northern Fresno Slough, thirty-three samples were collected from seven sampling stations. Boron was detected in twenty-seven of the samples. Concentrations ranged from 0.13 to 0.25 mg/L, with an average detected concentration of 0.19 mg/L. Boron concentrations in 2002 samples were lower than those collected in 2001.

At the Etchegoinberry sampling station in the Central Fresno Slough, boron was detected at 0.3 mg/L in November 2001 and at 0.18 mg/L in June 2002.

In 2001, samples were collected every month except September and December from the Southern Fresno Slough stations. Samples were collected three or four times during the pumping period in 2002 at these stations and one sample was collected at the TID intake in September. Concentrations ranged from 0.13 to 1.29 mg/L (this reading was from the TID sample). The average concentration of these forty-three samples was 0.29 mg/L. Excluding the TID sample, boron ranges from 0.13 to 0.41 mg/L, with an average concentration of 0.29 mg/L. Boron concentrations in the Southern Fresno Slough are similar in 2001 and 2002 for similar sampling dates.

The target level recommended by CDFG for boron for the MWA is 0.3 mg/L. Samples collected at the MWA in the spring of 2001 (February through May) and in November 2001 slightly exceeded this level, with the highest concentration (0.41 mg/L) occurring in April. MPG transfer pumping did not start until mid-May in 2001 and continued until mid-November prior to the Pool being drained. The boron concentrations recommended by CDFG are based on the water quality standards for the San Joaquin River at Vernalis and are lower than the criteria for other identified beneficial uses of Mendota Pool water.

3.3.2.3 Molybdenum

Analysis of surface water samples for molybdenum began in 2001 at the request of CDFG. Molybdenum was first tested in 2002 at the Columbia Canal intake and was detected at 5.1 μg/L.

Molybdenum data were collected at the seven Northern Fresno Slough stations in 2001 and 2002. Results indicate that molybdenum concentrations in the northern Slough ranged from <1.0 to 4.2 μg/L (Table 3-3). Except for the CCID Main Canal station, molybdenum concentrations were lower in 2002 than in 2001.

At the Etchegoinberry station in the central Slough, molybdenum was detected at 4.1 μg/L in 2001 and at 2.4 μg/L in 2002.

At the three stations in the southern Slough, molybdenum ranged from 1.0 to 8.4 μg/L, with lower concentrations measured in 2002 than in 2001.

All molybdenum concentrations were less than the target level recommended by CDFG for the MWA (10 μg/L) and much lower than the criterion for aquatic life protection of 19 μg/L. Molybdenum criteria have not been established for drinking water or irrigation uses.

3.3.2.4 Selenium

The Mendota Pool was included on California's Clean Water Act Section 303(d) list of water quality limited segments as impaired due to selenium in 2003.

As reported in the 2002 EA (Reclamation 2002), analytical data for selenium collected prior to June 2001 were not of adequate quality to be usable for comparing selenium concentrations to water quality guidelines. The detection limits were not low enough, and the method used for analysis was subject to interference. Because of these factors, it is possible that there were false positives, elevated concentrations, and false negatives reported for selenium prior to June 2001. To provide better accuracy in the evaluation of surface water quality, samples analyzed by laboratories other than Olson Biochemistry Laboratories, Frontier Geosciences, or Reclamation are not included in Table 3-3, nor are they included in the evaluation of selenium concentrations in surface water. (All available selenium data for surface water are included in Appendix C.)

Selenium was detected at low concentrations (3.32 μg/L or less) in 48 of 55 samples collected in 2001 and 2002 at stations in the northern Slough and analyzed by Olson Biochemistry Laboratories or Reclamation (Table 3-3). Selenium concentrations have been monitored by Reclamation at Check 21 on the DMC on a monthly basis since 1994, and in the CCID Main and Outside Canals since 1999 (B. Moore 2001, pers. comm.) (Figure 3-7). Detected concentrations at DMC Check 21 ranged from 0.5 to 3.32 μg/L. Samples from the CCID Outside Canal ranged from non-detect (<0.4 μg/L) to 2.69 μg/L. Samples from the CCID Main Canal ranged from <0.4 μg/L to 2.96 μg/L. Selenium concentrations at the CCID canals tracked those of the DMC fairly consistently over the period evaluated. This is expected because most of the water diverted by the CCID canals enters the Mendota Pool via the DMC. The highest selenium concentration detected in 2002 in the northern Slough was

1.19 μg/L at the DMC Check 21 in June 2002. Most selenium concentrations were less than 1.0 μg/L in 2002.

Data collected in 2001 at the Columbia Canal intake on the San Joaquin River arm of the Pool are not of adequate quality for this evaluation. Data collected in June 2002 are of adequate quality; selenium was detected at 0.71 μg/L at this station.

At Etchegoinberry (central Slough), selenium was measured at 0.47 μg/L in November 2001 and at 0.67 μg/L in June 2002.

At the three southern Fresno Slough stations, selenium was detected in 12 of 13 samples analyzed by Olson Biochemistry Laboratories at concentrations ranging from 0.048 to 0.95 μg/L.

The detected levels at the southern Slough stations are two orders of magnitude lower than drinking and irrigation water criteria, which are both 50 μg/L. The criterion for protection of aquatic life and the CDFG recommended target level for the MWA are both 2 μg/L. No selenium concentrations measured in the Mendota Pool in 2002 exceeded this target level.

3.3.2.5 Salinity

Grab surface water samples are collected monthly at the CCID Main Canal and DMC Check 21, and during and at the end of the pumping season at the other stations. Results of grab samples collected in 2001-2002 are summarized in Table 3-3. In addition to collection of surface water grab samples at thirteen locations around the Mendota Pool, EC is currently monitored using continuous recorders at Check 21 near the DMC terminus and at the intakes to the CCID Main Canal, CCID Outside Canal, Columbia Canal, the Firebaugh Intake Canal, and the MWA (starting in 2002).

TDS concentrations in the Mendota Pool (either measured directly or estimated from EC data) vary widely and are seasonally influenced. At the Columbia Canal intake, TDS was measured once at 240 mg/L (June 25, 2002). TDS results for surface water stations in the Northern Fresno Slough ranged from 210 to 479 mg/L in 2001-2002. At the Etchegoinberry station in the Central Slough, TDS was measured at 500 mg/L in November 2001 and at 280 mg/L in June 2002. Measured TDS concentrations in the southern Slough ranged from 280 mg/L at the MWA in July 2002 to 1,080 mg/L at the TID intake station in September 2002. TDS tends to be higher in the Southern Fresno Slough region. TDS measured at MWA, Lateral 6 & 7, and JID stations were generally lower in July-September 2002 than in the same period in 2001.

Reclamation has monitored EC at the terminus of the DMC since 1965. Based on thirty-seven years of daily data (1965–2001), the average EC at the terminus of the DMC is 618 µmhos/cm. EC measurements tend to be highest in the spring, lowest during the early summer (June - July), and increase steadily through the fall. Variability can be seen between water year types with the dry years tending to have the highest EC values during the summer, followed by normal and wet years. Normal water years tend to have higher EC measurements in the winter and spring than the other classifications.

EC concentrations in the Pool are highly variable over time and generally track the concentrations in the DMC. EC data from the DMC terminus are converted to TDS concentrations using a regression equation derived from the relationship between EC and TDS measured in surface water samples from the Mendota Pool in 2000-2001.

The daily mean EC values at the terminus of the DMC for the period from January 1999 through October 15, 2001 are plotted on Figure 3-8. The daily mean EC ranged between 285 and 1,256 µmhos/cm and averaged 483 µmhos/cm between January 1999 and October 2001.

Figure 3-9 shows the daily mean EC value at each of the five SJREC canal intakes from February 2000 to September 2001. The variation between the intakes averages 99 µmhos/cm, and ranges from 3 to 414 µmhos/cm. This variation is greatest during the spring months. Throughout most of the summer and fall months, differences between the daily average EC at the various intakes are relatively small. Water quality at the canal intakes generally tracks that of the DMC.

Certain canal intakes exhibited short-term elevated EC values as compared to the DMC. Daily average EC readings at the DMC were subtracted from concurrent daily average readings at the SJREC canal intakes to determine the magnitude of the deviations. The calculated deviations from the DMC for both the 2000 and 2001 pumping periods and non-pumping periods are summarized in Table 3-5. Negative values indicate that the EC at the canal intake is lower than the EC at the DMC. Both during the MPG pumping periods and periods when the MPG wells were not pumping, the range of deviations at all of the canals bracketed zero. The average deviations for the CCID Main Canal and the Firebaugh Intake Canal showed slightly poorer water quality (i.e., increased EC) during the MPG pumping period, the average deviation for the Columbia Canal showed slightly better water quality, and the CCID Outside Canal showed no difference. The observed deviations are variable and do not show any consistent pattern during MPG pumping periods.

The sodium absorption ratio (SAR) was calculated for those samples in which sodium, calcium, and magnesium were measured. The SAR provides an indication of the influence of salts in the water on soil permeability (Stromberg, undated). The SAR must be evaluated together with the salinity of the water to determine if the salt concentrations would be expected to impact the infiltration rate. A high SAR value will not impact the infiltration rate if the salinity of the water is also high. In *Water Quality for Agriculture* (Ayers and Westcot 1985), water is grouped into three classes (no restriction, slight to moderate restriction, and severe restriction) based on the degree of impairment for irrigation purposes due to the combined SAR and salinity values.

In the San Joaquin arm of the Mendota Pool, a SAR value of 1.6 was calculated in June 2002 (Table 3-3). SAR values ranged from 0.1 to 3.6 in the northern Slough region in 2001-2002. At the central Slough station, SAR values were 4.7 and 1.9 in November 2001 and June 2002, respectively. In the southern Slough, SAR values ranged from 0.1 to 12.2. The 12.2 SAR value was from TID. The highest value at the other three southern Slough stations was 6.4 at JID in April 2001. At the MWA, SAR values ranged from 0.1 to 6.2. All of these SAR values are relatively low, but the salinity of the samples was also low. Therefore, all of the surface water samples would be classified as slightly to moderately impaired for irrigation use based on SAR. Based on salinity alone (measured as TDS), 60 percent of the samples would be classified as non-impaired and 40 percent as slightly to moderately impaired.

The lowest water quality criterion for TDS is a target level of 400 mg/L as a 5-year average for Refuge Water Supply (Table 3-4). The 1-year average target level is 450 mg/L, and the monthly average is 600 mg/L. TDS at the MWA exceeded 600 mg/L in two samples collected in 2001 and in none of the samples collected to date in 2002. The 1-year TDS average based on grab samples was 501 mg/L in 2001, and in 2002 is 398 mg/L.

3.3.2.6 Summary of Surface Water Quality

The DMC is the primary/dominant source of surface water in the Mendota Pool, and therefore it largely controls the surface water quality. There is a north to south gradient in water quality in the Fresno Slough in concentrations of TDS/EC, boron, and molybdenum. In general, surface water quality was better in 2002 than in 2001, as indicated by lower concentrations of most target constituents.

3.4 GROUNDWATER SYSTEM

3.4.1 REGIONAL HYDROGEOLOGY

The proposed action will be implemented within the San Joaquin Valley, which represents the southern two-thirds of the Central Valley, a structural trough about 400 miles long and 50 miles wide (WWD 1996). This trough is filled with thousands of feet of unconsolidated alluvial and marine sediments, the top 2,000 feet of which includes the aquifers penetrated by almost all water wells in the area. Streams and rivers flowing out of the adjacent mountains on both the east and west deposited the alluvial sediment, which varied in composition from coarse sand and gravel to fine silt and clay. As the alluvial sediments in the trough accumulated, the San Joaquin Valley occasionally contained large lakes or seas that resulted in the deposition of laterally extensive clay layers.

The Sierra Nevada, California’s largest mountain range, borders the east side of the San Joaquin Valley and is predominantly composed of uplifted granitic rock overlain in areas by sedimentary and metamorphic rock. Alluvial deposits resulting from the erosion of the Sierra Nevada consist primarily of sands, with variable amounts of silt and clay. Within the San Joaquin Valley, this alluvium decreases in thickness and increases in depth below the surface toward the west. These coarse-textured sediments are characterized by high permeability and a low concentration of water soluble solids.

The Diablo Range of the California Coast Ranges borders the west side of the San Joaquin Valley and consists of complex, folded, and uplifted mountains that are composed predominantly of sandstones and shales of marine origin. These sandstones and shales contain salts, as well as trace elements such as selenium. Sediments eroding from these mountains form gently sloping alluvial fans. The texture of these deposits depends on their relative position on the alluvial fan, but generally grades from coarse sand and gravel close to the mountains to fine silt and clay to the east. The fine textured sediments are characterized by low permeability and increased concentrations of water soluble solids, primarily salts and trace elements. The alluvial sediments from both mountain ranges interfinger extensively in the western half of the Valley.

One of the principal subsurface hydrogeological features of the San Joaquin Valley is the Corcoran Clay formation. Formed as a lake bed about 600,000 years ago, this clay layer ranges in thickness from 20 to 200 feet and occurs throughout all but the eastern and western margins of the San Joaquin Valley. Varying in depth from 300 to 500 feet in the valley trough to 850 feet along the Diablo Range, the Corcoran Clay divides the groundwater system vertically into two major aquifers, a lower, confined aquifer system and an upper, semi-confined aquifer system.

In addition to the clay layers centered around the Tulare Lake bed, the central axis of the San Joaquin Valley is capped by surficial flood-basin deposits created by geologically recent flooding along the San Joaquin River and Fresno Slough. Although these deposits are generally only 5 to 35 feet thick, their fine texture and low permeability greatly restrict downward movement of water, including seepage from overlying surface water bodies such as the San Joaquin River, Fresno Slough, and the Mendota Pool.

3.4.2 MENDOTA POOL AREA

As within most of the San Joaquin Valley, the Corcoran Clay divides the groundwater system in the Mendota Pool area and WWD vertically into an upper semi-confined aquifer system, and a lower, confined aquifer system, separated by the Corcoran Clay. Near the Mendota Pool, groundwater pumping occurs primarily from the upper semi-confined aquifer.

3.4.2.1 Upper Aquifer System

Near the Mendota Pool, most of the wells are completed entirely above the Corcoran Clay and, therefore, almost all of the groundwater pumped in this area is from the upper, semi-confined aquifer system. Although there are several clay layers of sufficient thickness and continuity to substantially impede vertical movement of groundwater in the upper aquifer system in the general vicinity of the Mendota Pool, the clay layer that creates the greatest limitation on vertical groundwater flow is a shallow, subsurface clay layer usually 10 to 15 feet thick that is identified frequently in the lithologic logs from wells near the Mendota Pool. This layer has been termed the A-clay and acts as a confining bed between the shallow and deep portions of the aquifer system overlying the Corcoran Clay. In the Mendota Pool area, the A-clay is generally encountered at depths between 70 and 100 feet below ground surface. This clay is locally missing in some areas and is commonly present in two layers in the area east of the Fresno Slough. The A-clay pinches out to the west near the Mendota Airport and to the east, east of San Mateo Road.

Vertical flow between the shallow and deep water-bearing zones of the upper aquifer system is limited by the vertical hydraulic conductivity of the A-clay (where it is present) and other shallow clay layers. The vertical hydraulic conductivity for the A-clay was estimated to be 0.024 gpd/ft^2 based on a 14-day aquifer test at a well located northwest of Mendota at the Arbios facility (KDSA 1989). Near the San Joaquin River branch of the Mendota Pool, groundwater quality in the shallow water-bearing zone is good due to recharge from the Mendota Pool. In areas west of the Fresno Slough, however, the quality of the shallow groundwater is poor due to naturally occurring saline groundwater and agricultural drainage. The shallow groundwater quality improves near the Slough and is better at the northern end of the Slough. East of the Slough, groundwater quality degradation has occurred in the vicinity of Spreckels Sugar Co.

Wells primarily completed in strata above the A-clay, or the equivalent depth of this clay (generally less than 130 feet), are termed “shallow” in this EIS. Wells completed in strata below the A-clay, or its equivalent depth, but above the Corcoran Clay, are termed “deep”. The majority of the MPG wells along the Fresno Slough branch of the Mendota Pool are shallow. All MPG wells along the San Joaquin River arm of the Mendota Pool are deep.

3.4.2.2 Lower Aquifer System

The lower aquifer system is the confined zone beneath the Corcoran Clay, which is considered to be continuous throughout the Mendota area. The Corcoran Clay acts as a relatively effective barrier to vertical flow between the upper and lower aquifers due to its thickness and low permeability. In the vicinity of the Mendota Pool, no production wells are screened entirely in the lower aquifer, although there are a few “composite” wells (screened above and below the Corcoran Clay) near the San Joaquin River branch of the Mendota Pool. The number of composite wells increases east of the Chowchilla Bypass, especially in Madera County, and there is a significant amount of pumpage from the lower aquifer in this area. The lower aquifer is also tapped extensively by wells in Panoche WD and WWD west of the study area.

At the USGS monitoring well cluster west of the Mendota Airport, monitoring well 31J6 is completed below the Corcoran Clay. Even though most of the pumpage in the Mendota area is from the upper aquifer, water levels are considerably lower below the Corcoran Clay due to pumpage from the lower aquifer both east and west of the Mendota area. The downward vertical gradient across the Corcoran Clay averaged 0.8 foot/foot at this location in 2001.

3.4.2.3 Hydraulic Connection between Surface Water and Groundwater

The hydraulic connection between surface water in the Mendota Pool and groundwater differs between the Fresno Slough and the San Joaquin River arms of the Mendota Pool. Since at least the late 1980s, an unsaturated zone has apparently been present beneath the Fresno Slough branch of the Mendota Pool and was initially caused by drought conditions as well as geologic factors

(Woodward-Clyde Consultants 1994). These factors include the presence of a clay layer beneath the Mendota Pool and the accumulation of silts and other fine sediments on the bottom of the Mendota Pool.

The shallow clay layer observed near the Fresno Slough branch by earlier investigators would limit the percolation rate of water from the Slough and reduce the effect of groundwater pumping on percolation even during periods when there is a direct hydraulic connection between shallow groundwater and surface water in the Slough (Jones and Stokes 1995). Furthermore, the Slough has accumulated a bed of clay and silt since Mendota Dam was constructed in 1863 that would also limit percolation (Jones and Stokes 1995). Much of the silt may have been carried in from the DMC after its construction in 1951. Contour maps of shallow groundwater levels produced by KDSA and LSCE (2000a) show no evidence of a groundwater mound beneath the Slough even when no shallow pumping is occurring, which suggests that there is less seepage from this branch of the Pool. Water levels in shallow wells near the Slough are consistently lower than the bottom of the Slough, indicating the absence of a direct hydraulic connection between the Slough and shallow groundwater.

Prior to the installation of shallow monitoring wells near the San Joaquin River arm of the Mendota Pool by NLF in 1999, data were not available to determine the degree of hydraulic connection in this area. Based on data from the shallow monitoring wells, the shallow groundwater contour maps show a groundwater mound beneath the San Joaquin River arm of Mendota Pool. The presence of this mound and the relatively shallow groundwater water levels in these monitoring wells suggest that a direct connection between surface water and groundwater exists in this area. This may be partially the result of the reestablishment of summer flows in this portion of the San Joaquin River in 1999 and 2000.

Water level data from shallow NLF monitoring wells indicate that deep zone pumping in NLF and FWD has only a minimal effect on the shallow portion of the upper aquifer, due to the presence of confining layers such as the A-clay. MPG pumping from the deep zone is therefore unlikely to cause significant seepage from the San Joaquin River.

3.4.2.4 Groundwater Levels

Groundwater levels in a large number of wells in the Mendota area have been monitored at least bimonthly by the MPG and NLF since 1999. Historical water level data are also available for some of these wells. Both the recent and historical data have been used to create groundwater elevation contour maps and water level hydrographs, which are contained in the Phase I Report

(KDSA and LSCE 2000a) and the 2000 through 2003 Annual Reports (LSCE and KDSA 2001-2003). Groundwater contour maps prepared since 1999 indicate that the areal extent of drawdowns caused by MPG shallow zone pumping is generally limited to the vicinity of the well field along the Fresno Slough because the shallow aquifer is primarily unconfined. These drawdowns do not extend as far north as the San Joaquin River. Deep zone drawdowns extend much further from the pumping wells because the deep aquifer is much more confined. Drawdowns caused by deep wells located near the San Joaquin River extend on both sides of the River, i.e., drawdowns caused by wells in Madera County extend into Fresno County and drawdowns caused by wells in Fresno County extend into Madera County. Simulations of MPG deep zone transfer pumping conducted with the groundwater model indicate that these drawdowns would extend a maximum of 3.5 miles from the center of the MPG wells in FWD.

Hydrographs of wells included in the monitoring program indicate that, at present, groundwater overdraft is not occurring in the southern and western portion of the study area. Small residual drawdowns have occurred in some of the FWD wells in recent years, however, especially in wells near the San Joaquin River. These wells are affected by lack of recharge from the River in recent years and by overdraft occurring north of the River in Madera County. Water levels in MPG deep wells west of the Fresno Slough have recovered fully in recent years. Water levels in most non-MPG deep wells west of the Slough and the River have also exhibited full recovery. This includes the CCID, FCWD, and City of Mendota wells. The only deep wells in this area showing small residual drawdowns are the USGS monitoring wells west of the Mendota Airport.

Overdraft has occurred for decades in the northeastern portion of the study area in Madera County. The overdraft is indicated by steadily declining groundwater levels in wells monitored historically by Reclamation and DWR and more recently by NLF and the MPG. The approximate locations of the overdrafted areas are indicated by cones of depression shown on groundwater elevation contour maps prepared by DWR (Figure 3-10). In 1989, the center of the southernmost cone of depression east of the Chowchilla Bypass was located approximately 10 miles north of the San Joaquin River. By 1999, the cone of depression had expanded in a southerly direction so that the center was only about 8 miles north of the River. The expansion of the cone of depression is primarily due to additional wells and increased pumping resulting from land use changes in the area during the past decade. During this period, a significant amount of acreage was converted from native vegetation and crops such as grain to crops such as almonds, grapes, and alfalfa, which have much higher water requirements. Most of this area has limited surface water rights and relies primarily on groundwater. Increased pumping in the area causes overdraft due to geologic conditions and the lack of adequate surface water recharge. Lack of flow in the San Joaquin River downstream of Gravelly Ford since construction of Friant Dam in 1944 is a significant factor. Agricultural and urban pumpage in Madera County estimated by DWR in Bulletin 118 for 2003 are approximately 551,000 acre-feet per year and 15,000 acre-feet per year, respectively. The sum of natural and applied water recharge is estimated to be 425,000 acre-feet per year, which leaves a deficit of approximately 141,000 acre-feet per year.

The area affected by historical overdraft is primarily east and north of the NLF and CCC service areas, but lack of full recovery in NLF and CCC wells in recent years indicates that this overdraft has been spreading to the south and west. Although the determination of overdraft conditions requires a longer period of record than is available for most wells, water level data collected since 1999 indicate that deep wells in the eastern and northern portions of NLF and CCC, adjacent to the historically overdrafted areas, have also experienced overdraft in recent years. MPG transfer pumping does not contribute measurably to this overdraft because these areas are generally beyond the maximum extent of water level impacts caused by MPG pumping.

Deep wells in the western and southern portions of NLF and CCC have also experienced residual drawdowns since 1999, and the potential for overdraft appears to be high throughout the NLF and CCC service areas. Although some of these wells are closer to the MPG wells in FWD, MPG transfer pumping does not appear to be a major factor in causing overdraft in this area. Hydrographs included in the 2000 to 2002 Annual Reports suggest that both drawdowns and residual drawdowns occurring in the NLF wells since 1999 are largely independent of the volume of MPG transfer pumping. For example, drawdowns in NLF wells were similar during periods when deep zone MPG transfer pumping was large (15,600 acre-feet in 2001) or small (3,700 acre-feet in 2002 and zero in 2003). Residual drawdowns in most NLF wells after the 2001 and 2002 irrigation seasons were also similar, even though MPG deep zone transfer pumping was much larger in 2001. Although the MPG conducted no transfer pumping in 2003, it appears that the residual drawdowns will be similar to previous years. This will be further evaluated at the end of year.

In the shallow zone, historical water level data are more limited, and the period of record is insufficient to determine conclusively that long-term overdraft is occurring in certain areas. Data collected since 1999 from shallow monitoring wells north of the San Joaquin River in NLF and CCC indicate that overdraft is probably occurring in the shallow zone in the northern portion of the study area. This area receives little surface water recharge, and drawdowns caused by deep zone pumping propagate to the shallow zone because the A-clay is apparently absent. Water levels in monitoring wells in the eastern portion of NLF near the San Joaquin River also show indications of overdraft because this reach of the River has not had significant flow since January 2001. Only the shallow NLF and CCC monitoring wells near the San Joaquin River arm of the Mendota Pool have not shown signs of overdraft since 1999.

Water level data from shallow wells in the western portion of the study area indicate that overdraft is not occurring in this area. Although a number of shallow wells experienced small residual drawdowns after the 2000 and 2001 irrigation seasons, most of these wells experienced full recovery after 2002. This includes the shallow MPG wells along the Fresno Slough arm of the Pool and monitoring wells near the Meyers Farm Water Bank at Spreckels Sugar Co. Only the shallow USGS monitoring wells west of the Mendota Airport, which are too far from the Pool to receive surface water recharge, showed small residual drawdowns at the end on 2002.

3.4.2.5 Lateral Groundwater Flow

Historical water level data indicate that the direction of groundwater flow in the Mendota area under predevelopment conditions was toward the San Joaquin River and Fresno Slough from both directions (east and west) When this groundwater reached the trough of the Valley, it either discharged to the River or Slough or flowed to the northwest (generally parallel to the River).

Groundwater flow directions can be inferred from regional groundwater elevation contour maps produced by DWR. A recent groundwater contour map for the Madera groundwater basin, obtained from DWR (Spring 1999) is shown on Figure 3-10. Similar to maps for previous years, this map shows a large cone of depression in western Madera County east of the Chowchilla Bypass. The DWR maps probably exaggerate the depth and areal extent of this cone of depression because data from a number of composite wells (completed above and below the Corcoran Clay) are used for contouring in this area. This map suggests that the majority of the groundwater that flows into overdrafted areas of western Madera County comes from the southeast, where it originates as recharge from the San Joaquin River east of Gravelly Ford. The San Joaquin River below Friant Dam generally has flow only as far west as Gravelly Ford, and this is a losing reach of the river (i.e., the river stage is higher than shallow groundwater levels so that recharge from the river flows to the shallow aquifer). The riverbed is very permeable in this area, and the volume of groundwater recharge is relatively large. The Fresno River north of the cone of depression also provides groundwater recharge when it is flowing.

The cone of depression in the overdrafted areas of Madera County results in groundwater flow into these areas from all directions. North of Mendota Dam, this cone of depression is largely responsible for the northeasterly direction of groundwater flow on the east side of the San Joaquin River and steeper gradients west of the River. East of Mendota Dam, a groundwater divide exists beneath the San Joaquin River (Figure 3-10). North of the San Joaquin River, groundwater flows north into the overdrafted portion of western Madera County. South of the San Joaquin River, groundwater flows southeast into a similarly overdrafted area in Fresno County near Raisin City.

3.4.3 WESTLANDS WATER DISTRICT

3.4.3.1 Upper Aquifer System

The upper aquifer system in WWD is the semi-confined zone above the Corcoran Clay. Salinity of the groundwater in the upper aquifer system is frequently higher than desirable for irrigation use (Jones and Stokes 1995). Limited groundwater level data are available for the upper aquifer system. The groundwater flow direction in this zone during 1987 to 1993 was generally northeastward, from the foot of the Coast Ranges toward the valley trough (Jones and Stokes 1995). The upper aquifer system in WWD corresponds stratigraphically with the upper aquifer system east of WWD.

Water level changes in WWD have had large effects on the gradient for groundwater flow in the western portion of the San Joaquin Valley. Declining water levels in WWD from the 1920s to the 1960s reduced the gradient for groundwater flow to the northeast in the upper aquifer (above the Corcoran Clay). Similarly, rising water levels since the late 1960s have steepened the regional gradient for groundwater flow. Data for the upper aquifer are extremely limited prior to the 1940s, but it is likely that current water levels are generally similar to water levels during the predevelopment period. The primary exception would be in the drainage impaired areas, where current water levels are slightly higher than historical levels. The largest water level changes have occurred in the central and western portions of WWD west of the study area. Less change has occurred within the study area, and these changes are considered to have had a relatively minor effect on the regional gradient in the Mendota area. This is indicated by water level data from the westernmost wells in the MPG monitoring program (the USGS monitoring well cluster in Section 10A), which are located approximately four miles west of the Fresno Slough. Data from these wells do not show evidence of increasing water levels since measurements began in 1987. Water levels in the two shallowest wells in this cluster have been high throughout the monitoring period, and the relatively steep gradient between this area and the Slough is included in the evaluation of existing groundwater conditions.

3.4.3.2 Lower Aquifer System

Most production wells in WWD are screened in the lower aquifer (i.e., below the Corcoran Clay). Groundwater quality in the lower, confined aquifer varies with depth throughout the District. The thickness of the lower aquifer ranges from about 200 feet in the Mendota area to over 2,000 feet in the western portion of WWD (Bull and Miller 1975).

The lower water-bearing zone is recharged primarily by subsurface inflow from the east and northeast and deep percolation of groundwater through the Corcoran Clay. The Corcoran Clay separates the upper and lower water-bearing zones in the majority of the District. The Corcoran Clay is not continuous west of Huron. Typically, water quality varies with depth, with the poorest quality occurring at the upper and lower limits of the aquifer and better water quality somewhere between. The upper limit of the aquifer is the base of the Corcoran Clay. The USGS identified the lower limit of the aquifer as the base of the fresh groundwater. The quality of the groundwater below the base of fresh water exceeds 2,000 parts per million total dissolved solids.

WWD has tracked changes in groundwater elevations relative to groundwater pumping since 1976 (Table 3-6) (WWD 2002). Groundwater elevations have declined when pumping exceeded 160,000 to 175,000 acre-feet per year. WWD does not supply groundwater to district farmers nor does the district regulate or control groundwater pumping; individuals pump their own groundwater. However, WWD surveys the static water levels in the wells and the water quality and quantity of the pumped groundwater, as part of its Groundwater Management Plan (WWD 1996). Recent analysis of the groundwater level data indicates that the estimated safe yield may be between 135,000 and 200,000 acre-feet per year (WWD 1996).

Under predevelopment conditions, groundwater flow directions in the lower aquifer below the Corcoran Clay in WWD were similar to those in the upper aquifer (generally to the northeast toward the Fresno Slough and the San Joaquin River). Pumping below the Corcoran Clay in WWD and other areas along the west side of the San Joaquin Valley caused large drawdowns, which resulted in a reversal of gradient by the 1950s. Since that time, the direction of groundwater flow in the lower aquifer has generally been to the southwest.

3.4.4 LAND SUBSIDENCE

Land subsidence is defined as the lowering of the ground surface over a large area, in this case as a result of lowered groundwater levels due to groundwater pumping. Land subsidence in the San Joaquin Valley has been caused primarily by inelastic compaction of silt and clay layers and is most likely to occur in lacustrine deposits such as the Corcoran Clay. Other deposits such as the Coast Range alluvium (Diablo alluvial fan and flood plain deposits) also contain high percentages of these fine-grained sediments and are relatively compressible. Inelastic compaction of the silt and clay layers occurs relatively slowly and can continue for years after water levels have stopped declining.

Much less compaction occurs in coarser-grain sediments such as the Sierran sands along the east side of the valley. This formation also contains interbedded silt and clay layers, but the sand layers are predominant. Compaction in this formation tends to be primarily elastic and is much less likely to cause irreversible subsidence. Elastic compaction and expansion of the coarse-grained sediments occurs relatively instantaneously in response to water level changes.

3.4.4.1 Mendota Area

The following discussion of land subsidence is based largely on the analysis presented in the Phase II report "Long Term Impacts of Transfer Pumping by the MPG" prepared by KDSA and LSCE (2000b) and the 2000 and 2001 annual monitoring reports (LSCE and KDSA 2001 and 2002).

Most subsidence in the Mendota Pool area has been the result of regional pumping from the lower aquifer below the Corcoran Clay. Even though this pumping occurs primarily west, southwest, and northeast of Mendota, it has historically caused water-level declines and compaction in the Corcoran Clay and other clays in the Mendota area. Water levels below the Corcoran Clay have generally been recovering in the Mendota area since the late 1960s, when groundwater pumping decreased after surface water supplies became available from the SLC.

In the Mendota area, almost all of the groundwater pumping is from the aquifers above the Corcoran Clay, which are composed primarily of Sierran sands, with interbedded silt and clay layers. The generally elastic nature of compaction in this formation is evidenced by historical compaction data collected by DWR between 1966 and 1982 at the Yearout Ranch extensometer, which is located east of San Mateo Avenue just south of FWD (Figure 2-1). Historical data from the Yearout Ranch extensometer were analyzed by KDSA and LSCE (2000b) to determine the correlation between water-level changes and measured compaction that would allow prediction of future compaction at this location. Compaction and water levels above the Corcoran Clay at the Yearout Ranch site were measured continuously for a 17-year period (1966 to 1982). The annual rate of compaction was relatively constant from 1966 to 1977 and closely followed the trend of the lowest water levels, which declined from about 70 feet to almost 100 feet during this period. The total inelastic compaction above the Corcoran Clay between 1966 and 1982 was reported to be 0.265 foot, and there is evidence that approximately 0.25 foot of additional compaction above the Corcoran Clay may have occurred at the Yearout Ranch site between 1982 and 1999. The majority of the subsidence due to drawdowns of less than approximately 35 feet in the upper aquifer system has already occurred. As a result, compaction due to drawdowns less than 35 feet at Yearout Ranch is thought to be primarily elastic and reversible as the water table recovers each winter.

In 1999, CCID reinitiated data collection at the Yearout Ranch extensometer, and the MPG installed a new extensometer west of the Mendota Airport at Fordel, Inc. Compaction data collected from both extensometers during the 1999-2002 period are summarized in Table 3-7. Inelastic compaction could not be calculated for 1999 because data collection did not begin until mid-year. Data collected during the three-year period from 2000 to 2002 indicate that subsidence due to inelastic compaction above the Corcoran Clay from all pumping during the three-year period from 2000 to 2002 was approximately 0.006 foot at the Fordel extensometer and 0.046 foot at the Yearout Ranch extensometer (LSCE and KDSA 2003). Because inelastic compaction corresponds primarily to deep zone pumping, it varied during this period with the maximum occurring in 2001 and the minimum in 2002.

As discussed in the 2002 Annual Report (LSCE and KDSA 2003), the relationship between water level and compaction measured at the Yearout Ranch extensometer was estimated based on historical data available for this site. This relationship was used in conjunction with drawdown simulated with the groundwater flow model to estimate the amount of annual and cumulative subsidence attributed to MPG transfer pumping. The estimated partitioning of inelastic compaction between MPG transfer pumping and other pumping in the area is shown in Table 3-8. The amount of cumulative subsidence attributed to MPG transfer pumping at the Yearout Ranch extensometer between 2000 and 2002 was 0.014 foot. This is slightly less than the average of 0.005 foot per year specified in the Settlement Agreement.

3.4.4.2 Westlands Water District

Prior to the delivery of CVP water to WWD, the annual groundwater pumpage ranged from 800,000 to 1,000,000 acre-feet during the 1950 to1968 period. Because most wells in WWD are screened below the Corcoran Clay, the majority of this pumpage was from the lower aquifer, causing the sub-Corcoran piezometric groundwater surface to reach the lowest recorded average elevation of more than 150 feet below mean sea level by 1968. The large quantity of groundwater pumped prior to delivery of CVP water caused compaction in the Corcoran Clay and other fine-grained sediments, resulting in land subsidence which ranged from 1 to 24 feet between 1926 and 1970 (U.S. Geological Survey 1988, as cited in WWD 1999). During this period, approximately eight feet of subsidence occurred near the western edge of the City of Mendota. Generally, the area southwest of the City of Mendota is one of the most severely subsidence-impacted areas in the San Joaquin Valley.

Compaction data from six extensometer sites along the California Aqueduct in the Mendota-Huron area are summarized on Table 3-9. These extensometers were installed by the USGS between 1958 and 1969 to monitor compaction in depth intervals ranging from about 900 to 2,300 feet. The total land subsidence may be greater than the measured compaction, especially at the shallower extensometers, due to unmeasured compaction below the monitored depth intervals. By far the most compaction was recorded at extensometer T16S/R15E-34N1, which is located about 20 miles south of Mendota and has the longest period of record, with a total of over 11 feet between 1958 and 1976. Annual compaction measured at the other extensometers prior to 1976 ranged from less than one foot to about four feet.

Beginning in 1968, surface water deliveries from the CVP largely replaced groundwater for irrigation, and the rate of compaction had decreased by as much as one order of magnitude in the early 1970s. However, pumping increased again during the 1976-77 drought, due to a reduction of up to 75 percent in WWD’s entitlement of CVP water. In response, the annual pumpage increased from about 100,000 acre-feet in 1976 to 470,000 acre-feet in 1977. The piezometric surface declined by almost 100 feet in 1977 (Table 3-6), and compaction measured at the extensometers during 1976-77 ranged from 0.10 to 0.53 foot. There was significant water level recovery in the two years following the drought, and expansion ranging from 0.02 to 0.20 foot was recorded at all but one extensometer.

In the early 1980s, responsibility for operation and maintenance of many extensometer sites was transferred to DWR, including the sites listed on Table 3-9. Due to problems with this transition, there is a data gap between 1979 and 1983. Between 1983 and 1986, continued expansion was measured at four of the six extensometers. This trend was reversed during the drought that began in 1987, as pumpage in WWD increased to 600,000 acre-feet in 1991 and 1992. Compaction measured during the 1987-92 drought ranged from

0.12 to 0.95 foot. Following the drought, four of the six extensometers indicated slight expansion between 1993 and 1998. The cumulative compaction measured at these extensometers for the entire period of record ending in 1998 ranged from about 1.5 feet to almost 12 feet.

3.4.5 GROUNDWATER QUALITY

Groundwater quality in the Mendota area is highly variable, with the poorest water quality occurring in the western portion of the study area and the best water quality in the eastern area near the San Joaquin River. The primary groundwater quality concern is high salinity, which is both naturally occurring and caused by deep percolation of applied irrigation water. Localized degradation due to percolated wastewater has also occurred in certain areas. Except for areas that benefit from recharge from the San Joaquin River or the Mendota Pool, shallow groundwater generally has higher salinity than deep groundwater above the Corcoran Clay in the study area. The shallow and deep wells located along the San Joaquin River east of Mendota Dam, including the NLF, CCC, and FWD wells (Table 3-10 and Table 3-11), have the best water quality in the study area due to surface water recharge.

Groundwater quality degradation has occurred for decades in the western portion of the study area due to northeasterly movement of a “front” of saline groundwater, which is present west of the Fresno Slough and San Joaquin River. This poor quality groundwater flows into the Mendota area because the regional hydraulic gradient is toward the northeast. MPG and other groundwater pumping near the saline front steepens the gradient and accelerates the movement of this water toward the pumping wells.

The most significant areas of degradation in the shallow zone include the south-central and southern portion of the MPG well field along the Fresno Slough. This degradation is caused by northeasterly migration of the saline front, which is exacerbated by pumping of the shallow MPG wells in this area. East of the Slough, some of the MPG wells near Whites Bridge experienced water quality degradation due to percolated wastewater from the Spreckels Sugar Co. factory. When the MPG wells are pumped, the altered gradient causes the wastewater to flow southwest toward the MPG wells.

In the deep zone, the most significant areas of past degradation include the USGS monitoring wells west of the Mendota Airport and the City of Mendota wells near Bass Avenue. The City has shifted most of its pumpage to new wells drilled east of the Slough at the BB Ranch. The degradation rate observed at some deep wells west of the Fresno Slough and the San Joaquin River is consistent with the overall influence of regional groundwater flow conditions on migration of the saline front. Areas that have higher degradation rates are influenced by other factors, including MPG pumping. East of the Slough, the southernmost FWD wells have apparently experienced slight degradation due to the downward and northerly migration of wastewater from Spreckels Sugar Co. Wells located along the San Joaquin River east of Mendota Dam, including the NLF and FWD wells, have the best water quality in the study area and have not shown evidence of degradation.

Groundwater was sampled periodically during 1999, 2000, 2001, and 2002 at MPG wells (Terra Linda, Fordel, Conejo West, Coelho/Coelho, Coelho/Coelho/Fordel, Silver Creek, Meyers, Five Star, FWD, Baker, and Panoche Creek) and municipal, monitoring, and non-MPG irrigation wells (USGS, Hansen Farms, City of Mendota, Locke Ranch, NLF, Spreckels Sugar Co., and CCID) as part of the monitoring program conducted by the MPG, the SJREC, and NLF (KDSA and LSCE 2000a, b, and LSCE and KDSA 2001, 2002). Data for Meyers Farming monitoring well P-6 are not included in this evaluation because this well is impacted by tile drainage from an adjacent field, and the constituent levels are anomalous as compared to nearby wells. Well P-6 is no longer included in the monitoring program. Groundwater quality data for parameters of interest are tabulated separately for the shallow (above the A-clay) and deep (below the A-clay) zones of the upper aquifer near the Mendota Pool in Tables 3-7 and 3-8, respectively. The most recent data available are included for each well for water quality parameters of particular interest: arsenic, boron, selenium, molybdenum, and salinity (measured as EC or TDS). Historical data for all constituents and dates are provided in Appendix C. The wells are sorted according to geographic region (San Joaquin River Arm, Northern Fresno Slough, Central Fresno Slough, Southern Fresno Slough, North of Mendota, West or East of the Fresno Slough, and North of the San Joaquin River), as described in Section 3.3.1.5.

3.4.5.1 Arsenic

Arsenic was detected in 9 of 55 shallow and 6 of 39 deep production or monitoring wells tested in groundwater monitoring programs in the Mendota Pool area (Tables 3-10 and 3-11). Detected concentrations were generally at, or just above, the detection limit of 2 μg/L. Most of the detected concentrations in the shallow wells were along the Northern Fresno Slough, where the highest detected concentration was 4 μg/L. Arsenic was detected at 3 μg/L in one deep MPG production well in FWD. It was also detected in the three new City of Mendota wells along the San Joaquin River arm of the Pool at concentrations up to 5.8 μg/L. The only other area where arsenic was detected in deep wells was west of Fresno Slough, where it was detected in two wells at concentrations of 5 μg/L or less.

The lowest water quality criteria target levels for arsenic are 5 μg/L for Refuge Surface Water Quality and 10 μg/L for protection of aquatic life (Table 3-4). Arsenic was not detected in any MPG production well in the most recent monitoring event at a level exceeding the Refuge Surface Water Quality target level.

3.4.5.2 Boron

Boron was detected in all wells tested. Concentrations in shallow wells ranged from 0.21 to 7.70 mg/L. The highest detected boron concentration occurred in a very shallow monitoring well west of the Fresno Slough. None of the 13 shallow MPG wells along the northern Fresno Slough had boron concentrations exceeding the "severe or unacceptable" Refuge Water Supply Objective of 0.6 mg/L; the average boron concentration was 0.33 mg/L. Of the 26 shallow wells along the Central Fresno Slough, 14 exceeded 0.6 mg/L boron in the most recent testing. Shallow wells in the Southern Fresno Slough had boron concentrations ranging from 0.31 to 1.20 mg/L, with an average of 0.62 mg/L. Again, the highest boron concentrations in this area were detected in nonproduction wells. The shallow and deep NLF monitoring wells north of the San Joaquin River had boron concentrations ranging from 0.15 to 0.28 mg/L. Boron in nonproduction wells east of Fresno Slough ranged from non-detect (<0.1) to 1.30 mg/L, and the shallow USGS wells west of Fresno Slough had 1.43 and 4.10 mg/L boron.

Deep wells had boron concentrations ranging from 0.05 to 4.98 mg/L overall. Boron in wells north of the San Joaquin River ranged from 0.04 to 0.60 mg/L and averaged 0.23 mg/L. In deep wells along the San Joaquin River arm of the Pool, the highest boron concentration was 0.61 mg/L, with an average concentration of 0.22 mg/L in the 15 wells tested. In the northern Fresno Slough region, the maximum boron concentration detected in deep wells was 0.70 mg/L, and the average boron concentration of the seven wells tested in this region was 0.52 mg/L. Boron concentrations in deep wells in the central Fresno Slough region ranged from 0.55 to 1.11 mg/L, with an average of 0.81 for the four wells tested. There are no deep wells included in the monitoring programs in the southern Fresno Slough area.

In general, boron concentrations are higher in deep wells located away from the Pool. In deep wells north of the City of Mendota, boron ranged from 0.10 to 1.40 mg/L. Concentrations in wells (non-pumping) east and west of Fresno Slough ranged from 0.44 to 4.98 mg/L, with the highest concentrations present in the upgradient wells to the west (USGS well 10A4 and Hansen Farms well 7C1).

The lowest water quality criterion for boron is the target level of 0.3 mg/L for Refuge Surface Water Supply (Table 3-4). The severe or unacceptable value for Refuge Surface Water Supply is 0.6 mg/L. Average boron concentrations for shallow wells were less than 0.6 mg/L in the northern Fresno Slough and north of the San Joaquin River areas but greater than 0.6 mg/L in other areas. Deep wells averaged less than 0.6 mg/L in all but the Central Fresno Slough and west of Fresno Slough regions.

3.4.5.3 Molybdenum

The most recent molybdenum concentrations measured in shallow wells ranged from 1.6 to 58.4 μg/L. The lowest average molybdenum concentration was in the northern Fresno Slough shallow wells, while the highest concentration was observed in a shallow monitoring well west of the Fresno Slough. Molybdenum concentrations in deep wells ranged from 1.8 to 37 μg/L. Average molybdenum concentrations in the various regions ranged from 5.5 (San Joaquin River Arm) to 21.9 μg/L (west of Fresno Slough). No molybdenum data were collected for wells north or west of the San Joaquin River in the monitoring program.

The lowest water quality criteria for molybdenum are the target levels of 10 μg/L for both Refuge Surface Water Supply and Aquatic Life Protection (Table 3-4). Only two of the 23 deep production wells had molybdenum concentrations greater than 10 μg/L. However, 30 of 44 shallow production wells exceeded 10 μg/L molybdenum. The majority of these shallow wells are located in the central and southern Fresno Slough regions. Many of these wells also have high TDS levels and will not be included in the MPG pumping program, or pumping from these wells will be limited.

3.4.5.4 Selenium

As noted in Section 3.3.2.4, data quality issues have been identified regarding the accuracy of many of the historical selenium analyses and analyses conducted by other monitoring programs. Results of a interlaboratory comparison program conducted in 2001 indicated that data quality objectives were probably not met for selenium results reported by laboratories other than Reclamation, Olson Biochemistry Laboratories (OBL), and Frontier Geosciences.

Review of recent selenium data for groundwater that are of acceptable quality indicates that selenium is not present above the detection limit of 0.4 μg/L in most wells in the Mendota Pool area. Selenium was detected in four shallow wells, and all concentrations were less than 1.0 μg/L. Selenium was detected in three deep wells, and the only well that exceeded 1.0 μg/L was the unused Hansen Farms well 7C1 (65.6 μg/L).

The lowest water quality criteria for selenium are the target levels of 2 μg/L for both Refuge Surface Water Supply and Aquatic Life Protection (Table 3-4). All production wells with data of adequate quality have selenium concentrations well below these criteria.

3.4.5.5 Salinity (as TDS)

Groundwater quality in the vicinity of the proposed action is highly variable. Patterns evident in the data were consistent with regional and local patterns described by previous investigators. Previous studies (Woodward Clyde Consultants 1994, cited in Jones and Stokes 1995) indicated that there was a local pattern in groundwater quality. Groundwater in wells away from the San Joaquin River and the Mendota Pool were, on average, about twice as saline as groundwater near the Mendota Pool, which was in turn about twice as saline as groundwater near the River (mean TDS concentrations of 1,756 mg/L, 777 mg/L, and 294 mg/L, respectively) (Jones and Stokes 1995). Among the MPG wells along the Fresno Slough, groundwater in the southern half of the well field (central Fresno Slough) was more saline than groundwater in the northern half of the well field (northern Fresno Slough). The composition of shallow groundwater near the Mendota Pool was chemically and isotopically intermediate between that of regional groundwater and groundwater near the River. This pattern indicates that the shallow groundwater quality benefits from recharge of surface water from the River and the Mendota Pool (Jones and Stokes 1995).

Salinity of Shallow Groundwater

The areal distribution of salinity in the shallow zone in 2002 is illustrated on a contour map of TDS concentrations (Figure 3-11) (LSCE and KDSA 2003). For shallow wells that were sampled more than once in 2002, results were averaged. In two cases (Meyers Farm monitoring well MF-6 and Spreckels' monitoring well MW-17), the 2002 TDS data appeared to be anomalous, and data from other years were substituted. 2001 data were also used for Meyers Farm monitoring well P-1 because this well was not sampled in 2002.

Shallow wells located along the northern portion of the Fresno Slough generally have lower salinity than shallow wells located further south. TDS concentrations in the shallow wells located in the northern Fresno Slough region (Fordel and Terra Linda) ranged between 390 and 870 mg/L in the most recent samples, with an average of 593 mg/L (Table 3-10). Shallow wells in the central Fresno Slough region had TDS concentrations from 460 to

6,000 mg/L. Four monitoring wells located west of the Fresno Slough at Meyers Farming had very high TDS, which contributed to an average concentration of 2,139 mg/L TDS for the central Fresno Slough region. In the southern Fresno Slough region, TDS concentrations were generally higher, ranging from 680 to 6,200 mg/L, with the highest concentrations occurring in the shallow Meyers Farming monitoring wells. The average TDS (1,879 mg/L) was slightly lower than the central Fresno Slough.

West of the Fresno Slough, TDS was measured in shallow upgradient USGS wells at concentrations of 3,490 and 5,750 mg/L.

TDS in shallow monitoring wells east of Fresno Slough (Meyers Farming and Spreckels Sugar Co.) ranged from 220 to 4,100 mg/L. The higher TDS concentrations east of the Slough are associated with groundwater degradation due to wastewater from the Spreckels Sugar Co. factory. Historically, this wastewater percolated from ponds west of the plant site, and is currently used to irrigate permanent pasture on the Spreckels' property.

The SAR was calculated, as data were available, for the groundwater samples shown in Table 3-10. SAR values varied widely between wells and regionally, following a similar pattern to TDS. The SAR in the northern Fresno Slough shallow wells ranged from 2.1 to 6.4, with an average of 3.8. The SAR in the central Fresno Slough shallow wells ranged from 3.5 to 25.3, with an average of 11.9, and the southern Fresno Slough SAR ranged from 4.4 to 26.9, averaging 11.4. SAR values for shallow NLF monitoring wells north of the San Joaquin River ranged from 3.1 to 13.0. SAR values in shallow monitoring wells east and west of the Fresno Slough varied significantly, ranging from 0.6 to 67.7. The two extreme values of the SAR range both occurred east of the Fresno Slough at Spreckels Sugar Co. monitoring wells. The higher value reflects shallow groundwater degraded due to wastewater, whereas the lower value is indicative of background water quality unaffected by wastewater.

When evaluated together with the EC, the SAR values in almost all of the shallow wells indicate either no impairment or slight to moderate impairment for irrigation purposes. The SAR values for two of the wells (Coelho West wells CW-4 and CW-5) indicate severe impairment. The elevated SAR values in these wells may be an indication that these northernmost wells in the Coelho West cluster are affected by Spreckels' wastewater. The highest SAR value for any of the shallow wells included in the monitoring program was reported at Spreckels Sugar Co. well MW-1 (67.7). The lowest SAR in any shallow monitoring well was 0.6 in Spreckels Sugar Co. well MW-30.

Salinity of Deep Groundwater

The deep zone TDS contour map (Figure 3-12) (LSCE and KDSA 2003) covers a larger area with more detail than the shallow-zone contour map due to the availability of water quality data from a large number of wells north and west of the San Joaquin River. As in the shallow zone, average TDS concentrations were used for wells where more than one sample was collected in 2002. For NLF wells, 2001 data were used exclusively because the 2002 data were questionable due to sample labeling errors.

Deep wells along the San Joaquin River arm of the Mendota Pool had TDS concentrations ranging from 150 to 520 mg/L, with an average of 362 mg/L (Table 3-11). TDS in deep wells north of the San Joaquin River showed similar salinity, ranging from 173 to 608 mg/L, with an average of 356 mg/L. The TDS concentrations in wells located further south near Spreckels Sugar Co. were higher than in wells near the River.

The pattern of water quality in deep wells along the Fresno Slough is similar to that in the shallow wells, with salinity generally lower in northern Fresno Slough wells than in central Fresno Slough wells (Table 3-11). In wells along the northern Fresno Slough, TDS ranged between 450 and 1,040 mg/L, with an average of 787 mg/L (data for 7 of 8 wells). TDS in deep wells along the central Fresno Slough ranged from 900 to 2,140 mg/L and averaged 1,623 mg/L (data for 4 of 5 wells). There are no deep wells along the southern Fresno Slough.

Deep wells west of the San Joaquin River ranged from 340 to 1,600 mg/L TDS, and average 816 mg/L, while wells to the south (west of Fresno Slough) range from 350 to 7,100 mg/L and average 2,728 mg/L. The upgradient Hansen Farms and USGS wells are included in this area and have TDS concentrations ranging from 2,370 to 7,100 mg/L. TDS concentrations in deep monitoring wells at Spreckels Sugar Company east of the Fresno Slough ranged between 740 and 4,500 mg/L. Because the water quality in some of these wells has been affected by deep percolation of wastewater, these concentrations are not representative of the deep groundwater quality in all areas of Spreckels Sugar Company.

SAR values in deep wells along the northern Fresno Slough ranged from 15.6 to 25.5, and along the central Fresno Slough, SAR ranged from 22.0 to 29.4. Based on the SAR, all of the deep MPG wells would be classified as either slight to moderate or severe in terms of impairment for irrigation purposes, using the classification system in Ayers and Westcot (1985). In non-MPG deep wells, the SAR of wells sampled in 2001 ranged from 2.2 in City of

Mendota well No. 6 (1/23/96, most recent data available) to 26.4 in Spreckels Sugar Co. well MW-15 (6/06/01) (Table 3-11).

Water Quality Criteria for Salinity (as TDS)

The lowest water quality criterion for TDS is a target level of 400 mg/L (as a 5-year average) for Refuge Surface Water Supply (Table 3-4). The 1-year average target level is 450 mg/L, and the monthly average is 600 mg/L. Many MPG production wells have TDS concentrations exceeding 600 mg/L, especially in the southern Fresno Slough region. However, salinity contributions from these wells will not cause salinity in the southern Fresno Slough to exceed average water quality criteria for Refuge Surface Water Supply, due to adaptive management of pumping programs, which limits the amount of groundwater pumped from wells with high TDS levels into the Slough.

A TDS criterion of 2,000 mg/L was established as the upper limit for all wells in the MPG transfer-pumping program (LSCE and KDSA 2003). Beginning in 2003, any well that exceeds this limit cannot be used for transfer pumping. This limit also applies to pumping for adjacent use by wells that use the Pool as a conveyance facility. During the fall, when there is less flow in the Slough and the MWA diverts water to fill its ponds, a more restrictive TDS criterion for groundwater quality of 1,200 mg/L is used to ensure that surface water quality is not degraded. The 1,200 mg/L criterion does not apply to pumping for adjacent use.

3.5 SEDIMENT

A sediment quality monitoring program in the Mendota Pool was implemented in August 2001. The objectives of the sediment monitoring program are to provide baseline characterization of metal concentrations in Mendota Pool sediments and to allow for future identification of temporal and spatial trends in sediment quality.

The monitoring program was designed to allow assessment of spatial distribution of selected parameters (EC, arsenic, boron, molybdenum, and selenium) in the sediment. The sampling locations include areas that are not likely to be influenced by MPG pumping as well as areas that could receive inputs of metals from MPG water (Figure 3-13) and are collocated with surface water sampling stations. The station locations allow estimation of metals inputs from the San Joaquin River, the DMC, and the James Bypass.

Data are available for the first three rounds of sampling: August 22, 2001, October 30, 2001, and October 16, 2002. During each sampling event, triplicate sediment samples were collected at eight stations in the Mendota Pool. An Ekman grab sampler was used to collect sediment samples from the bottom of the Pool. Sediment for analysis was collected from the top 2 cm of sediment. The eight sampling stations include:

1. Near the Columbia Canal intake.
2. At Mendota Dam.
3. At the DMC outlet.
4. At the Firebaugh Intake Canal intake.
5. At the Etchegoinberry introduction point.
6. At the MWA approximately ¼ mile south of Whites Bridge Road.
7. At the James Irrigation District Booster Plant.
8. In Lateral 6.

The samples were analyzed for selenium, arsenic, boron, molybdenum, grain size (percent sand, silt, and clay), percent moisture, cation exchange capacity (CEC), EC, total organic carbon (TOC), and pH. The latter four parameters were analyzed to allow evaluation of the ability of the sediment to bind metals. Results are expressed on a dry weight basis except for EC, which is measured in a saturated paste, and pH, which is measured in a 1:1 dilution. The results of the sediment sampling program for 2001 and 2002 are provided in Table 3-12 and are categorized according to the same geographic regions as the surface water stations and groundwater wells. In general, concentrations of the metals and EC showed variability between replicates within each sampling station.

In the August 2001 sampling event, EC and arsenic were reported in all 24 samples. Boron was detected in 14 samples, and molybdenum was detected twice. The sample-specific detection limit for molybdenum ranged from 0.81 mg/kg (dry weight) to 2.1 mg/kg (dry weight).

Selenium was not detected in any of the samples in the August 2001 sampling event, but the sample-specific detection limits for selenium were high due to analytical interferences with aluminum. One sample from each station was subsequently reanalyzed by Frontier Geosciences using a more sensitive analytical technique that has lower detection limits and does not have interference from aluminum. Results from the reanalysis yielded concentrations ranging from 0.10 mg/kg (dry weight) to 2.94 mg/kg (dry weight). The selenium concentration at the Columbia Canal in the San Joaquin River arm of the Mendota Pool was 0.70 mg/kg (dry weight). The maximum reported concentration was in a sample collected near the mouth of the DMC in the central Mendota Pool region. Concentrations in samples collected at Mendota Dam and at the Firebaugh Intake Canal in this region were intermediate (0.72 and 0.86 mg/kg dry weight). The second highest concentration (1.58 mg/kg dry weight) was detected at Etchegoinberry, in the central Fresno Slough region. The lowest selenium concentrations were measured at the three stations in the southern Fresno Slough surrounding the MWA.

Samples collected in October 2001 and October 2002 were analyzed by Columbia Analytical Services in Kelso, Washington. Results from the October 2001 event are generally similar in magnitude and pattern to those from the August 2001 event. However, the reported concentrations of metals and EC were slightly lower than in August and appear to be less variable. Reported values for TOC and CEC were slightly higher than in the August event.

Arsenic and boron were detected in most of the October 2001 and 2002 samples. However, one boron result was less than the method detection limit and 14 of 48 boron results were between the method detection limit and the reporting limit. Arsenic ranged from 1.4 mg/kg to 10.9 mg/kg (dry weight). Boron ranged from <2.3 to 52.8 mg/kg (dry weight). Only 28 of 48 samples contained molybdenum at concentrations greater than the detection limit of 0.8 mg/kg (dry weight). Only one (2.4 mg/kg) of these samples contained molybdenum exceeding 1.8 mg/kg (dry weight). Selenium was detected in only two of the sediment samples from October 2001 or 2002, with detection limits ranging from 0.9 mg/kg to 1.2 mg/kg (dry weight).

Few sediment quality guidelines are available with which to evaluate sediment quality. For the parameters of concern in this analysis, guidelines are only available for arsenic and selenium (Table 3-4). The effects range-low (ER-L) value for arsenic identified by U.S. EPA (1996) is 12.1 mg (arsenic)/kg (dry weight). None of the detected arsenic concentrations exceeded this screening value. The highest concentrations occurred in the central Mendota Pool and the northern Fresno Slough region, extending as far south as Etchegoinberry.

Screening criteria for selenium have been developed by USFWS for the Grasslands Watershed (Reclamation 2000), which is located north of the Mendota Pool. The screening criteria for selenium include a target level of 2 mg/kg and a toxicity threshold of 4 mg/kg (dry weight). The detection limits for selenium in the August 2001 samples were elevated and variable. However, of the eight reanalyzed August 2001 samples, only one exceeded the target level. In the October 2001 and 2002 samples, selenium concentrations were all less than 1.2 mg/kg (dry weight); none exceeded the target level of 2 mg/kg.

The influence of MPG pumping can also be assessed by examining the spatial distribution of parameters of interest in the sediment. If MPG pumping was introducing metals and salts into the sediment, it would be expected that the sediments in the vicinity of the MPG wells would exhibit higher concentrations than those observed in sediments from other areas of the Pool.

The sediment quality data from the October 2001 sampling event were analyzed to determine whether they could be associated with MPG pumping. Due to the limited number of detected values for molybdenum and selenium only arsenic, boron, EC, and TOC could be analyzed using analysis of variance (ANOVA (Sokal and Rohlf 1981). Significant differences were identified between sampling stations for arsenic, boron, and EC in the ANOVA.

Mean arsenic concentrations (Figure 3-14) were lowest at the James Irrigation District Booster Plant station and at the Columbia Canal and Lateral 6 stations. Highest arsenic concentrations were found at the DMC and Mendota Dam stations. The spatial patterns of the 2001 and 2002 results are similar, although the arsenic concentration at the DMC terminus was lower in 2002.

Exceedances of applicable sediment quality guidelines (Table 3-4) occur primarily in samples from the northern portion of the Pool. Average arsenic concentrations tend to decrease towards the southern portion of the Pool. The limited spatial data suggest that the MPG wells are not contributing to increased arsenic concentrations in the Fresno Slough. In addition, arsenic was generally not detected, or was detected at very low concentrations, in the groundwater samples from the MPG production wells (Table 3-10 and 3-11). These data indicate that the MPG wells do not influence the arsenic concentrations in the sediments.

Boron was highest in sediment samples from the DMC, Whites Bridge Road, and Lateral 6 stations (Figure 3-15). Lowest concentrations were observed at the Columbia Canal and James Irrigation District Booster Plant stations. The spatial patterns of the 2001 and 2002 results are similar, although boron concentrations tended to be lower at several stations in 2002.

The highest EC values (Figure 3-16) were detected at the DMC and Lateral 6 stations, whereas the lowest concentrations were found at the Columbia Canal, Etchegoinberry, and Whitesbridge Road stations. The spatial patterns of the 2001 and 2002 results are similar. However, EC values were lower at most stations in 2002. The limited data show no indication that the spatial distribution of salinity in the sediment samples is associated with inflow from the MPG wells.

Sediments in the San Joaquin River arm of the Pool (i.e., Columbia Canal station) appear to consistently have the lowest metals and salt concentrations. Sediment conditions at samples in the southern Pool vary depending on which analyte is being considered and on the date of the sampling event.

3.6 REGIONAL MONITORING PROGRAMS

Several monitoring programs are currently occurring in the vicinity of the proposed action. These monitoring programs are being undertaken by Reclamation, CVRWQCB, USGS, CDFG, SLDMWA, and WWD, TID, and JID. A brief summary of these monitoring programs is provided in this section.

3.6.1 U.S. BUREAU OF RECLAMATION

Reclamation currently has three ongoing monitoring programs along the DMC: sump monitoring, Warren Act pump-ins, and continuous selenium monitoring (Field 2002).

3.6.1.1 Sump Monitoring

Reclamation has been monitoring a series of six sumps located between Russell Avenue at mile point (MP) 97.68 and Washoe Avenue at MP 110.12. This program has been ongoing since 1986. Monitoring frequencies and parameters measured have changed over time. Since 1998, the sumps have been sampled twice yearly for metals, common cations, and common anions. Selenium and EC are measured weekly in all six sumps. Water from these sumps is periodically discharged to the DMC. Reclamation is evaluating other methods for disposing of this sump water.

3.6.1.2 Warren Act Pump-Ins

Reclamation is required to monitor water quality in wells that discharge directly into the DMC. Each well is sampled prior to entry into the program and subsequently every three years. Parameters measured include Title 22 metals and pesticides.

3.6.1.3 Selenium Monitoring

A selenium monitoring program was initiated in July 2002 at the request of the USFWS. Daily composite samples for selenium, boron, and TDS are collected using an autosampler at three locations along the DMC: at the headworks (MP 3.5), Check 13 (O'Neill Forebay), and Bass Avenue (DMC terminus). Monthly composite samples are collected for molybdenum at these same locations.

3.6.1.4 Drinking Water Quality

A fourth program was initiated in November 2002 at the request of the California Department of Health Services (DHS). This program collects biweekly samples from the DMC between the headworks and Check 13. The samples are analyzed for alkalinity, TOC, and coliforms.

3.6.2 Central Valley Regional Water Quality Control Board

The focus of the CVRWQCB monitoring efforts is on the San Joaquin River below the confluence of Bear Creek (Lander Avenue) and consists of two major programs that are relevant to the Proposed Action: the Selenium Control Program and the Surface Water Ambient Monitoring Program (SWAMP). The CVRWQCB also participates in the Grasslands Watershed monitoring program. The CVRWQCB is also conducting monitoring for organophosphate pesticides, nutrients, and mercury within the San Joaquin River Basin. These programs are implemented through cooperative arrangements between CVRWQCB, USGS, USFWS, the Department of Pesticide Registration, and U.C. Davis. The CVRWQCB compiles data for a total of 62 stations within the San Joaquin River system. The Selenium Control Program, SWAMP, and Grasslands Watershed programs are described below.

3.6.2.1 Selenium Control Program

This program was initiated in 1985. The program involves collection of weekly samples for selenium, boron, and EC at 14 stations on the San Joaquin River and in the Grasslands Watershed. The purpose of this monitoring program is to assess impacts to the Grasslands Watershed. At the majority of stations, flow is reported on a daily basis; other parameters are sampled weekly. However, at certain locations, EC is reported on a daily basis. Furthermore, at other stations (e.g., CCID, and the San Joaquin River at Crows Landing) the measurements are only conducted during the irrigation season (May through September). A summary of the available data from 1985 through 1995 is available at the State Water Resources Control Board website

(http://www.swrcb.ca.gov/rwqcb5/programs/agunit/load/10yrload.htm).

3.6.2.2 Surface Water Ambient Monitoring Program (SWAMP)

The SWAMP was initiated in 2000, as a cooperative project between the CVRWQCB, USGS, Reclamation, and the University of California at Davis. The program samples between 50 to 60 sites along tributaries to the San Joaquin River between South Dos Palos and Lodi.

3.6.2.3 Grassland Watershed Program

The Grasslands Watershed monitoring program was initiated in May 1985 to evaluate the effects of subsurface agricultural drainage on surface water quality in the Grasslands Watershed (Crader 2002). The study area is located on the western side of the San Joaquin River, between Mendota and Newman. The original program was modified in 1997 to reflect changes in the drainage patterns within the study area. Current sampling efforts are conducted at ten sites including inflow, internal flow, and outflow locations. Inflow sampling sites include the CCID Main Canal at Russell Blvd., the Agatha Canal at Mallard Road, and Camp 13 Slough. Grab samples for EC, selenium, and boron are collected at all sites on a weekly basis. Additional parameters including temperature, pH, molybdenum, trace elements, minerals, and TSS are collected at intervals varying from weekly to quarterly at four locations. Automated samplers collect daily composite samples for EC, and weekly composites for boron and selenium. The automated samplers are located at the inflow and outflow of the San Luis Drain.

3.6.3 Westlands Water District

WWD conducts annual monitoring of water levels and groundwater quality (EC) in water user’s wells. Currently, there are approximately 750 groundwater wells in WWD. Groundwater levels are monitored in the winter to determine static elevations. EC is measured during periods of high groundwater pumpage (i.e., summer) (WWD 1996).

3.6.4 Tranquillity Irrigation District

Tranquillity ID participates in the MPG surface water monitoring program at the Lateral 6 sampling station (Green 2002). In addition, Tranquillity ID measures water levels and TDS in five deep wells (250 feet deep) and several shallow wells during the spring and fall. Occasionally, these wells will also be monitored for general minerals. The CDHS monitors two sub-Corcoran Clay drinking water wells within Tranquillity ID.

3.6.5 James Irrigation District

James ID is the furthest south of the irrigation districts that obtain water from the Mendota Pool. A continuous EC recorder at the James ID booster plant monitors EC and temperature (Mallyon 2002). This location is also a grab sampling location for the MPG monitoring program. James ID also conducts annual groundwater monitoring on a network of 58 deep wells for groundwater levels and EC. Wells are only monitored when they are actively pumping. Approximately 15 to 20 years of data have been compiled by James ID.

3.7 Biological Resources

Although the area is highly agricultural, several areas in the vicinity of the proposed action could support plants and wildlife species. These areas include the MWA, the Mendota Pool, and fallowed or idled agricultural lands.

CDFG has suggested that the action could affect special-status species and their habitats through plowing of fallowed agricultural fields that may have been recolonized, and through regional land subsidence. CDFG refuge managers also expressed concerns about the possible adverse effects on the MWA and wetland habitats near Mendota Pool and elsewhere along Fresno Slough. The USFWS has expressed concerns about the possible effects of reduced surface water and sediment quality on the giant garter snake (J. Winkle, USFWS, pers. comm. 2001).

3.7.1 Mendota Wildlife Area

The 12,425-acre MWA is the largest publicly owned and managed wetland in the San Joaquin Valley. The refuge is bisected by the Fresno Slough and is adjacent to the 900-acre Alkali Sink Ecological Reserve (Figure 1-3).

Approximately 8,300 acres of wetlands are maintained on the refuge, including almost 6,800 acres of seasonal wetlands. Surface waters near this refuge may or may not support wetland or riparian habitat depending on the type of channel (i.e., lined or unlined), maintenance activities, hydrologic conditions, and adjacent land use activities (Jones and Stokes 1995). Vegetation at the MWA is primarily managed to encourage production of native plants that provide food for waterfowl.

Originally, the vegetation near Fresno Slough was predominantly tule marsh and alkali sink scrub (Jones and Stokes 1995). Today, much of this vegetation has been eliminated by conversion to agriculture, but tule marsh persists around the margins of Fresno Slough and fragments of alkali sink scrub remain at the Alkali Sink Ecological Reserve. Other native communities at MWA are valley sink scrub, valley sacaton grasslands, and heavily grazed scalds and vernal pools.

The MWA supports approximately 10 to 20 million waterfowl use-days per year, as well as a wide variety of nongame species (Huddleston, 2002). Waterfowl populations fluctuate from year to year and from month to month. Table 3-13 presents an estimate of average waterfowl use-days. During the winter and spring, thousands of shorebirds, white-faced ibis, cattle egret, greater egret, snowy egret, great blue heron, and long-bill curlews, frequent the MWA and nest. These species are not reflected in this estimate.

3.7.1.1 Special-Status Species

Several special-status wildlife species have been recorded at MWA: giant garter snakes, white-faced ibis, Swainson’s hawks, and tricolored blackbirds. Fresno kangaroo rats have been recorded at the adjacent Alkali Sink Ecological Reserve. Palmate-bracted bird’s-beak is a special-status plant that has been recorded at MWA and also occurs at the Alkali Sink Ecological Reserve, along with the rare plants heartscale and Hoover’s eriastrum.

3.7.1.2 Water Source and Quality

Seasonal wetlands and grain crops are irrigated with CVP water delivered via the Mendota Pool. WWD facilities, including Laterals 4 and 6, provide water to MWA for domestic use. Groundwater is not used for irrigation at the MWA. All wells at MWA have been sealed because of excess boron in groundwater (Jones and Stokes 1995). In general, water use at the refuge varies seasonally, with most water diversions occurring during the fall to fill ponds for migrating waterfowl. An average of 16,553 acre-feet/year of water was delivered to the refuge during 1997-2000. The MWA contracted for 27,584 acre-feet for the 2001 water year (Loudermilk 2001). Water from the MWA is returned to the Mendota Pool in the spring (March-April) for reuse (R. Huddleston 2001, pers. comm.). In 2002, between 1,800 and 2,200 acre-feet were discharged to the Pool (S. Brueggemann 2003, pers. comm.). The majority of the water delivered to the MWA in the fall is lost to seepage or evaporation (A. Gordus 2002, pers. comm.).

3.7.2 Mendota Pool

The Mendota Pool is formed by a dam that is owned, operated, and maintained by CCID. The dam backs up water in the Fresno Slough to the James Bypass and in the San Joaquin River almost to San Mateo Avenue. The Mendota Pool is surrounded by areas of intensive agriculture and, consequently, has limited wildlife habitat value. The margins of the Mendota Pool support some areas of emergent vegetation dominated by cattails and tules; a few cottonwoods and willows grow above the water line. Open water habitat may attract migratory ducks such as mallards, gadwalls, and ruddy ducks. Emergent vegetation provides limited habitat for marsh-dwelling species such as rails, herons, and various songbirds.

Most of the Mendota Pool is less than 10 feet deep, with the deepest areas no more than 20 feet deep. Inflows and outflows from the Mendota Pool are balanced so that the Mendota Pool remains at a relatively constant depth. The Mendota Pool must remain above 14.5 feet at the Mendota Dam gage for users in the southern portion of the Mendota Pool (e.g., the MWA) to be able to draw water (R. Huddleston 2001, pers. comm.). However, the Mendota Pool is drained regularly by CCID to allow dam maintenance and repair activities to be carried out, as occurred between November 1999 and January 2000 and again in November 2001. These abrupt changes in water level reduce the overall fish and wildlife habitat values of the Mendota Pool.

The Mendota Pool was drained in late November 2001 to allow the dam to be inspected. Isolated areas of ponded water remained in low lying portions of the Pool. A team of two fisheries biologists visited the Pool on December 6, 2001 to conduct a qualitative survey of fish species presence and relative abundances (Table 3-14). Sampling was attempted at five locations using duplicate hauls of a 50-foot seine net. A summary of site conditions is provided below.

Mendota Dam/Outside Canal intake/Main Canal intake

This area could not be sampled due to unstable condition of the in-channel substrate. The in-channel substrate was dominated with silt/mud and a small component of sand. Low-water banks along the pools were approximately 8 feet and were comprised of mainly mud/silt. No vegetation was found in-channel or on low-water banks. Streamflow was intermittent, with pockets of standing water that formed pools of various depths. Water was being diverted into the Main Canal to allow biannual inspection of the Mendota Dam.

Columbia Canal intake confluence with the San Joaquin River (CC)

The San Joaquin River was sampled at the mouth of the Columbia Canal intake. In-channel substrate was very stable and consisted of clay-mud and a mix of sand and cobble near armored banks. Emergent vegetation (*Ludwigia* sp.) was growing 5 feet from the edge of the bank, and small patches of aquatic vegetation (*Elodea* sp. and *Myriophyllum* sp.) were found in-channel.

Firebaugh Canal intake

Water depth adjacent to the intake was too shallow to sample. No fish were visually observed near the intake structure. A snowy egret was observed fishing in a small flowing channel approximately 500 feet from the intake. No vegetation was found in-channel or near the low-water banks.

Delta-Mendota Canal outlet (DMC)

The southern bank (opposite of the boat dock) of the canal was sampled approximately 500 feet downstream of its outlet. The in-channel substrate consisted of a stable hard clay/mud bottom near the outlet and became unstable mud/silt towards the Pool. Little or no aquatic emergent vegetation was found at the sampling location.

Fresno Slough upstream of White's Bridge (WBR)

The southern Fresno Slough was sampled approximately 1,000 feet upstream of the White's Bridge on the eastern bank. The water level had receded 25 feet from the average water level as a result of draining the Pool. The in-channel substrate was dominated by sand/mud with a fine amount of silt. Emergent vegetation was found growing near the edge of bank. Sparse emergent vegetation (*Scirpus* sp.) was found near the low-water bank. Aquatic vegetation was sparse.

The fish community in the Pool was dominated by a mix of introduced and native species (Table 3-14). Dominant species in the catch included threadfin shad, bluegill, inland silverside, and redear sunfish.

3.7.2.2 Special-Status Species

Several special-status wildlife species have been recorded near the Mendota Pool including giant garter snakes, Swainson's hawks, yellow-billed cuckoos, and bank swallows (Jones and Stokes 1995). Swainson's hawks may be the only special-status wildlife species remaining near the Mendota Pool. Yellow-billed cuckoos have not been sighted there since the 1950s, and giant garter snakes and bank swallow have not been detected since 1976 and 1980, respectively (Jones and Stokes 1995). Sanford's arrowhead is apparently the only special-status plant species that has been recorded near the Mendota Pool (Jones and Stokes 1995).

3.7.3 Fallow Agricultural Lands

A variety of row, orchard, and vine crops are produced in WWD, and the proportions represented by different crops vary each year. Similarly, the amount of fallow land varies annually, and may range from 16,340 acres (as in 1984) to 125,082 acres (as in 1991). Fallow lands are temporarily removed from production and are a normal part of agricultural processes in the San Joaquin Valley. In contrast, idle lands are areas that are removed from production for extended periods and generally remain unmanaged (i.e., unplowed). Very little arable land in WWD remains idle (J. Bryner 2001, pers. comm.). Idle lands near known special-status populations have a higher probability of being recolonized with endangered species than fallow lands that are part of normal farm operations.

While it is true that land idled near native habitat may become occupied by threatened or endangered species, it is also true that land is idled or fallowed and subsequently brought back into agricultural production for reasons not related to this action. Extended drought, lowered prices for commodities, increased power costs, and routine rotation of crops are all causes for lands to be fallowed or idled and later replanted. Fallowed land is routinely disced for weed control, and idled land is usually brought back into production in years when water is abundant.

3.7.3.1 Special-Status Species

Because of the large size of the WWD, numerous special-status wildlife species have been observed within its boundaries, including Swainson's hawks, prairie falcons, burrowing owls, San Joaquin antelope squirrels, San Joaquin pocket mice, giant kangaroo rats, Fresno kangaroo rats, Tipton kangaroo rats, San Joaquin kit foxes, and blunt-nosed leopard lizards (Jones and Stokes 1995). Many of these sightings were made in remnant habitat areas along levees and along the margins of roads and fields. Some of these species, including many of the rodents, were originally present in the area but have been largely eliminated from their former habitat areas. Special-status plants that have been recorded in the WWD are Lost Hills crownscale and San Joaquin woolythreads.

3.7.4 ENDANGERED AND THREATENED SPECIES

A list of Federal and State threatened, endangered, proposed listed, candidate, rare, species of concern, and/or species of special concern that may occur in the study area was requested from the USFWS on August 29, 2001. On October 24, 2001, the USFWS provided a list of protected species in the eleven 7.5-minute USGS quadrangles surrounding the action vicinity. A list of state endangered, threatened, proposed listed, candidate, rare, and species of special concern was obtained from a query of the CNDDB. In addition, a letter from W. Loudermilk, Regional Manager San Joaquin Valley and

Southern Sierra Region CDFG, dated July 13, 2001, identified protected species in the action vicinity.

Table 3-15 lists species that CDFG identified as special status species in the study area (Loudermilk 2001). The table lists the species name, listing, the most recent sighting recorded within the action area according to the CNDD, habitat requirements for the species, site use, and when breeding occurs. The USGS quads used to run the CNDDB include Mendota, Tranquillity, Firebaugh, Poso Farm Oxalis, Dos Palos, Charleston School, Coit Ranch, Jamesan, San Joaquin, and Helm. The table also includes species identified by the USFWS, primarily those listed in Jamesan, Tranquillity, Coit Ranch, Mendota Dam, and Firebaugh USGS quadrangles. Included are species that CDFG and USFWS have identified in comments to the EA for the 2001 pumping program (Reclamation 2001a) and in personal communications. Species most likely to be found in upland desert habitats were not included. Desert habitats do not occur is this highly agricultural area. Plant species that CDFG and USFWS have identified are listed in Table 3-16.

Wetland/aquatic and riparian species are most likely to be affected by changes in water quality. These impacts could occur directly to the organism or their habitat or indirectly, such as impacts on their foodbase. Terrestrial or grassland species could be affected by increased flooding due to land subsidence. Some species, such as the giant garter snake, utilize both aquatic and upland habitats.

The giant garter snake (*Thamnophis gigas*) is listed as threatened under the federal Endangered Species Act and California Endangered Species Act. This species has the potential to be affected by the proposed action. The giant garter snake is endemic to wetlands in the Sacramento and San Joaquin Valleys. It inhabits marshes, Sloughs, ponds, small lakes, and low gradient streams, and may be found in irrigation and drainage canals and in rice fields. Giant garter snakes utilize wetland areas during their active season, but move to higher elevation uplands for cover and refuge from floodwaters during their winter dormant period. During the dormant period, the giant garter snake inhabits small mammal burrows above flood elevations. Breeding occurs between March and April, with young born between July and September. The giant garter snake feeds on aquatic prey, including amphibians and small fish.

Historically, the MWA, Mendota Pool, and the Grasslands supported robust populations of the giant garter snake (USFWS 1993). Since the late 1970s, the population levels in the project vicinity have declined due to a variety of factors, including predatory fish, flooding, vehicular mortality, disturbance, and elevated levels of selenium and salinity in the Grasslands. The most recent sighting recorded in the CNDDB of the giant garter snake in the vicinity of the Pool and MWA was in 1999.

3.8 LAND USE

All MPG irrigated lands, in the WWD and SLWD, are located in western Fresno County. In the Fresno County General Plan, the area containing the MPG farmlands in WWD and SLWD is designated as the Westside Valley Area. This area is generally bounded by the Coast Ranges to the west, the Fresno Slough to the east, and the county borders to the north and south. Also included in the action area of effect is a small area of southwestern Madera County along the Chowchilla Bypass north of the San Joaquin River (Figure 1-3). This area is located in the San Joaquin Valley portion of Madera County.

Lands in these areas of Fresno and Madera Counties are predominately used for agriculture and irrigated agriculture. Agriculture is a significant part of the economic base for the county. Specific crop patterns change in response to market demands, but significant acreage is devoted to permanent crops such as orchards and vineyards.

3.9 TRANSPORTATION

Fresno County is a regional hub for business and industry in the San Joaquin Valley. It is centrally located between the San Francisco and Los Angeles metropolitan regions. Its location attracts businesses that produce agricultural and nonagricultural products for distribution to other parts of the state and the country, as well as businesses that support agriculture and transport/distribution industries. Interstate-5 provides access to north-south travel throughout the state and Highway 180 provides east-west travel through Fresno County and access to Highway 99. Transportation in the immediate action area is provided by a network of rural county roads.

3.10 AIR QUALITY

The Mendota Pool is located within the San Joaquin Valley Air Basin. Comprising about 24,840 square miles, the air basin represents approximately 16 percent of the geographic area of California and is the second largest air basin in the state. Major urban centers in the air basin include Bakersfield, Fresno, Modesto, and Stockton.

Air quality is regulated by both federal and California Ambient Air Quality Standards (AAQS). Federal AAQS establish primary and secondary national AAQS. National primary standards define air quality levels that are protective of public health, while the secondary standards are protective of public welfare (i.e., they prevent degradation of the environment, impaired visibility, damage to vegetation and property, etc.).

The San Joaquin Valley Air Basin has a Mediterranean climate generally consisting of hot dry summers and cool wet winters. Approximately 90 percent of the rainfall occurs between November and April, with little to no precipitation from late spring to early fall. Semi-permanent systems of high barometric pressure from fronts frequently establish over the air basin, deflecting low pressure systems that might otherwise bring cleansing rain and wind. The strength and duration of the inversion determines the amount of atmospheric mixing that will occur, which subsequently contributes to PM10 concentrations (i.e. airborne dust) in the air basin (SJVUAPCD 1994). Coupled with the topography, the prevailing summer climate conditions allow small particles of man-made compounds, as well as soot, ash, and dust, to become suspended in the air and subsequently trapped by the surrounding mountains.[2]

The San Joaquin Valley Air Basin has recently been reclassified from a serious nonattainment area to a severe nonattainment area as a result of its failure to meet federal AAQS for ozone, making the San Joaquin Valley one of the most polluted parts of the country. This San Joaquin Valley Air Pollution Control District alleges that its failure to attain the federal AAQS is in part due to air emissions generated in the Bay Area. Based on a 1994 San Joaquin Valley Air Quality Study, ozone emissions are transported from the Bay Area to the San Joaquin Valley via the Altamont Pass, thus contributing to emissions in the San Joaquin Valley[3].

3.11 NOISE

Magnitude and frequency of environmental noise vary considerably over the course of the day and throughout the week, caused in part by changing conditions and the effects of seasonal vegetative covers. Two measures of sound level used by federal agencies for the time-varying quality of environmental noise are the equivalent sound level (L_{eq}) and the average day/night sound level (L_{dn}). The L_{eq} is an A-weighted sound level containing the same sound energy as the instantaneous sound levels measured over a specific time period. The L_{dn} takes into account the duration and time of day that a noise is encountered. Late night and early morning noise levels are adjusted by adding 10 decibels (dBA) to the measurement. Daytime noise

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2 About the District, The Air Quality Mission, http://www.valleyair.org/General_info/aboutdist.htm)

3 Valley Air District to sue state over smog drift from Bay Area, February 20, 2002, San Joaquin Valley Air Polluton Control District Media Release, http://www.valleyair.org/Recent_news/Media_releases/lawsuitmediarelease.pdf.)

levels are not adjusted. After adjustment, the hourly values are used to determine a 24-hour average sound level.

The U.S. Environmental Protection Agency (EPA) has identified 55 dBA as being the maximum sound level that will not adversely affect public health and welfare by interfering with speech or other activities in outdoor areas. Noise attributed to any additional groundwater pump operation must not exceed a L_{dn} for 55 dBA at any preexisting noise-sensitive areas (schools, hospitals, or residences). A L_{dn} of 55 dBA is the evaluation threshold for noise impacts.

The City of Mendota is approximately 1 mile west of the nearest Mendota Pool production well. Most of the lands near the action area are used for agricultural production with few, if any, residences in close proximity to any production wells.

3.12 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

The action is located in unincorporated Fresno County generally referred to as the Westside Valley Area of the county. The study area for evaluation of socioeconomic impacts includes incorporated cities of Firebaugh, Mendota, San Joaquin, and Huron. These communities are within commuting distances to the MPG irrigated lands. The study area does not include communities outside of Fresno County because socioeconomic impacts are expected to be related primarily to agricultural employment nearest to the MPG irrigated lands.

Demographic and economic data for the western Fresno region was compiled from the U.S. Census Bureau and the California Department of Finance. Unless otherwise noted, all data presented below are from the U.S. Census 2000 estimates.

3.12.1 POPULATION

Lands included in the proposed action are located in unincorporated Fresno County, in an area characterized by low population density. These lands are located in four census county subdivisions with a total population of approximately 40,000 persons. The total population of Fresno County in 2000 was approximately 800,000, with over 80 percent of the population living in urbanized areas. According to the 2000 census, about 36 percent of the total county population was under the age of 19, about 54 percent was between the ages of 19 and 64, and about 10 percent was over the age of 64.

Huron is the largest city in the study area with a population of 13,105 (2000). The second largest city is Mendota, with a population of 10,028 (2000). The study area had a total population of 39,390, of which 4,545 persons were inmates in the State prison. Residents in the study area showed a slightly larger number of persons per household (4 versus 3) and a higher proportion of minorities compared to the county (over 87 percent versus 44 percent). The western valley area of the county also has a higher percentage of families in poverty, 32 percent, compared to the county at 18 percent. Overall unemployment in the cities (Firebaugh, Mendota, San Joaquin, and Huron) in 2001 ranged between 10 and 34 percent, without seasonal adjustment. This is generally higher than the county’s 13 percent unemployment in the same year. This is potentially due to the seasonal nature of agricultural employment.

3.12.2 INDUSTRY

Agriculture is the largest industry in Fresno County. In 2000, Fresno County was ranked number one in the state for its agricultural production value, which was estimated at nearly 3.5 million dollars. Nearly 50 percent of the county land area is devoted to farms.

3.12.3 ENVIRONMENTAL JUSTICE

The memorandum accompanying Executive Order 12898 identifies that one method to consider environmental justice under NEPA is to address, whenever feasible, significant and adverse environmental effects of proposed federal actions on minority populations, low-income populations, and Indian tribes. In addition, each federal agency must provide opportunities for effective community participation in the NEPA process.

The market for seasonal workers on local farms draws thousands of migrant workers, commonly of Hispanic origin. The population of some small communities typically increases during harvest.

Table 3-1. Monthly Climate Summary for Five Points Weather Station[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	54.70	62.90	68.20	75.60	84.30	92.20	96.80	94.50	88.80	79.60	64.80	54.40	76.40
Mean Temperature (F)	45.50	51.20	55.00	60.30	67.50	74.70	79.50	78.00	73.10	64.80	53.00	45.10	62.30
Average Min. Temperature (F)	36.30	39.50	41.80	45.00	50.70	57.20	62.10	61.50	57.40	49.90	41.30	35.80	48.20
Maximum Total Precipitation (in.)	4.91	4.50	3.56	1.58	0.93	2.50	0.40	0.36	2.64	1.08	3.09	2.38	14.57
Average Total Precipitation (in.)	1.31	1.21	1.06	0.50	0.14	0.15	0.03	0.03	0.26	0.29	0.83	0.86	6.67
Minimum Total Precipitation (in.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.95
Evapotranspiration (Et_0, inches)[2]	1.27	2.00	3.95	6.11	7.74	8.46	8.69	7.96	6.18	4.51	2.35	1.17	60.39

[1]NCDC 1961-1990 Monthly Normals (Western Regional Climate Center, http://www.wrcc.dri.edu/; 5/24/2002)

[2]Five Points - reference evapotranspiration (California Irrigation Management System, http://www.cimis.water.ca.gov/, 5/24/2002)

Table 3-2. Summary Water Budget for the Mendota Pool (May-September, 1997-2001)

Component	1997 Inflow (cfs)	1997 Outflow (cfs)	1998[a] Inflow (cfs)	1998[a] Outflow (cfs)	1999 Inflow (cfs)	1999 Outflow (cfs)	2000 Inflow (cfs)	2000 Outflow (cfs)	2001 Inflow (cfs)	2001 Outflow (cfs)
Northern Pool										
San Joaquin River	116.5		660.8		97.3		43.7			
Delta-Mendota Canal	2004.5		896.4		1945.2		1912.2			
MPG Wells in FWD	22.4		0.0		12.3		27.3			
Exchange Contractors		1336.0		1463.9		1344.0		1275.7		
SLCC Arroyo Canal		348.8		417.7		408.0		380.5		
San Joaquin River		-0.4		1840.0		2.8		9.7		
Newhall Land & Farming		23.9		7.9		4.2		3.0		
Evaporation		3.2		2.5		2.8		2.2		
Seepage[c]		8.0		8.0		8.0		8.0		
Totals for Northern Pool	**2143.5**	**1719.5**	**1557.2**	**3740.0**	**2054.9**	**1769.8**	**1983.2**	**1679.2**		
Southern Pool										
MPG Wells Along Fresno Slough	79.7		4.2		51.3		66.6		62.5	
James Bypass	0.0		2362.6		0.0		0.0		0.0	
James & Tranquillity ID, Fresno Slough WD	0.0		0.0		0.5		5.9		9.6	
James & Tranquillity ID		225.2		115.5		188.8		182.9		159.3
Mendota Wildlife Area		43.0		27.8		46.2		51.4		50.4
Lateral 6&7		46.6		63.2		42.8		22.7		23.6
Other[b]		35.5		18.6		13.3		27.2		36.8
Evaporation		16.0		12.2		13.7		11.0		14.6
Seepage[c]		39.3		39.3		39.3		39.3		39.3
Totals for Southern Pool	**79.7**	**405.6**	**2366.9**	**276.5**	**51.9**	**344.1**	**72.6**	**334.6**	**72.1**	**324**

[a] 1998 was a wet year with significant inflows from the San Joaquin River and the James Bypass throughout the irrigation season.
[b] Includes Terra Linda Farms, Coelho/Gardner/Hanson, Meyers Farming, Reclamation District 1606, Hughes, Melvin, Wilson, and Fresno Slough Water District.
[c] Seepage was estimated based on measurements made over a 2-day period in November 1999, and was assumed to be constant.

Table 3-3. Recent Surface Water Quality Laboratory Results (2001-2002) [1]

Sample Date	Lab[2]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
San Joaquin River Arm									
Columbia Canal									
7/19/2001	FGL	421	-	-	-	-	-	-	-
9/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/3/2001	BSK	630	-	-	-	-	0.2	-	DQO
6/25/2002	FGL	383	240	7.8	1.6	3	0.16	-	-
6/25/2002	OBL	-	-	-	-	-	-	5.1	0.71
7/10/2002	BSK	320					0.1		
8/22/2002	BSK	450					0.1		
9/10/2002	BSK	610					0.2		
10/2/2002	BSK	610					0.2		
Minimum detected value or detection limit		**383**	**240**	**7.8**	**1.6**	**3**	**0.16**	**5.1**	**0.71**
Maximum detected value		**660**	**240**	**7.8**	**1.6**	**3**	**0.20**	**5.1**	**0.71**
Mean of detected values		**524**	**240**	**7.8**	**1.6**	**3**	**0.19**	**5.1**	**0.71**
Northern Fresno Slough									
Mendota Dam									
7/19/2001	FGL	390	-	-	-	-	-	-	-
7/19/2001	OBL	-	-	-	-	<3	<0.25	3.4	0.59
11/5/2001	FGL	668	380	8.0	2.7	<2	0.25	-	-
11/5/2001	OBL	-	-	-	-	-	-	2.8	0.59
6/25/2002	FGL	344	210	7.9	1.4	3	0.15	-	-
6/25/2002	OBL	-	-	-	-	-	-	1.6	0.68
CCID Main Canal									
1/3/2001	USBR	222	-	7.9	-	-	-	-	-
1/3/2001	OBL	-	-	-	-	-	-	-	0.65
2/7/2001	USBR	595	-	7.7	-	-	-	-	-
2/7/2001	OBL	-	-	-	-	-	-	-	1.08
3/8/2001	USBR	562	-	7.7	-	-	-	-	-
3/8/2001	OBL	-	-	-	-	-	-	-	2.32
4/3/2001	USBR	778	-	-	-	-	-	-	-
4/3/2001	OBL	-	-	-	-	-	-	-	2.96
5/9/2001	USBR	513	-	-	-	-	-	-	-
5/9/2001	OBL	-	-	-	-	-	-	-	0.56
6/6/2001	USBR	488	-	-	-	-	-	-	-
6/6/2001	OBL	-	-	-	-	-	-	-	0.99
6/26/2001	USBR	452	-	-	-	-	-	-	-
6/26/2001	OBL	-	-	-	-	-	-	-	<0.4
7/19/2001	FGL	410	-	-	-	-	-	-	-
7/19/2001	OBL	-	-	-	-	<3	<0.25	3.6	0.6
7/24/2001	USBR	423	-	-	-	-	-	-	-
7/24/2001	OBL	-	-	-	-	-	-	-	0.89
8/29/2001	USBR	639	-	-	-	-	-	-	-
8/29/2001	OBL	-	-	-	-	-	-	-	0.78

Table 3-3. Recent Surface Water Quality Laboratory Results (2001-2002) [1]

Sample Date	Lab[2]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
9/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/2/2001	USBR	720	-	-	-	-	-	-	-
10/2/2001	OBL	-	-	-	-	-	-	-	0.48
10/3/2001	BSK	630	-	-	-	-	0.2	-	DQO
10/30/2001	USBR	666	-	-	-	-	-	-	-
10/30/2001	OBL	-	-	-	-	-	-	-	<0.4
11/5/2001	FGL	657	390	8.0	2.8	<2	0.21	-	-
11/5/2001	OBL	-	-	-	-	-	-	3.3	0.57
12/5/2001	USBR	982	-	-	-	-	-	-	-
12/5/2001	OBL	-	-	-	-	-	-	-	0.82
1/8/2002	USBR	698	-	-	-	-	-	-	-
2/7/2002	USBR	197	-	-	-	-	-	-	-
6/25/2002	FGL	387	240	7.9	1.5	3	0.17	-	-
6/25/2002	OBL	-	-	-	-	-	-	4.2	0.79
7/2/2002	OBL								<0.4
7/10/2002	BSK	310					0.1		
8/7/2002	OBL								<0.4
8/22/2002	BSK	460					0.1		
9/4/2002	OBL								<0.4
9/10/2002	BSK	640					0.2		
10/2/2002	BSK	660					0.2		
10/2/2002	OBL								<0.4
11/6/2002	OBL								0.4
12/4/2002	OBL								0.8
Mowry Bridge									
7/19/2001	FGL	430	-	-	-	-	-	-	-
7/19/2001	OBL	-	-	-	-	<3	<0.25	3.6	0.7
11/5/2001	FGL	652	370	7.9	2.8	<2	0.2	-	-
11/5/2001	OBL	-	-	-	-	-	-	2.62	0.51
6/25/2002	FGL	359	250	7.7	0.1	2	0.17	-	-
6/25/2002	OBL	-	-	-	-	-	-	1.3	0.81
DMC Check 21									
1/3/2001	USBR	358	-	7.7	-	-	-	-	-
1/3/2001	OBL	-	-	-	-	-	-	-	<0.4
2/7/2001	USBR	570	-	7.8	-	-	-	-	-
2/7/2001	OBL	-	-	-	-	-	-	-	1.75
3/8/2001	USBR	543	-	7.7	-	-	-	-	-
3/8/2001	OBL	-	-	-	-	-	-	-	2.38
4/3/2001	USBR	857	-	-	-	-	-	-	-
4/3/2001	OBL	-	-	-	-	-	-	-	3.32
5/9/2001	USBR	524	-	-	-	-	-	-	-
5/9/2001	OBL	-	-	-	-	-	-	-	0.84
6/6/2001	USBR	495	-	-	-	-	-	-	-
6/6/2001	OBL	-	-	-	-	-	-	-	0.86
6/26/2001	USBR	434	-	-	-	-	-	-	-

Table 3-3. Recent Surface Water Quality Laboratory Results (2001-2002) [1]

Sample Date	Lab[2]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
6/26/2001	OBL	-	-	-	-	-	-	-	<0.4
7/19/2001	FGL	418	-	-	-	-	-	-	-
7/19/2001	OBL	-	-	-	-	<3	<0.25	3.1	0.67
7/24/2001	USBR	469	-	-	-	-	-	-	-
7/24/2001	OBL	-	-	-	-	-	-	-	0.8
8/29/2001	USBR	620	-	-	-	-	-	-	-
8/29/2001	OBL	-	-	-	-	-	-	-	0.66
9/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
9/20/2001	FGL	770	479	8.1	3.6	3	0.25	2	DQO
10/2/2001	USBR	686	-	-	-	-	-	-	-
10/2/2001	OBL	-	-	-	-	-	-	-	0.48
10/3/2001	BSK	570	-	-	-	-	0.2	-	DQO
10/30/2001	USBR	676	-	-	-	-	-	-	-
10/30/2001	OBL	-	-	-	-	-	-	-	<0.4
11/5/2001	FGL	651	380	7.9	2.8	<2	0.2	-	-
11/5/2001	OBL	-	-	-	-	-	-	2.98	0.5
12/5/2001	USBR	767	-	-	-	-	-	-	-
12/5/2001	OBL	-	-	-	-	-	-	-	1.56
1/8/2002	USBR	687	-	-	-	-	-	-	-
2/7/2002	USBR	698	-	-	-	-	-	-	-
6/5/2002	FGL	504	320	7.9	1.9	-	0.24	-	-
6/5/2002	OBL	-	-	-	-	-	-	1.0	1.19
6/25/2002	FGL	340	220	7.7	0.1	<2	0.15	-	-
6/25/2002	OBL	-	-	-	-	-	-	1.3	0.78
7/9/2002	FGL	321	210	8.0	1.4	-	0.15	-	-
8/9/2002	FGL	474	270	7.5	2.4	2	0.13	-	-
8/9/2002	OBL	-	-	-	-	-	-	<1.0	0.79
9/8/2002	FGL	535	304	7.8	2.4	-	0.14	-	-
9/20/2002	FGL	623	360	-	-	-	-	-	-
7/2/2002	OBL								0.5
7/9/2002	FGL	321	210	8	1.4		0.15		
7/10/2002	BSK	300					0.1		
8/7/2002	OBL								<0.4
8/9/2002	FGL	474	270	7.5	2.4	2	0.13		
8/9/2002	OBL							<1	0.79
8/22/2002	BSK	490					0.1		
9/4/2002	OBL								0.5
9/8/2002	FGL	535	304	7.8	2.4		0.14		
9/10/2002	BSK	620					0.1		
9/20/2002	FGL	623	360						
9/20/2002	OBL							<1	1.34
10/2/2002	BSK	660					0.2		
10/2/2002	OBL								<0.4
10/4/2002	FGL	637	381	7.9	3.1	3	0.2		
11/4/2002	FGL	605	353	8.1	3	<2	0.15		
11/4/2002	OBL							<1	<0.4

Table 3-3. Recent Surface Water Quality Laboratory Results (2001-2002) [1]

Sample Date	Lab[2]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
11/6/2002	OBL								0.6
12/4/2002	OBL								0.9
12/26/2002	FGL	817	506	7.8	3.1	2	0.4		
12/26/2002	OBL							4.3	1.9
CCID Outside Canal									
1/3/2001	USBR	592	-	7.8	-	-	-	-	-
1/3/2001	OBL	-	-	-	-	-	-	-	<0.4
2/7/2001	USBR	514	-	7.8	-	-	-	-	-
2/7/2001	OBL	-	-	-	-	-	-	-	1.1
3/8/2001	USBR	550	-	7.7	-	-	-	-	-
3/8/2001	OBL	-	-	-	-	-	-	-	2.18
4/3/2001	USBR	683	-	-	-	-	-	-	-
4/3/2001	OBL	-	-	-	-	-	-	-	2.69
5/9/2001	USBR	525	-	-	-	-	-	-	-
5/9/2001	OBL	-	-	-	-	-	-	-	0.95
6/6/2001	USBR	463	-	-	-	-	-	-	-
6/6/2001	OBL	-	-	-	-	-	-	-	0.92
6/26/2001	USBR	445	-	-	-	-	-	-	-
6/26/2001	OBL	-	-	-	-	-	-	-	<0.4
7/19/2001	FGL	417	-	-	-	-	-	-	-
7/19/2001	OBL	-	-	-	-	<3	<0.25	3.8	0.69
7/24/2001	USBR	479	-	-	-	-	-	-	-
7/24/2001	OBL	-	-	-	-	-	-	-	1.0
8/29/2001	USBR	624	-	-	-	-	-	-	-
8/29/2001	OBL	-	-	-	-	-	-	-	0.93
9/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/2/2001	USBR	731	-	-	-	-	-	-	-
10/2/2001	OBL	-	-	-	-	-	-	-	0.4
10/3/2001	BSK	680	-	-	-	-	0.2	-	DQO
10/30/2001	USBR	667	-	-	-	-	-	-	-
10/30/2001	OBL	-	-	-	-	-	-	-	0.49
11/5/2001	FGL	662	370	8.0	2.9	<2	0.2	-	-
11/5/2001	OBL	-	-	-	-	-	-	2.48	0.51
12/5/2001	USBR	866	-	-	-	-	-	-	-
12/5/2001	OBL	-	-	-	-	-	-	-	0.68
1/8/2002	USBR	887	-	-	-	-	-	-	-
2/7/2002	USBR	336	-	-	-	-	-	-	-
6/25/2002	FGL	387	250	7.7	0.1	<2	0.17	-	-
6/25/2002	OBL	-	-	-	-	-	-	1.9	0.83
7/2/2002	OBL								<0.4
7/10/2002	BSK	310					0.1		
8/7/2002	OBL								<0.4
8/22/2002	BSK	450					0.1		
9/4/2002	OBL								<0.4

Table 3-3. Recent Surface Water Quality Laboratory Results (2001-2002) [1]

Sample Date	Lab[2]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
9/10/2002	BSK	630					0.2		
10/2/2002	BSK	660					0.2		
10/2/2002	OBL								<0.4
11/6/2002	OBL								0.5
12/4/2002	OBL								<0.4
Firebaugh Intake Canal									
7/19/2001	FGL	423	-	-	-	-	-	-	-
7/19/2001	OBL	-	-	-	-	<3	<0.25	3.5	0.67
9/12/2001	BSK	660	-	-	-	-	0.2	-	DQO
10/3/2001	BSK	590	-	-	-	-	0.2	-	DQO
11/5/2001	FGL	664	390	8.0	2.8	<2	0.22	-	-
11/5/2001	OBL	-	-	-	-	-	-	3.1	0.46
6/25/2002	FGL	401	260	7.9	0.1	2	0.18	-	-
6/25/2002	OBL	-	-	-	-	-	-	2.1	0.84
7/10/2002	BSK	320					0.1		
8/22/2002	BSK	450					0.1		
9/10/2002	BSK	640					0.2		
10/2/2002	BSK	770					0.2		
West of Fordel									
7/19/2001	FGL	390	-	-	-	-	-	-	-
11/5/2001	FGL	675	380	8.7	3.0	<2	0.2	-	-
11/5/2001	OBL	-	-	-	-	-	-	2.42	0.505
6/25/2002	FGL	358	220	8.7	0.1	3	0.16	-	-
6/25/2002	OBL	-	-	-	-	-	-	1.4	0.71
Minimum detected value or detection limit		**197**	**210**	**7.5**	**0.1**	**2**	**0.10**	**1.00**	**<0.4**
Maximum detected value		**982**	**506**	**8.7**	**3.6**	**3**	**0.40**	**4.30**	**3.32**
Mean of detected values		**555**	**320**	**7.9**	**2.0**	**3**	**0.18**	**2.69**	**0.96**
Central Fresno Slough									
Etchegoinberry									
7/19/2001	FGL	423	-	-	-	-	-	-	-
11/5/2001	FGL	854	500	8.2	4.7	<2	0.3	-	-
11/5/2001	OBL	-	-	-	-	-	-	4.05	0.47
6/25/2002	FGL	439	280	8.0	1.9	3	0.18	-	-
6/25/2002	OBL	-	-	-	-	-	-	2.4	0.67
Minimum detected value or detection limit		**423**	**280**	**8.0**	**1.9**	**<2**	**0.18**	**2.40**	**0.47**
Maximum detected value		**854**	**500**	**8.2**	**4.7**	**3**	**0.30**	**4.05**	**0.67**
Mean of detected values		**572**	**390**	**8.1**	**3.3**	**3**	**0.24**	**3.23**	**0.57**
Southern Fresno Slough									
Mendota Wildlife Area[3]									
1/31/2001	FGL	853	540	7.8	4.3	-	0.28	-	-
2/22/2001	FGL	682	430	7.8	2.7	-	0.33	-	-
3/28/2001	FGL	670	440	7.9	3.1	-	0.35	-	-

Table 3-3. Recent Surface Water Quality Laboratory Results (2001-2002) [1]

Sample Date	Lab[2]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
4/25/2001	FGL	772	490	8.2	4.0	-	0.41	-	-
5/30/2001	FGL	1,030	650	8.5	6.1	<2	0.32	6	DQO
6/26/2001	FGL	711	457	8.4	4.1	2	0.26	4	DQO
7/19/2001	FGL	573	367	8.8	3.2	-	-	-	-
7/19/2001	OBL	-	-	-	-	<3	0.2	4.2	0.62
8/15/2001	FGL	660	430	9.0	4.0	2	0.21	3	DQO
9/10/2001	FGL	1,010	600	-	-	-	-	-	-
9/20/2001	FGL	777	492	8.7	4.3	2	0.21	3	DQO
11/5/2001	FGL	1060	610	8.4	6.2	<2	0.33	-	-
11/5/2001	OBL	-	-	-	-	-	-	8.42	<0.4
6/5/2002	FGL	678	440	8.4	3.3	-	0.22	-	-
6/5/2002	OBL	-	-	-	-	-	-	2.0	0.73
6/25/2002	FGL	667	410	8.6	0.1	<2	0.23	-	-
6/25/2002	OBL	-	-	-	-	-	-	3.0	0.7
7/9/2002	FGL	533	340	8.6	2.9	-	0.20	-	-
7/15/2002	FGL	514	330	-	-	-	-	-	DQO
7/25/2002	FGL	500	280	-	-	-	-	-	-
8/9/2002	FGL	659	400	8.4	3.9	<2	0.17	-	-
8/9/2002	OBL	-	-	-	-	-	-	2.2	0.54
8/14/2002	FGL	613	370	-	-	-	-	-	-
8/19/2002	FGL	658	400	-	-	-	-	-	-
9/8/2002	FGL	849	515	8.3	4.2	-	0.3	-	-
9/20/2002	FGL	824	500	-	-	-	-	-	-
7/9/2002	FGL	533	340	8.6	2.9	2	0.2		
7/15/2002	FGL	514	330						
7/25/2002	FGL	500	280						
8/9/2002	FGL	659	400	8.4	3.9	<2	0.17		
8/9/2002	OBL							2.2	0.54
8/14/2002	FGL	613	370						
8/19/2002	FGL	658	400						
9/8/2002	FGL	849	515	8.3	4.2		0.25		
9/20/2002	FGL	824	500						
9/20/2002	OBL							1.1	0.5
9/27/2002	FGL	823	490						
10/4/2002	FGL	850	520	8.3	4.5	2	0.2		
10/11/2002	FGL	717	410						
10/17/2002	FGL	654	380						
11/4/2002	FGL	620	366	8.4	2.8	<2	0.17		
11/4/2002	OBL							<1	<0.4
12/26/2002	FGL	630	401	7.9	2.7	<2	0.27		
12/26/2002	OBL							2	1.16
Lateral 6 & 7									
1/31/2001	FGL	742	480	7.8	3.9	-	0.25	-	-
2/22/2001	FGL	787	500	8.4	3.5	-	0.27	-	-
3/28/2001	FGL	680	450	8.4	2.9	-	0.32	-	-

Table 3-3. Recent Surface Water Quality Laboratory Results (2001-2002) [1]

Sample Date	Lab[2]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
4/25/2001	FGL	718	480	8.5	4.5	-	0.26	-	-
5/30/2001	FGL	1,020	650	8.4	5.2	<2	0.33	5	DQO
6/26/2001	FGL	820	529	9.0	4.5	4	0.33	6	DQO
7/19/2001	FGL	677	446	8.7	3.8	-	-	-	-
7/19/2001	OBL	-	-	-	-	<3	0.23	5.5	0.69
8/15/2001	FGL	685	440	8.7	4.5	3	0.21	3	DQO
9/20/2001	FGL	1,020	650	8.4	5.7	3	0.27	5	DQO
11/5/2001	FGL	889	560	8.5	4.8	<2	0.26	-	-
11/5/2001	OBL	-	-	-	-	-	-	5.42	0.475
6/5/2002	FGL	720	470	8.2	3.5	-	0.25	-	-
6/5/2002	OBL	-	-	-	-	-	-	1.0	0.9
7/9/2002	FGL	459	300	8.2	2.3	-	0.23	-	-
7/15/2002	FGL	533	340	-	-	-	-	-	DQO
7/25/2002	FGL	522	310	-	-	-	-	-	-
8/9/2002	FGL	675	420	8.0	3.8	2	0.21	-	-
8/9/2002	OBL	-	-	-	-	-	-	1.6	0.512
8/14/2002	FGL	680	390	-	-	-	-	-	-
8/19/2002	FGL	680	410	-	-	-	-	-	-
9/8/2002	FGL	742	451	8.2	3.7	-	0.2	-	-
9/20/2002	FGL	874	540	-	-	-	-	-	-
7/9/2002	FGL	459	300	8.2	2.3	3	0.23		
7/15/2002	FGL	533	340						
7/25/2002	FGL	522	310						
8/9/2002	OBL							1.6	0.51
8/9/2002	FGL	675	420	8	3.8	2	0.21		
8/14/2002	FGL	680	390						
8/19/2002	FGL	680	410						
9/8/2002	FGL	742	451	8.2	3.7		0.22		
9/20/2002	FGL	874	540						
9/20/2002	OBL							2.8	0.71
9/27/2002	FGL	906	540						
10/4/2002	FGL	851	529	8.2	4.5	2	0.21		
10/11/2002	FGL	872	520						
10/17/2002	FGL	781	450						
11/4/2002	OBL							1.4	<0.4
11/4/2002	FGL	694	400	8.6	3.3	<2	0.17		
12/26/2002	OBL							3.5	0.9
12/26/2002	FGL	752	476	8.5	3.2	2	0.21		
James ID (Booster Plant)									
1/31/2001	FGL	710	450	8.2	4.2	-	0.3	-	-
3/28/2001	FGL	805	510	8.6	4.1	-	0.35	-	-
4/25/2001	FGL	826	550	8.4	6.4	-	0.37	-	-
5/30/2001	FGL	824	540	8.7	5.7	10	0.38	8	DQO
6/26/2001	FGL	784	514	8.7	4.4	2	0.29	5	DQO
7/19/2001	FGL	665	442	8.6	3.8	-	-	-	-
7/19/2001	OBL	-	-	-	-	<3	0.23	4.9	0.57

Table 3-3. Recent Surface Water Quality Laboratory Results (2001-2002) [1]

Sample Date	Lab[2]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
8/15/2001	FGL	687	440	8.5	3.9	3	0.21	3	DQO
9/20/2001	FGL	1,030	656	8.2	5.6	3	0.28	5	DQO
11/5/2001	FGL	933	580	8.4	4.8	<2	0.27	-	-
11/5/2001	OBL	-	-	-	-	-	-	6.68	0.585
6/5/2002	FGL	708	440	8.0	3.4	-	0.25	-	-
6/5/2002	OBL	-	-	-	-	-	-	2.0	0.95
7/9/2002	FGL	463	300	8.3	2.4	-	0.22	-	-
7/15/2002	FGL	530	320	-	-	-	-	-	DQO
7/25/2002	FGL	512	310	-	-	-	-	-	-
8/9/2002	FGL	672	420	7.7	2.5	2	0.13	-	-
8/9/2002	OBL	-	-	-	-	-	-	1.2	0.638
8/14/2002	FGL	666	390	-	-	-	-	-	-
8/19/2002	FGL	671	400	-	-	-	-	-	-
9/8/2002	FGL	737	470	8.1	3.6	-	0.22	-	-
9/20/2002	FGL	860	510	-	-	-	-	-	-
7/9/2002	FGL	463	300	8.3	2.4		0.22		
7/15/2002	FGL	530	320						
7/25/2002	FGL	512	310						
8/9/2002	FGL	672	420	7.7	2.5	2	0.13		
8/9/2002	OBL							1.2	0.64
8/14/2002	FGL	666	390						
8/19/2002	FGL	671	400						
9/8/2002	FGL	737	470	8.1	3.6		0.22		
9/20/2002	FGL	860	510						
9/20/2002	OBL							6.5	0.69
9/27/2002	FGL	935	560						
10/4/2002	FGL	940	587	8.1	5.3	2	0.25		
10/11/2002	FGL	893	530						
10/17/2002	FGL	874	510						
11/4/2002	FGL	755	423	8.4	3.6	<2	0.19		
11/4/2002	OBL							3.3	<0.4
12/26/2002	FGL	719	430	8.1	3.7	<2	0.21		
12/26/2002	OBL							4.2	0.61
Tranquillity ID Intake									
7/25/2002	FGL	540	320	-	-	-	-	-	DQO
8/9/2002	FGL	712	410	-	-	-	-	-	DQO
8/14/2002	FGL	703	420	-	-	-	-	-	DQO
8/19/2002	FGL	672	390	-	-	-	-	-	DQO
9/8/2002	FGL	1570	925	8.0	12.2	-	1.29	-	DQO
9/20/2002	FGL	1790	1080	-	-	-	-	-	DQO
7/25/2002	FGL	540	320						
8/9/2002	FGL	712	410						
8/14/2002	FGL	703	420						
8/19/2002	FGL	672	390						
9/8/2002	FGL	1570	925	8	12.2		1.29		

Table 3-3. Recent Surface Water Quality Laboratory Results (2001-2002) [1]

Sample Date	Lab[2]	EC (μmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (μg/L)	B (mg/L)	Mo (μg/L)	Se (μg/L)
9/20/2002	FGL	1790	1080						
9/27/2002	FGL	2240	1390						
10/4/2002	FGL	2370	1480						
10/11/2002	FGL	2430	1510						
10/17/2002	FGL	1330	770						
11/4/2002	FGL	977	580						
Minimum detected value or detection limit		**459**	**280**	**7.7**	**0.1**	**<2**	**0.13**	**1.00**	**<0.4**
Maximum detected value		**1,790**	**1,080**	**9.0**	**12.2**	**10**	**1.29**	**8.42**	**1.16**
Mean of detected values		**736**	**453**	**8.3**	**4.0**	**3**	**0.26**	**3.72**	**0.67**

1. Additional surface water data for 2002 were obtained subsequent to the preparation of this EIS. The supplemental data are provided in Appendix C, Table C-5.
2. Laboratory Abbreviations: BSK - BSK Analytical Laboratories, Fresno, CA; FGL - Fruit Growers Laboratory, Santa Paula, CA; USBR - U.S. Bureau of Reclamation, hydrolab field measurement (EC), OBL - Olson Biochemistry Lab, Brookings, SD; OBL - Olson Biochemistry Lab, Brookings, SD
3. Until the EC analysis on 11/18/2000, samples were taken one mile south of Whitesbridge Road. From the complete chemical analysis (11/18/2000) until 4/25/2001 samples were taken at Whitesbridge Road. Subsequent samples were taken one quarter mile south of Whitesbridge Road. The sample taken on 8/15/2001 and subsequent samples were taken at Whitesbridge Road.

DQO = Data quality objectives for this analysis were not met for this sample. Results are not included in the EIS evaluation of this parameter. Results are reported in Appendix C.

Table 3-4. Relevant Water and Sediment Quality Screening Benchmarks for Selected Constituents or Parameters

Parameter	Target Value[1]	Severe or Unacceptable Value[2]	Reference	Notes
Drinking Water Protection Criteria				
Arsenic	50 µg/L		Marshack, 2000	Primary MCL
Boron	630 µg/L		Marshack, 2000	U.S. EPA IRIS reference dose
Molybdenum	35 µg/L		Marshack, 2000	U.S. EPA IRIS reference dose
Selenium	50 µg/L		Marshack, 2000	Primary MCL
Electrical Conductivity	900 µS/cm		DWR, 2000	Recommended Secondary MCL
Total Dissolved Solids	500 mg/L		Marshack, 2000	Secondary MCL
Irrigation Water Objectives				
Arsenic	100 µg/L		Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations Toxicity to plants varies widely, ranging from 12 mg/l for Sudan grass to less than 0.05 mg/l for rice.
Boron	700 µg/L	3000 µg/L	Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations
Selenium	20 µg/L		Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations Toxic to plants at concentrations as low as 0.025 mg/l and toxic to livestock if forage is grown in soils with relatively high levels of added selenium. An essential element to animals but in very low concentrations
Electrical Conductivity	700 µS/cm	3000 µS/cm	Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations
Total Dissolved Solids	450 mg/L	2000 mg/L	Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations
Sodium Adsorption Ratio			Ayers & Westcott, 1985	Food and Agriculture Organization of the United Nations
SAR = 0-3 and EC =	>700 µS/cm	<200 µS/cm		
SAR = 3-6 and EC=	>1200 µS/cm	<300 µS/cm		
SAR = 6-12 and EC=	>1900 µS/cm	<500 µS/cm		
Sediment Objectives				
Arsenic	12.1 mg/kg d.w.	49.6 mg/kg d.w.	US EPA 1996	Effects Range Low; Severe=Effects range median (Hyalella azteca)
Selenium	2 mg/kg d.w.	4 mg/kg d.w.	Reclamation, 2000	Draft Environmental Impact Statement (EIS)/Environmental Impact Report (EIR): Grassland Bypass Project, 2001-2009 (Reclamation 2000)

Table 3-4. Relevant Water and Sediment Quality Screening Benchmarks for Selected Constituents or Parameters

Parameter	Target Value[1]	Severe or Unacceptable Value[2]	Reference	Notes
Refuge Water Supply Objectives				
Arsenic	5 µg/L	10 µg/L	CDFG, 2001	Preliminary Draft Water Quality Objectives for Refuge Water Supplies (11/14/1995) (Title 34, P.L. 102-575, Section 3406(d))
Boron	300 µg/L	600 µg/L	CDFG, 2001	Proposed California Regional Water Quality Control Board Boron and Salinity Objectives for Full Protection of Beneficial Uses in the Lower San Joaquin River at Vernalis.
Molybdenum	10 µg/L	19 µg/L	CDFG, 2001	Preliminary Draft Water Quality Objectives for Refuge Water Supplies (11/14/1995) (Title 34, P.L. 102-575, Section 3406(d))
Selenium	2 µg/L	5 µg/L	CDFG, 2001	Draft Environmental Impact Statement (EIS)/Environmental Impact Report (EIR): Grassland Bypass Project, 2001-2009 (Reclamation 2000)
Total Dissolved Solids	400 mg/L	800 mg/L	CDFG, 2001	Reclamation Water Contract # 14-OC-200-7859A for Refuge Water Supplies to Mendota WA. (5-year average; 1-year average = 450 mg/L; monthly average = 600 mg/L)
Electrical Conductivity	440 µmhos/cm	700-1000 µmhos/cm	CDFG, 2001	Proposed California Regional Water Quality Control Board Boron and Salinity Objectives for Full Protection of Beneficial Uses in the Lower San Joaquin River at Vernalis.
Aquatic Life Protection Criteria (Sacramento River and San Joaquin River Basin Plan)				
Arsenic	10 µg/L		CVRWQCB, 1998	Dissolved concentration
Boron	800 µg/L		CVRWQCB, 1998	Total concentration; Monthly mean, non-critical year
Electrical Conductivity	150 µS/cm		CVRWQCB, 1998	90th percentile; @25°C
Molybdenum	19 µg/L		CVRWQCB, 1998	Total concentration; Monthly mean
Selenium	2 µg/L		CVRWQCB, 1998	Total concentration; Monthly mean; same as Reclamation (2000)
Total Dissolved Solids	600 mg/L		CVRWQCB, 1998	Total concentration; Monthly mean; 90th percentile

[1] Target Value: Concentration below which no adverse effects are likely.
[2] Severe or Unacceptable Value: Concentration at which adverse or toxic effects may become evident.

Table 3-5. Deviations of Average Daily EC Measurements (μmhos/cm) at Canal Intakes from Concurrent Measurements at Check 21 on the DMC during 2000 and 2001

	CCID Main Canal	CCID Outside Canal	Columbia Canal	Firebaugh Canal	SLCC Arroyo Canal
2000 Pumping Program					
Outside of MPG Pumping Period					
Average	-61.7	25.0	48.3	-38.2	25.0
Minimum	-421.0	-43.0	-242.0	-383.0	-65.0
Maximum	130.0	91.0	206.0	140.0	111.0
During MPG Pumping Period					
Average	14.6	27.3	-38.8	9.1	19.9
Minimum	-23.0	-47.0	-352.0	-130.0	-182.0
Maximum	38.0	127.0	65.0	122.0	109.0
2001 Pumping Program					
Outside of MPG Pumping Period					
Average	41	25	86	33	51
Minimum	-143	-292	-78	-327	-445
Maximum	111	68	261	181	261
During MPG Pumping Period					
Average	50	11	50	30	53
Minimum	-225	-210	-235	-174	-146
Maximum	174	51	228	102	129

Note:
A negative value indicates that the water entering the canal has a lower EC than the water in the DMC.

Table 3-6. Groundwater Pumpage and Change in Groundwater Levels in Westlands Water District

Crop Year	Pumpage (af)	Elevation (ft msl)	Change in Groundwater Elevation (ft)
1976	97,000	-2	9
1977	472,000	-99	-97
1978	159,000	-4	95
1979	140,000	-13	-9
1980	106,000	4	17
1981	99,000	11	7
1982	105,000	32	21
1983	31,000	56	24
1984	73,000	61	5
1985	228,000	63	2
1986	145,000	71	8
1987	159,000	89	18
1988	160,000	64	-25
1989	175,000	63	-1
1990	300,000	9	-54
1991	600,000	-32	-41
1992	600,000	-62	-30
1993	225,000	1	63
1994	325,000	-51	-52
1995	150,000	27	78
1996	50,000	49	22
1997	30,000	63	14
1998	15,000	63	0
1999	20,000	65	2
2000	225,000	43	-22
2001	215,000	25	-18
2002	175,000		

Source: WWD (2002)

Table 3-7. Water Levels and Compaction at Fordel and Yearout Ranch Extensometers

Year	Location	Water Level[1]						Annual Compaction			Cumulative Inelastic Compaction (ft)
		Minimum Depth to Water (date)	Minimum Depth to Water (ft)	Maximum Depth to Water (date)	Maximum Depth to Water (ft)	Drawdown (ft)	Recovery (ft)	Total (ft)	Elastic (ft)	Inelastic[2] (ft)	
1999	Fordel, Inc.	01/08/99	27.7	09/06/99	88.91	61.21	58.1	NA[3]	0.0345	NA[3]	NA
	Yearout Ranch		NA		NA	NA	NA	NA[3]	0.0980	NA[3]	NA
2000	Fordel, Inc.	03/22/00	30.81	08/17/00	99.96	69.15	66.06	0.0426[4]	0.0405[4]	0.0021	0.0021
	Yearout Ranch	03/06/00	36.66	08/18/00	121.43	84.77	83.82	0.1115	0.0970	0.0145	0.0145
2001	Fordel, Inc.	02/25/01	33.9	06/28/01	89.19	55.29	52.52	0.0346	0.032[5]	0.003[5]	0.005
	Yearout Ranch	02/25/01	37.84	06/19/01	132.12	94.28	88.05	0.1090	0.0882	0.0208	0.0353
2002	Fordel, Inc.	01/07/02	35.7	07/01/02	70.5	34.80	35.29	NA	0.0243	0.001[6]	0.006[6]
	Yearout Ranch	02/25/02	44.07	07/30/02	114.02	69.95	67.75	0.095[6]	0.084[6]	0.011[6]	0.046[6]

1. Water levels at Fordel are measured at USGS well T13S/R15E-31J3 (located approximately 150 feet north of extensometer).
2. Calculated as the difference between the recovered compaction levels at the beginning and end of the year.
3. Total and inelastic compaction could not be calculated in 1999 because data collection did not begin until July.
4. Values were increased by 0.003 foot, based on the difference in drawdown between July 11 and August 17, 2000, to correct for unmeasured periods.
5. Estimated value. See explanation in 2001 Annual Report.
6. Estimated value. See explanation in text.

Table 3-8. Simulated and Measured Drawdown and Compaction at the Yearout Ranch Extensometer (2000-2002)

Year	Simulation	Drawdown				Compaction			
		Simulated Drawdown (ft)	Simulated Drawdown (%)	Measured Drawdown (ft)	Distribution of Measured Drawdown[1] (ft)	Simulated Inelastic Compaction (ft)	Measured Inelastic Compaction (ft)	Distribution of Measured Inelastic Compaction: Annual[1] (ft)	Distribution of Measured Inelastic Compaction: Cumulative (ft)
2000	Transfer Pumping	13.0	15.6		13.1	0.0025		0.0023	0.0023
	Other Pumping	70.6	84.4		71.6	0.0139		0.0122	0.0122
	All Pumping	83.6	100.0	84.77		0.0164	0.0145		0.0145
2001	Transfer Pumping	35.7	39.1		36.9	0.0079		0.0081	0.0104
	Other Pumping	55.5	60.9		57.4	0.0123		0.0127	0.0249
	All Pumping	91.2	100.0	94.28		0.0201	0.0208		0.0353
2002	Transfer Pumping	23.8	33.0		23.1	0.0029		0.0036	0.014
	Other Pumping	48.3	67.0		46.9	0.0059		0.0074	0.032
	All Pumping	72.1	100.0	69.95		0.0089	0.011[2]		0.046

1. Calculated as measured value times percentage based on simulation.
2. Estimated value. See explanation in text.

Table 3-9. Compaction Measured at Six Extensometers Along California Aqueduct in WWD[1]

Extensometer ID	Measured Interval (ft)	Start of Record	Compaction Prior to 1980 (ft)[2]				Compaction After May 1983 (ft)[3]				Total[4] (ft)
			Before 1976	1976-77	1978-79	Subtotal	May '83-1986	1987-92	1993-Apr. '98	Subtotal	
T14S/R12E-12H1	0-913	1/10/1965	1.82	0.19	0.03	2.21	0.00	0.12	0.05	0.17	2.22
T14S/R13E-11D6	0-1,358	5/25/1961	4.21	0.22	-0.08	4.63	-0.12	0.18	-0.09	-0.03	4.32
T16S/R15E-34N1	0-2,000	9/25/1958	11.26	0.43	-0.05	12.26	-0.10	0.55	-0.15	0.30	11.94
T17S/R15E-14Q1	0-2,317	11/4/1969	0.80	0.53	-0.20	1.24	-0.10	0.71	-0.28	0.33	1.46
T18S/R16E-33A1	0-1,070	3/10/1965	0.98	0.10	-0.02	1.15	-0.12	0.95	0.34	1.17	2.23
T20S/R18E-06D1	0-1,007	1/11/1965	1.36	0.18	-0.07	1.59	0.00	0.28	-0.15	0.13	1.60

1. Postive values indicate compaction; negative values indicate expansion.
2. From R.L. Ireland, J.F. Poland, and F.S. Riley **1984** - *Land Subsidence in the San Joaquin Valley, California, as of 1980, USGS Professional Paper 437-I*
3. Albert W. Steele, Department of Water Resources, San Joaquin District, pers. comm. **2004**
4. Actual compaction may be greater than measured compaction due to missing data:
   - All extensometers missing data from 1979 to May 1983
   - 33A1 missing data for 1987; 14Q1 missing data for 1988

Table 3-10. Recent Groundwater Quality Laboratory Results (Shallow Wells) (2001-2002)

Well Owner & Well ID	Sample Date	Lab[a]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
NORTHERN FRESNO SLOUGH										
MPG Production Wells										
Fordel, Inc.										
M-2	06/25/02	FGL	1150	690	6.8	5.1	3	0.44		
M-2	06/25/02	OBL	-	-	-	-	-	-	4.2	<0.4
M-3	06/28/01	FGL	1390	810	6.8	6.4	3	0.51	10.0	-
M-3	06/28/01	OBL	-	-	-	-	-	-	-	<0.4
M-4	10/01/01	FGL	1250	760	6.7	5.4	3	0.52	-	-
M-4	10/01/01	OBL	-	-	-	-	-	-	5.7	<0.4
M-5	10/01/01	FGL	769	480	6.9	3.4	<2	0.35	-	-
M-5	10/01/01	OBL	-	-	-	-	-	-	4.6	<0.4
M-6	06/25/02	FGL	650	390	6.7	2.1	3	0.26		
M-6	06/25/02	OBL							3.3	0.4
Terra Linda Farms										
TL-4A	10/02/01	FGL	935	570	7.6	2.9	<2	0.21	-	-
TL-4A	10/02/01	OBL	-	-	-	-	-	-	8.7	<0.4
TL-4C	06/25/02	FGL	1380	870	6.9	4.3	<2	0.41		
TL-4C	06/25/02	OBL							1.6	<0.4
TL-10A	09/12/01	FGL	896	560	7.6	3.5	<2	0.26	-	-
TL-10A	09/12/01	OBL	-	-	-	-	-	-	10.6	<0.4
TL-10B	09/12/01	FGL	989	580	7.5	3.6	3	0.25	-	-
TL-10B	09/12/01	OBL	-	-	-	-	-	-	10.2	<0.4
TL-10C	06/25/02	FGL	727	420	7.2	3.5	4	0.26		
TL-10C	06/25/02	OBL							11.5	<0.4
TL-11	09/12/01	FGL	774	450	7.6	3.7	<2	0.28	-	-
TL-11	09/12/01	OBL	-	-	-	-	-	-	13.7	<0.4
TL-16	10/01/01	FGL	921	550	7.7	2.4	<2	0.22	-	-
TL-16	10/01/01	OBL	-	-	-	-	-	-	6.9	<0.4
TL-17	06/25/02	FGL	926	580	6.7	3.6	3	0.31	-	-
TL-17	06/25/02	OBL	-	-	-	-	-	-	1.8	<0.4
Minimum detected value or detection limit			**650**	**390**	**6.7**	**2.1**	**<2**	**0.21**	**1.6**	**<0.4**
Maximum detected value			**1390**	**870**	**7.7**	**6.4**	**4**	**0.52**	**13.7**	**0.4**
Mean of detected values			**981**	**593**	**7.1**	**3.8**	**3**	**0.33**	**7.1**	**0.4**
CENTRAL FRESNO SLOUGH										
MPG Production Wells										
Coelho/Gardner/Hanson										
CGH-1A	06/27/02	FGL	1530	1000	6.9	4.0	<2	0.29	-	-
CGH-1A	06/27/02	OBL	-	-	-	-	-	-	1.1	<0.4
CGH-1B	10/17/02	FGL	1940	1200	7.1	-	<2	0.35	-	DQO
CGH-1C	09/10/01	FGL	944	580	7.0	4.3	<2	0.30	-	-
CGH-1C	09/10/01	OBL	-	-	-	-	-	-	4.9	<0.4
CGH-1C	10/17/02	FGL	1400	840	7.5	-	<2	0.31	-	-
CGH-2	06/27/02	FGL	-	-	7.3	8.9	<2	0.41	-	-
CGH-2	06/27/02	OBL	-	-	-	-	-	-	5.2	<0.4
CGH-2	08/19/02	FGL	2410	1490	-	-	-	-	-	-
CGH-2	10/17/02	FGL	2470	1510	7.1	-	<2	0.40	-	DQO
CGH-3	08/20/02	FGL	3410	2150	7.0	11.7	<2	0.54	-	-
CGH-3	08/20/02	OBL	-	-	-	-	-	-	7.7	<0.4
CGH-4	09/10/01	FGL	4250	2620	7.9	23.6	<2	0.98	-	-
CGH-4	09/10/01	OBL	-	-	-	-	-	-	16.0	<0.4
CGH-5	08/03/99	FGL	-	2130	8.0	16.4	<2	0.70	-	DQO
CGH-5	07/13/00	FGL	3290	-	-	-	-	-	-	-
CGH-5	10/17/02	FGL	4870	3000	-	-	<2	-	-	-
CGH-6A	06/27/01	FGL	-	-	-	-	<2	-	-	-
CGH-6A	08/20/02	FGL	3980	2480	7.4	12.3	-	0.75	-	-
CGH-6A	08/20/02	OBL	-	-	-	-	-	-	16.2	<0.4
CGH-6B	10/17/02	FGL	3390	2110	7.8	-	<2	0.54	-	DQO

Table 3-10. Recent Groundwater Quality Laboratory Results (Shallow Wells) (2001-2002)

Well Owner & Well ID	Sample Date	Lab[a]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
CGH-6C	10/17/02	FGL	2290	1400	7.7	-	<2	0.46	-	-
CGH-6D	10/17/02	FGL	1990	1160	7.6	-	<2	0.46	-	-
CGH-8	09/22/99	FGL	3000	-	-	-	-	-	-	-
CGH-9	06/27/02	FGL	2030	1290	7.6	11.1	<2	0.49	-	-
CGH-9	06/27/02	OBL	-	-	-	-	-	-	15.2	<0.4
CGH-10	08/19/02	FGL	1560	1010	7.6	11.1	<2	0.40	-	-
CGH-10	08/19/02	OBL	-	-	-	-	-	-	13.0	0.4
CGH-11	06/27/02	FGL	-	-	7.1	11.3	<2	0.80	-	-
CGH-11	06/27/02	OBL	-	-	-	-	-	-	15.5	<0.4
CGH-11	08/19/02	FGL	3320	2130	-	-	-	-	-	-
Meyers Farming										
MS-1	03/23/99	TL	-	2800	-	-	-	0.62	-	DQO
MS-1A	09/10/01	FGL	6570	4410	7.2	16.3	<2	1.12	15.4	-
MS-1A	09/10/01	OBL	-	-	-	-	-	-	-	<0.4
MS-2	09/10/01	FGL	5000	3050	7.8	17.7	<2	0.69	21.3	-
MS-2	09/10/01	OBL	-	-	-	-	-	-	-	<0.4
MS-3	09/10/01	FGL	3860	2290	7.9	25.3	<2	0.65	25.9	-
MS-3	09/10/01	OBL	-	-	-	-	-	-	-	<0.4
MS-4	09/10/01	FGL	2730	1790	7.7	14.0	<2	1.00	40.7	-
MS-4	09/10/01	OBL	-	-	-	-	-	-	-	<0.4
MS-6	06/27/02	FGL	-	-	8.0	12.7	<2	1.10	-	-
MS-6	06/27/02	OBL	-	-	-	-	-	-	41.2	<0.4
MS-6	08/21/02	FGL	3590	2210	-	-	-	-	-	-
MS-7	08/19/02	FGL	2930	1890	7.3	14.0	<2	0.98	-	-
MS-7	08/19/02	OBL	-	-	-	-	-	-	38.7	<0.4
Terra Linda Farms										
TL-12	10/02/01	FGL	769	460	-	4.8	<2	0.28	7.3	-
TL-12	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
TL-12	10/17/02	FGL	864	520	8.0	-	<2	0.24	-	-
TL-13	06/26/01	FGL	-	-	7.1	3.5	<2	0.26	4.0	-
TL-13	10/02/01	FGL	860	520	-	-	-	-	-	-
TL-13	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
TL-14	06/26/02	FGL	1190	750	7.2	6.1	<2	0.24	-	-
TL-14	06/26/02	OBL	-	-	-	-	-	-	8.5	<0.4
TL-15	06/26/01	FGL	-	-	7.3	5.7	<2	0.28	10.0	-
TL-15	10/02/01	FGL	955	560	-	-	-	-	-	-
TL-15	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
Silver Creek Packing Co.										
SC-3B	02/27/02	FGL	847	510	7.3	4.4	-	0.29	-	-
SC-3B	10/17/2002	FGL	1750	1020	6.9		<2	0.28	-	-
SC-4B	06/26/02	FGL	1420	840	6.7	5.0	<2	0.33	-	-
SC-4B	06/26/02	OBL	-	-	-	-	-	-	4.7	<0.4
Minimum detected value or detection limit			**769**	**460**	**6.7**	**3.5**	**<2**	**0.24**	**1.1**	**0.4**
Maximum detected value			**6570**	**4410**	**8.0**	**25.3**	**NA**	**1.12**	**41.2**	**0.4**
Mean of detected values			**2544**	**1616**	**7.4**	**11.1**	**NA**	**0.53**	**15.6**	**0.4**
SOUTHERN FRESNO SLOUGH										
MPG Production Wells										
Coelho West										
CW-1	09/12/01	FGL	-	-	-	-	<2	-	-	-
CW-1	08/21/02	FGL	1060	680	8.1	11.1	-	0.40	-	-
CW-1	08/21/02	OBL	-	-	-	-	-	-	13.7	<0.4
CW-2	06/25/02	FGL	-	-	-	-	<2	-	-	-
CW-2	06/25/02	OBL	-	-	-	-	-	-	19.7	<0.4
CW-2	08/21/02	FGL	1160	710	8.5	14.0	-	0.43	-	-
CW-3	06/25/01	FGL	-	-	-	-	<2	-	-	-
CW-3	08/21/02	FGL	1650	1020	8.1	16.9	-	0.56	-	-
CW-3	08/21/02	OBL	-	-	-	-	-	-	28.4	<0.4
CW-4	09/12/01	FGL	-	-	-	-	<2	-	-	-

Table 3-10. Recent Groundwater Quality Laboratory Results (Shallow Wells) (2001-2002)

Well Owner & Well ID	Sample Date	Lab[a]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
CW-4	08/21/02	FGL	1600	1000	7.5	11.3	-	0.50	-	-
CW-4	08/21/02	OBL	-	-	-	-	-	-	18.2	0.9
CW-5	06/28/01	FGL	-	-	-	-	<2	-	-	-
CW-5	08/20/02	FGL	2640	1590	8.0	26.9	-	0.81	-	-
CW-5	08/20/02	OBL	-	-	-	-	-	-	44.2	<0.4
Five Star										
FS-1	09/12/01	OBL	-	-	-	-	-	-	18.0	<0.4
FS-1	08/21/02	FGL	1160	710	7.9	7.1	<2	0.36	-	-
FS-2	10/03/01	FGL	1190	740	7.4	4.4	<2	0.36	-	-
FS-2	10/03/01	OBL	-	-	-	-	-	-	13.9	<0.4
FS-3	09/12/01	FGL	-	-	8.0	11.9	<2	0.50	-	-
FS-3	09/12/01	OBL	-	-	-	-	-	-	24.0	-
FS-3	10/02/01	FGL	1930	1200	-	-	-	-	-	-
FS-3	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
FS-4	10/02/01	FGL	1740	1060	7.8	13.8	<2	0.50	-	-
FS-4	10/02/01	OBL	-	-	-	-	-	-	24.0	<0.4
FS-5	06/25/02	FGL	-	-	7.6	5.1	<2	0.31	-	-
FS-5	06/25/02	OBL	-	-	-	-	-	-	7.9	<0.4
FS-5	08/21/02	FGL	1200	740	-	-	-	-	-	-
FS-6	09/12/01	FGL	2340	1390	7.9	9.6	<2	0.52	-	-
FS-6	09/12/01	OBL	-	-	-	-	-	-	23.2	<0.4
FS-7	10/03/01	FGL	2500	1600	7.3	7.9	<2	0.53	-	-
FS-7	10/03/01	OBL	-	-	-	-	-	-	17.7	<0.4
FS-8	10/03/01	FGL	2240	1310	7.7	12.1	<2	0.60	-	-
FS-8	10/03/01	OBL	-	-	-	-	-	-	19.0	<0.4
FS-9	09/12/01	FGL	2090	1290	7.9	9.8	<2	0.56	-	-
FS-9	09/12/01	OBL	-	-	-	-	-	-	17.6	<0.4
FS-10	06/25/02	FGL	1630	1060	7.4	6.1	<2	0.39	-	-
FS-10	06/25/02	OBL	-	-	-	-	-	-	11.4	<0.4
Other Wells										
Meyers Farming										
P-1	06/28/01	FGL	4810	3380	7.7	13.7	2	0.89	50.0	-
P-1	06/28/01	OBL	-	-	-	-	-	-	-	<0.4
P-2	04/01/99	BSK	5800	4100	-	-	-	0.89	-	DQO
P-3	04/01/99	BSK	5300	3600	-	-	-	1.10	-	DQO
P-4	04/01/99	BSK	8900	6200	-	-	-	1.20	-	DQO
P-5	04/01/99	BSK	6000	4200	-	-	-	1.00	-	DQO
Minimum detected value or detection limit			**1060**	**680**	**7.3**	**4.4**	**<2**	**0.31**	**7.9**	**<0.4**
Maximum detected value			**8900**	**6200**	**8.5**	**26.9**	**2**	**1.20**	**50.0**	**0.9**
Mean of detected values			**2847**	**1879**	**7.8**	**11.4**	**2**	**0.62**	**21.9**	**0.9**
WEST OF FRESNO SLOUGH										
Other Wells										
USGS										
31J4	06/27/01	FGL	5940	3490	7.0	15.8	<2	1.43	10.0	-
31J4	06/27/01	OBL	-	-	-	-	-	-	-	<0.4
10A2	09/28/99	FGL	6960	5750	7.2	4.7	2	4.10	-	DQO
Meyers Farming										
S-1	08/05/99	FGL	7470	5100	6.7	17.3	<2	1.40	-	DQO
S-2	08/05/99	FGL	7410	5560	6.9	19.8	<2	7.70	-	DQO
S-3	06/24/02	FGL	8220	6000	7.4	17.0	3	3.06	-	-
S-3	06/24/02	OBL	-	-	-	-	-	-	58.4	0.7
Minimum detected value or detection limit			**5940**	**3490**	**6.7**	**4.7**	**<2**	**1.40**	**10.0**	**<0.4**
Maximum detected value			**8220**	**6000**	**7.4**	**19.8**	**3**	**7.70**	**58.4**	**0.7**
Mean of detected values			**7200**	**5180**	**7.0**	**14.9**	**3**	**3.54**	**34.2**	**NA**

Table 3-10. Recent Groundwater Quality Laboratory Results (Shallow Wells) (2001-2002)

Well Owner & Well ID	Sample Date	Lab[a]	EC (μmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (μg/L)	B (mg/L)	Mo (μg/L)	Se (μg/L)
EAST OF FRESNO SLOUGH										
Other Wells										
Meyers Farming										
MF-1[b]	03/26/02	FGL	2170	1370	7.0	6.4	DQO	0.20	-	DQO
MF-2[c]	03/26/02	FGL	2450	1500	7.1	8.0	DQO	0.29	-	DQO
MF-3	03/26/02	FGL	1810	1100	7.1	5.8	DQO	0.23	-	DQO
MF-4	03/27/02	FGL	2810	1580	6.9	6.3	DQO	0.28	-	DQO
MF-5	03/27/02	FGL	2750	1710	6.9	7.7	DQO	0.37	-	DQO
Spreckels Sugar Co.										
MW-1	06/05/01	BSK	3800	2600	8.1	67.7	-	1.30	-	-
MW-2	06/05/01	BSK	2200	1400	7.0	8.3	-	0.40	-	-
MW-3	05/27/02	FGL	2510	1480	6.9	7.9	DQO	0.47	-	DQO
MW-4	06/05/01	BSK	1900	1200	6.8	12.0	-	0.20	-	-
MW-5	06/05/01	BSK	1700	1000	6.8	7.2	-	0.20	-	-
MW-6	06/05/01	BSK	1300	830	6.8	3.2	-	0.20	-	-
MW-9	06/05/01	BSK	840	580	6.4	1.1	-	<0.1	-	-
MW-13	06/05/01	BSK	2200	1700	7.3	7.8	-	0.20	-	-
MW-17	06/06/01	BSK	3600	2100	6.9	5.4	-	0.40	-	-
MW-18	06/06/01	BSK	6800	3700	7.4	21.9	-	0.40	-	-
MW-19	06/06/01	BSK	4200	2100	7.5	21.7	-	0.50	-	-
MW-20	06/06/01	BSK	2100	1400	7.3	10.0	-	0.40	-	-
MW-21	06/04/01	BSK	2100	1300	7.3	10.5	-	0.30	-	-
MW-23	06/04/01	BSK	4400	2400	7.4	18.6	-	0.40	-	-
MW-24	06/05/01	BSK	2400	1700	6.7	3.3	-	0.20	-	-
MW-25	06/06/01	BSK	2400	1500	7.7	21.5	-	0.50	-	-
MW-26	06/04/01	BSK	4900	2000	7.5	15.0	-	0.30	-	-
MW-27	06/06/01	BSK	7100	4100	7.4	20.8	-	0.30	-	-
MW-28	06/05/01	BSK	1800	1400	7.3	4.8	-	0.30	-	-
MW-29	06/05/01	BSK	1600	1200	6.7	2.1	-	0.10	-	-
MW-30	06/05/01	BSK	340	250	6.2	0.6	-	<0.1	-	-
MW-31	06/06/01	BSK	810	570	7.0	1.2	-	<0.1	-	-
MW-32	06/05/01	BSK	290	220	6.5	0.8	-	<0.1	-	-
Minimum detected value or detection limit			**290**	**220**	**6.2**	**0.6**	**NA**	**<0.1**	**NA**	**NA**
Maximum detected value			**7100**	**4100**	**8.1**	**67.7**	**NA**	**1.30**	**NA**	**NA**
Mean of detected values			**2617**	**1571**	**7.1**	**11.0**	**NA**	**0.35**	**NA**	**NA**
NORTH OF SAN JOAQUIN RIVER										
Other Wells										
Newhall Land and Farming										
MW-2	06/11/02	JML	1090	-	7.1	4.0	-	0.17	-	-
MW-3	06/11/02	JML	320	-	7.3	3.1	-	0.15	-	-
MW-4	06/11/02	JML	1270	-	8.0	13.0	-	0.28	-	-
MW-5	06/11/02	JML	1060	-	7.5	5.3	-	0.25	-	-
Minimum detected value or detection limit			**320**	**-**	**7.1**	**3.1**	**-**	**0.15**	**-**	**-**
Maximum detected value			**1270**	**-**	**8.0**	**13.0**	**-**	**0.28**	**-**	**-**
Mean of detected values			**935**	**-**	**7.5**	**6.4**	**-**	**0.21**	**-**	**-**

[a] Laboratory Abbreviations: USGS - U.S. Geological Survey; FGL - Fruit Growers Laboratory, Santa Paula; BSK - BSK Analytical Laboratories, Fresno; TL - The Twining Laboratories, Inc.;
BCL - BC Laboratories, Bakersfield; CLS - California Laboratory Services, Rancho Cordova
OBL-Olson Biochemistry Laboratories

[b] Formerly E-1

[c] Formerly E-2

DQO = Data quality objectives for this analysis were not met for this sample. Results are not included in the EIS evaluation of this parameter. Results are reported in Appendix C.

NA = Not applicable

Table 3-11. Recent Groundwater Quality Laboratory Results (Deep Wells) (2001-2002)

Well Owner & Well ID	Sample Date	Lab[a]	EC (μmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (μg/L)	B (mg/L)	Mo (μg/L)	Se (μg/L)
SAN JOAQUIN RIVER ARM										
MPG Production Wells										
Baker Farming Co.										
BF-1	06/26/02	FGL	555	380	8.7	15.9	<2	0.18	-	-
BF-1	06/26/02	OBL	-	-	-	-	-	-	5.9	<0.4
BF-2	06/26/02	FGL	496	310	8.6	12.5	<2	0.09	-	-
BF-2	06/26/02	OBL	-	-	-	-	-	-	3.1	<0.4
BF-3	10/01/01	FGL	511	310	8.8	11.7	<2	0.09	-	-
BF-3	10/01/01	OBL	-	-	-	-	-	-	3.5	<0.4
BF-4	10/02/01	FGL	539	310	8.8	13.3	<2	0.09	-	-
BF-4	10/02/01	OBL	-	-	-	-	-	-	3.0	<0.4
BF-5	10/01/01	FGL	462	300	8.5	6.0	<2	0.11	-	-
BF-5	10/01/01	OBL	-	-	-	-	-	-	3.8	<0.4
Farmers Water District										
R-1	06/25/01	FGL	-	-	-	-	<2	-	-	-
R-1	08/20/02	FGL	436	290	8.8	13.7		0.09	-	-
R-1	08/20/02	OBL	-	-	-	-	-	-	5.8	<0.4
R-2	10/02/01	FGL	-	-	-	-	<2	-	-	-
R-2	10/02/01	OBL	-	-	-	-	-	-	2.0	<0.4
R-2	06/17/02	TL	540	330	8.4	28.2	-	0.07	-	-
R-3	06/25/02	FGL	-	-	-	-	<2	-	-	-
R-3	06/25/02	OBL	-	-	-	-	-	-	<1.0	<0.4
R-3	08/20/02	FGL	778	520	7.9	11.5	-	0.08	-	-
R-4	10/01/01	FGL	-	-	-	-	3	-	-	-
R-4	10/01/01	OBL	-	-	-	-	-	-	3.1	<0.4
R-4	06/17/02	TL	240	150	8.7	13.6	-	<0.05	-	-
R-6	10/01/01	FGL	-	-	-	-	<2	-	-	-
R-6	10/01/01	OBL	-	-	-	-	-	-	6.1	<0.4
R-6	06/17/02	TL	480	290	8.2	6.3	-	0.07	-	-
R-7	10/01/01	FGL	-	-	-	-	<2	-	-	-
R-7	10/01/01	OBL	-	-	-	-	-	-	1.8	<0.4
R-7	06/17/02	TL	470	280	8.4	9.0	-	0.05	-	-
R-8	10/02/01	FGL	-	-	-	-	<2	-	-	-
R-8	08/20/02	FGL	616	420	8.7	18.3		0.24	-	-
R-8	08/20/02	OBL	-	-	-	-	-	-	8.7	<0.4
R-9	06/17/02	TL	710	440	8.4	23.1	-	0.31	-	-
R-10	10/02/01	FGL	-	-	-	-	<2	-	-	-
R-10	10/02/01	OBL	-	-	-	-	-	-	15.5	<0.4
R-10	06/17/02	TL	800	490	8.4	28.3	-	0.46	-	-
R-11	06/25/02	FGL	-	-	-	-	<2	-	-	-
R-11	06/25/02	OBL	-	-	-	-	-	-	9.3	<0.4
R-11	08/20/02	FGL	535	370	8.7	-		0.25		

Table 3-11. Recent Groundwater Quality Laboratory Results (Deep Wells) (2001-2002)

Well Owner & Well ID	Sample Date	Lab[a]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
Panoche Creek Farms										
PCF-1	06/26/02	FGL	575	390	8.6	13.0	<2	0.19	-	-
PCF-1	06/26/02	OBL	-	-	-	-	-	-	4.8	<0.4
Minimum detected value or detection limit			**240**	**150**	**7.9**	**6.0**	**<2**	**0.05**	**1.8**	**<0.4**
Maximum detected value			**800**	**520**	**8.8**	**28.3**	**3.0**	**0.46**	**15.5**	**NA**
Mean of detected values			**546**	**349**	**8.5**	**15.0**	**3.0**	**0.16**	**5.5**	**NA**
NORTHERN FRESNO SLOUGH										
MPG Production Wells										
Fordel, Inc.										
M-1	06/28/01	FGL	-	-	8.3	22.2	<2	0.56	9.0	-
M-1	10/01/01	FGL	1200	730	-	-	-	-	-	-
M-1	10/01/01	OBL	-	-	-	-	-	-	-	<0.4
Coelho/Coelho										
Conejo West	09/28/99	FGL	-	870	8.3	24.8	<2	0.70	-	DQO
Conejo West	07/13/00	FGL	1550	-	-	-	-	-	-	-
Coelho/Coehlho/Fordel										
CCF-1	06/26/01	FGL	-	-	8.2	25.5	<2	0.62	8.0	-
CCF-1	10/02/01	FGL	1740	1040	-	-	-	-	-	-
CCF-1	10/02/01	OBL	-	-	-	-	-	-	-	<0.4
Terra Linda Farms										
TL-1	06/25/02	FGL	1450	880	8.1	19.4	<2	0.41	-	-
TL-1	06/25/02	OBL	-	-	-	-	-	-	3.5	<0.4
TL-2	07/13/00	FGL	1440	-	-	-	-	-	-	-
TL-3	10/01/01	FGL	733	450	8.4	15.6	<2	0.35	-	-
TL-3	10/01/01	OBL	-	-	-	-	-	-	5.5	<0.4
TL-7	06/26/02	FGL	1250	760	8.4	24.2	<2	0.47	-	-
TL-7	06/26/02	OBL	-	-	-	-	-	-	7.3	<0.4
TL-8	06/25/02	FGL	1250	780	8.3	24.4	<2	0.51	-	-
TL-8	06/25/02	OBL	-	-	-	-	-	-	7.7	<0.4
TL-9	09/22/99	FGL	1387	-	-	-	-	-	-	-
Minimum detected value or detection limit			**733**	**450**	**8.1**	**15.6**	**<2**	**0.35**	**3.5**	**<0.4**
Maximum detected value			**1740**	**1040**	**8.4**	**25.5**	**NA**	**0.70**	**9.0**	**NA**
Mean of detected values			**1333**	**787**	**8.3**	**22.3**	**NA**	**0.52**	**6.8**	**NA**
CENTRAL FRESNO SLOUGH										
MPG Production Wells										
Terra Linda Farms										
TL-5	06/26/01	FGL	1530	900	8.3	29.4	<2	0.55	9.0	-
TL-5	06/26/01	OBL	-	-	-	-	-	-	-	<0.4
TL-6	09/22/99	FGL	4040	-	-	-	-	-	-	-
Fordel, Inc.										
Fordel/Bio	07/13/00	FGL	1350	-	-	-	-	-	-	-

Table 3-11. Recent Groundwater Quality Laboratory Results (Deep Wells) (2001-2002)

Well Owner & Well ID	Sample Date	Lab[a]	EC (μmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (μg/L)	B (mg/L)	Mo (μg/L)	Se (μg/L)
Silver Creek Packing Co.										
SC-5	06/27/01	FGL	3970	2140	8.0	24.3	<2	1.11	7.0	-
SC-5	06/27/01	OBL	-	-	-	-	-	-	-	<0.4
SC-6	06/26/01	FGL	2770	1560	8.0	27.7	<2	0.72	5.0	-
SC-6	06/26/01	OBL	-	-	-	-	-	-	-	<0.4
Coelho/Gardner/Hanson										
CGH-7	07/13/00	FGL	1710	-	-	-	-	-	-	-
Meyers Farming										
MS-5	06/27/02	FGL	-	-	8.4	22.0	<2	0.84	-	-
MS-5	06/27/02	OBL	-	-	-	-	-	-	16.6	<0.4
MS-5	08/20/02	FGL	3190	1890	-	-	-	-	-	-
Other Wells										
AES Mendota										
No. 6	06/13/02	FGL	1430	-	8.4	-	-	-	-	-
Minimum detected value or detection limit			**1350**	**900**	**8.0**	**22.0**	**<2**	**0.55**	**5.0**	**<0.4**
Maximum detected value			**4040**	**2140**	**8.4**	**29.4**	**NA**	**1.11**	**16.6**	**NA**
Mean of detected values			**2499**	**1623**	**8.2**	**25.9**	**NA**	**0.81**	**9.4**	**NA**
NORTH OF MENDOTA										
Other Wells										
CCID										
5A	06/07/01	BSK	730	460	7.9	7.5	-	0.20	-	-
12C	06/07/01	CCID	1700	1200	7.3	5.7	-	0.50	-	-
15B	06/21/01	CCID	1100	730	7.3	4.0	-	0.30	-	-
16B	10/20/93	NA	839	523	6.8	3.1	-	-	-	-
23B	06/07/01	CCID	2600	1100	7.5	7.4	-	1.20	-	-
28B	09/29/99	FGL	1410	960	6.7	3.6	<2	0.40	-	DQO
32B	06/07/01	BSK	2100	1600	7.8	5.5	-	1.40	-	-
35A	06/07/01	CCID	1200	830	7.6	4.2	-	0.30	-	-
38A	06/15/01	CCID	620	340	7.9	14.9	-	0.10	-	-
Locke Ranch										
No. 8	09/29/99	FGL	633	420	8.3	10.4	<2	0.20	-	DQO
City of Mendota										
No. 2	02/25/98	BCL	1340	830	7.8	6.9	<10	0.44	-	DQO
No. 3	10/02/01	FGL	2660	1680	7.9	13.0	<2	1.36	-	-
No. 3	10/02/01	OBL	-	-	-	-	-	-	10.1	<0.4
No. 4	06/27/01	FGL	2890	1790	7.8	12.4	<2	1.30	8.0	-
No. 4	06/27/01	OBL	-	-	-	-	-	-	-	<0.4
No. 5	10/02/01	FGL	2180	1400	7.9	11.5	<2	1.21	-	-
No. 5	10/02/01	OBL	-	-	-	-	-	-	8.9	<0.4
No. 6	01/23/96	NA	630	350	7.4	2.2	<2	-	-	DQO
Minimum detected value or detection limit			**620**	**340**	**6.7**	**2.2**	**<2**	**0.10**	**8.0**	**<0.4**
Maximum detected value			**2890**	**1790**	**8.3**	**14.9**	**NA**	**1.40**	**10.1**	**NA**
Mean of detected values			**1509**	**948**	**7.6**	**7.5**	**NA**	**0.69**	**9.0**	**NA**

Table 3-11. Recent Groundwater Quality Laboratory Results (Deep Wells) (2001-2002)

Well Owner & Well ID	Sample Date	Lab[a]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
WEST OF FRESNO SLOUGH										
Other Wells										
USGS										
31J5	06/26/02	FGL	10100	7100	7.2	21.6	<2	3.15	-	-
31J5	06/26/02	OBL	-	-	-	-	-	-	18.2	<0.4
10A4	09/28/99	FGL	2820	2370	7.5	2.5	2	2.10	-	DQO
Hansen Farms										
7C1	06/27/01	FGL	-	-	7.8	20.9	5	4.98	37.0	-
7C1	10/03/01	FGL	9430	6300	-	-	-	-	-	-
7C1	10/03/01	OBL	-	-	-	-	-	-	-	65.6
Minimum detected value or detection limit			**2820**	**2370**	**7.2**	**2.5**	**2.0**	**2.1**	**18.2**	**<0.4**
Maximum detected value			**10100**	**7100**	**7.8**	**21.6**	**5.0**	**5.0**	**37.0**	**65.6**
Mean of detected values			**7450**	**5257**	**7.5**	**15.0**	**3.5**	**3.4**	**27.6**	**65.6**
EAST OF FRESNO SLOUGH										
Other Wells										
City of Mendota										
No. 7	06/12/01	NA	732	468	8.3	27.2	5.8	0.61	-	DQO
No. 8	06/12/01	NA	564	401	8.5	17.2	3.5	0.46	-	DQO
No. 9	08/27/01	NA	598	420	8.3	22.7	2.7	0.48	-	DQO
B&B Ranch										
Mowry Die.	05/17/01	JML	630	-	8.1	29.8	-	0.47	-	-
Mowry Riv.	05/17/01	JML	480	-	7.8	4.3	-	0.10	-	-
Spreckels Sugar Co.										
MW-7	06/05/01	BSK	6500	4500	6.6	23.3	-	0.20	-	-
MW-8	06/05/01	BSK	1300	810	7.8	14.2	-	<0.1	-	-
MW-10	06/05/01	BSK	1200	740	7.8	13.1	-	<0.1	-	-
MW-11	06/05/01	BSK	1700	1100	7.4	15.8	-	0.20	-	-
MW-12	06/05/01	BSK	4700	2800	7.4	21.7	-	0.30	-	-
MW-14	06/06/01	BSK	1600	980	7.4	6.1	-	0.20	-	-
MW-15	06/06/01	BSK	6400	3500	7.6	26.4	-	0.40	-	-
MW-16	06/06/01	BSK	6200	3400	7.2	23.0	-	0.40	-	-
MW-22	06/06/01	BSK	2000	1200	7.4	22.3	-	0.20	-	-
Minimum detected value or detection limit			**480**	**401**	**6.6**	**4.3**	-	**<0.1**	-	**<0.4**
Maximum detected value			**6500**	**4500**	**8.5**	**29.8**	-	**0.61**	-	**NA**
Mean of detected values			**2472**	**1693**	**7.7**	**19.1**	-	**0.34**	-	**NA**
NORTH OF SAN JOAQUIN RIVER										
Other Wells										
Columbia Canal Company										
Elrod-1	05/14/01	OBL	-	-	-	-	-	-	-	<0.4
Elrod -2	02/24/99	JML	400	-	7.8	21.2	-	0.26	-	-
Elrod-2	05/14/01	OBL	-	-	-	-	-	-	-	<0.4
N.F. Davis	02/24/99	JML	840	-	7.6	9.6	-	0.50	-	-
Cardella #1	05/04/01	JML	750	480	7.7	7.3	-	0.10	-	-

Table 3-11. Recent Groundwater Quality Laboratory Results (Deep Wells) (2001-2002)

Well Owner & Well ID	Sample Date	Lab[a]	EC (µmhos/cm @25°C)	TDS (mg/L)	pH	SAR	As (µg/L)	B (mg/L)	Mo (µg/L)	Se (µg/L)
Cardella #2	05/04/01	JML	510	326	8.1	5.7	-	0.30	-	-
Cardella #2	05/04/01	OBL	-	-	-	-	-	-	-	<0.4
Lopes-1	05/04/01	JML	510	326	8.1	5.7	-	0.30	-	-
Lopes-1	05/14/01	OBL	-	-	-	-	-	-	-	<0.4
CC-1	05/04/01	JML	270	173	8.6	3.4	-	0.04	-	-
CC-2	05/04/01	JML	350	224	8.6	4.3	-	0.06	-	-
CC-2	05/04/01	OBL	-	-	-	-	-	-	-	<0.4
DMA	06/04/99	JML	1740	-	7.2	9.4	-	0.37	-	-
Snyder	05/04/01	JML	950	608	7.9	9.0	-	0.52	-	-
Newhall Land and Farming										
MW-1	06/11/02	JML	670	-	7.4	2.8	-	0.18	-	-
No. 32	09/14/01	JML	1210	-	7.3	4.8	-	0.22	-	-
No. 32	09/14/01	OBL								0.7
No. 42	09/14/01	JML	1130	-	7.5	9.3	-	0.42	-	-
No. 42	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 53	09/14/01	JML	580	-	8.1	5.5	-	0.07	-	-
No. 53	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 74	09/14/01	JML	940	-	7.8	21.3	-	0.60	-	-
No. 74	09/14/01	OBL	-	-	-	-	-	0.10	-	<0.4
No. 78	09/14/01	JML	430	-	8.3	29.2	-	0.10	-	-
No. 78	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 89	09/14/01	JML	1050	-	7.4	5.9	-	0.16	-	-
No. 89	09/14/01	OBL	-	-	-	-	-	-	-	0.9
No. 91	09/14/01	JML	1020	-	7.7	6.1	-	0.19	-	-
No. 91	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 94	09/14/01	JML	380	-	8.5	24.3	-	0.14	-	-
No. 94	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
No. 95	09/14/01	JML	250	-	8.6	25.0	-	0.06	-	-
No. 95	09/14/01	OBL	-	-	-	-	-	-	-	<0.4
Minimum detected value or detection limit			**250**	**173**	**7.2**	**2.8**	**NA**	**0.04**	**NA**	**<0.4**
Maximum detected value			**1740**	**608**	**8.6**	**29.2**	**NA**	**0.60**	**NA**	**0.9**
Mean of detected values			**736**	**356**	**7.9**	**11.0**	**NA**	**0.23**	**NA**	**0.8**

[a] Laboratory Abbreviations: USGS - U.S. Geological Survey; FGL - Fruit Growers Laboratory, Santa Paula; OBL - Olson Biochemistry Laboratories of South Dakota State University, Brookings, SD; BSK - BSK Analytical Laboratories, Fresno; TL - The Twining Laboratories, Inc., Fresno; BCL - BC Laboratories, Bakersfield; JML - JM Lord, Fresno; AT - Agri Tech, Inc., Kerman; UAG - U.S. Agricultural Consultants and Laboratories, Burbank; CLS - California Laboratory Services, Rancho Cordova

NA = Not Available or Not Applicable; ND = Non Detect (detection limit unknown)

DQO = Data quality objectives for this analysis were not met for this sample. Results are not included in the EIS evaluation of this parameter. Results are reported in Appendix C.

Table 3-12. Results from Sediment Sampling Program (2001-2002)

Sampling Station	Date	Replicate	Lab[a]	Arsenic (mg/kg)[b]	Boron (mg/kg)[b]	Molybdenum (mg/kg)[b]	Selenium (mg/kg)[b]	Electrical conductivity (μmhos/cm)	TOC (mg/kg)[b]	TOC (percent)	pH	CEC (meq/100g)	%Moisture	% Sand	% Silt	% Clay
San Joaquin River Arm																
Columbia Canal	8/22/2001	1	FGL	4	<12	<1.2	<1.2	485	3123	0.31	6.6	7.14	58.7	58.0	34.0	8.0
	8/22/2001	1	FGS				0.703									
	8/22/2001	2	FGL	7	<15	<1.5	<7.5	534	4136	0.41	6.6	14.90	66.8	30.0	56.0	14.0
	8/22/2001	3	FGL	6	<12	<1.2	<6.2	565	4454	0.45	6.8	10.60	59.5	44.0	46.4	9.6
	10/30/2001	1	CAS	3.5	5.05 J	<0.8	<1.1	201		0.66	8.17	27.7	34.9	64.0	26.8	9.2
	10/30/2001	2	CAS	2.8	6.52 J	0.8 J	<0.9	160		0.81	8.09	25.9	40.7	54.7	34.6	10.7
	10/30/2001	3	CAS	3.9	7.99 J	<0.7	<1.1	132		1.12	7.84	30.6	47.5	43.1	46.3	10.6
	10/15/2002	1	CAS	3.3	6.4 B	<0.6	<1	44		1.37	7.55	33.7	51.8	27.4	58.3	15.1
	10/15/2002	2	CAS	2.7	2.9 B	<0.6	<1	79		0.8	7.36	21.1	38.5	54.1	36.7	8.1
	10/15/2002	3	CAS	1.9 B	<2.3	0.7 B	<1.1	63		0.53	7.34	14.0	30.7	67.4	23.5	6.2
Northern Fresno Slough																
Mendota Dam	8/22/2001	1	FGL	10	20	<1.5	<7.4	1140	4024	0.40	7.0	20.50	66.2	10.0	72.4	17.6
	8/22/2001	2	FGL	9	20	<1.2	<5.9	1070	4596	0.46	7.4	17.40	57.6	28.0	54.4	17.6
	8/22/2001	2	FGS				0.72									
	8/22/2001	3	FGL	8	20	<1.2	<5.8	951	5126	0.51	7.0	15.60	57.2	38.0	46.4	15.6
	10/30/2001	1	CAS	6	18	1.0 J	<0.9	236		1.18	7.6	28.8	51.5	24.3	68.7	7.0
	10/30/2001	2	CAS	6.1	15.2	1.0 J	<1.0	211		0.92	7.52	35.5	47.9	26.7	64.3	9.0
	10/30/2001	3	CAS	5.6	12.1	<0.7	<1.0	246		0.92	7.47	37.6	47.7	24.3	66.2	9.5
	10/15/2002	1	CAS	4.6	11.8	<0.6	<1.1	130.0		0.92	7.39	35.6	40.9	29.4	60.5	10.5
	10/15/2002	2	CAS	4.6	11.2	0.8 B	<1.1	156.0		1.06	7.30	38.9	44.6	21.2	66.3	11.4
	10/15/2002	3	CAS	4.1	9.2 B	0.6 B	<0.9	106.0		1.03	7.56	40.0	45.5	35.8	53.3	12.1
Delta-Mendota Canal	8/22/2001	1	FGL	13	70	2	<6.1	1280	5032	0.50	7.8	42.0	59.3	10.4	34.0	55.6
	8/22/2001	1	FGS				2.94									
	8/22/2001	2	FGL	4.8	11	<0.86	<4.3	782	1127	0.11	7.7	7.98	41.7	78.4	12.0	9.6
	8/22/2001	3	FGL	4.8	11	<0.86	<0.86	506	810	0.08	7.8	7.56	41.6	78.0	14.0	8.0
	10/30/2001	1	CAS	8.8	40	1.5 J	<1.1	265		1.08	7.7	27.5	48.8	16.2	49.9	33.9
	10/30/2001	2	CAS	10.9	41.3	1.5 J	<1.0	314		0.69	7.67	20.3	55.4	7.5	44.0	48.5
	10/30/2001	3	CAS	10.8	52.8	1.8 J	<1.0	329		0.88	8.03	21.5	53.0	9.8	41.0	49.1
	10/15/2002	1	CAS	6.7	23.7	2.40	1.1 B	212		0.89	7.37	26.4	46.5	13.4	50.1	37.6
	10/15/2002	2	CAS	7.1	35.2	1.8 B	<1	178		0.64	7.50	35.0	44.6	18.7	14.0	30.3
	10/15/2002	3	CAS	6.8	35.5	1.7 B	1.1 B	223		0.83	7.51	24.6	51.0	10.3	35.0	42.0
Firebaugh Intake Canal	8/22/2001	1	FGL	10	20	<1.3	<6.4	701	4410	0.44	7.2	18.8	60.7	20.4	40.0	39.6
	8/22/2001	2	FGL	9	20	<1.2	<5.9	763	4008	0.40	7.4	13.9	57.4	32.4	52.0	15.6
	8/22/2001	3	FGL	10	20	1	<6.3	688	5536	0.55	7.3	16.3	60.6	28.4	53.0	18.6
	8/22/2001	3	FGS				0.864									
	10/30/2001	1	CAS	5.8	16.3	<0.7	<1.0	168		1.11	8.38	43.3	48.4	24.1	67.8	8.1
	10/30/2001	2	CAS	5.1	17.2	<0.8	<1.1	197		1.02	7.38	17.6	49.0	28.6	64.4	7.0
	10/30/2001	3	CAS	6.1	15.8	<0.7	<1.0	225		1.23	7.09	26.2	47.1	24.5	69.3	6.2
	10/15/2002	1	CAS	4.5	12.3	0.6 B	<0.9	66		1.38	7.17	35.4	48.1	17.0	70.0	12.1
	10/15/2002	2	CAS	4.7	12.2	0.9 B	<1	57		1.15	7.28	35.7	41.4	14.8	70.8	12.7
	10/15/2002	3	CAS	4.4	8.8 B	1.2 B	<0.9	89		1.23	7.33	41.1	46.4	21.1	66.9	12.1

Table 3-12. Results from Sediment Sampling Program (2001-2002)

Sampling Station	Date	Replicate	Lab[a]	Arsenic (mg/kg)[b]	Boron (mg/kg)[b]	Molybdenum (mg/kg)[b]	Selenium (mg/kg)[b]	Electrical conductivity (µmhos/cm)	TOC (mg/kg)[b]	TOC (percent)	pH	CEC (meq/100g)	%Moisture	% Sand	% Silt	% Clay
Central Fresno Slough																
Etchegoinberry	8/22/2001	1	FGL	9	30	<2.1	<2.1	665	7978	0.80	7.3	30.40	75.8	18.4	40.0	41.6
	8/22/2001	1	FGS				1.58									
	8/22/2001	2	FGL	8	20	<1.8	<8.8	660	8464	0.85	7.3	27.70	71.6	16.4	46.0	37.6
	8/22/2001	3	FGL	7	<18	<1.8	<8.8	641	7837	0.78	7.3	26.40	71.7	14.4	48.0	37.6
	10/30/2001	1	CAS	6.9	27.4	<0.7	<1.0	144		1.76	7.65	35.9	73.6	0.5	58.2	41.3
	10/30/2001	2	CAS	5.8	27.2	1.0 J	<1.0	187		1.71	7.41	45.0	70.6	0.7	55.0	44.4
	10/30/2001	3	CAS	2.8	10.0 J	0.8 J	<1.0	182		0.72	7.84	19.2	36.0	66.8	27.1	6.1
	10/15/2002	1	CAS	5.0	20.6	0.9 B	<1.1	133		1.71	7.43	52.5	67.2	0.9	51.0	49.1
	10/15/2002	2	CAS	5.0	14.1	<0.6	<1.1	129		1.63	7.45	54.7	66.0	0.8	52.2	47.9
	10/15/2002	3	CAS	4.8	16.8	1 B	<1.1	112		1.73	7.60	57.1	69.8	1.1	54.3	48.5
Southern Fresno Slough																
Whitesbridge Road	8/22/2001	1	FGL	5	<22	<2.2	<2.2	909	5045	0.50	7.5	33.50	77.1	18.0	36.0	46.0
	8/22/2001	2	FGL	4	<20	<2	<2	951	7134	0.71	7.4	33.60	75.2	22.0	30.0	48.0
	8/22/2001	3	FGL	2.5	<9.5	<0.95	<0.95	443	1941	0.19	7.4	11.30	47.1	58.0	26.0	16.0
	8/22/2001	3	FGS				0.316									
	10/30/2001	1	CAS	4.5	31	<0.7	<1.0	205		1.47	7.37	46.5	71.4	2.4	49.5	48.1
	10/30/2001	2	CAS	4.5	29.7	1.3 J	<1.2	168		1.35	7.81	49.2	68.5	2.0	50.3	47.7
	10/30/2001	3	CAS	5.1	30.8	<0.7	<1.0	190		1.36	7.7	33.8	70.7	1.5	55.2	43.3
	10/15/2002	1	CAS	2.6 B	4.6 B	0.6 B	<1.1	168		0.20	7.60	13.4	25.7	74.6	19.1	3.8
	10/15/2002	2	CAS	3.20	4.2 B	0.7 B	<1	202		0.17	8.16	9.3	25.7	85.6	12.5	2.3
	10/15/2002	3	CAS	8.60	25.10	1.7 B	<1	162		0.32	8.30	34.8	38.0	53.7	24.3	16.2
James ID Booster Plant	8/22/2001	1	FGL	1.8	<8.4	<0.84	<4.2	570	1649	0.16	7.5	5.2	40.4	88.0	6.0	6.0
	8/22/2001	2	FGL	2.2	<8.1	<0.81	<4.1	526	874	0.09	7.5	3.9	38.4	90.0	5.0	5.0
	8/22/2001	3	FGL	1.7	<8.3	<0.83	<0.83	664	799	0.08	7.6	5.8	40.1	88.0	7.0	5.0
	8/22/2001	3	FGS				0.101									
	10/30/2001	1	CAS	2.7	10.2	<0.7	<1.0	255		0.84	7.8	39.7	47.3	30.1	58.7	11.2
	10/30/2001	2	CAS	2.3	6.6 J	<0.7	<1.0	265		0.54	7.5	24.4	42.1	53.0	37.4	9.5
	10/30/2001	3	CAS	2.9	9.7 J	<0.7	<1.0	298		1.00	7.6	16.9	47.9	35.1	53.6	11.3
	10/15/2002	1	CAS	2.5 B	6.3 B	<0.6	<1	112		0.73	7.8	22.2	40.9	37.6	58.4	9.7
	10/15/2002	2	CAS	2.60	10.80	1.1 B	<0.9	140		0.93	7.5	27.8	45.0	23.1	61.4	13.4
	10/15/2002	3	CAS	1.4 B	4.1 B	1.5 B	<1	170		0.42	8.1	11.9	28.8	73.3	20.0	6.1
Lateral 6	8/22/2001	1	FGL	10	60	<1	<10	1280	3402	0.34	8.0	43.8	51.1	14.4	34.0	51.6
	8/22/2001	1	FGS				0.485									
	8/22/2001	2	FGL	5	40	<1.1	<5.4	1260	5826	0.58	8.0	39.9	53.5	24.4	27.6	48.0
	8/22/2001	3	FGL	5.4	37	<0.97	<4.8	1160	6158	0.62	8.0	39.4	48.3	26.0	28.0	46.0
	10/30/2001	1	CAS	3.3	33	1.0 J	<1.1	305		0.99	8.1	19.6	59.2	2.4	74.5	23.1
	10/30/2001	2	CAS	3.4	28.9	<0.8	<1.1	277		0.96	8.0	33.7	59.4	9.5	67.8	22.7
	10/30/2001	3	CAS	3.7	28.0	<0.8	<1.1	247		0.99	8.1	25.0	58.1	11.6	64.8	23.6
	10/15/2002	1	CAS	3.2	17.2	1 B	<1.1	147		0.91	8.0	35.1	44.0	25.5	55.7	16.2
	10/15/2002	2	CAS	2.8	25.7	0.8 B	<1	147		1.02	8.2	42.6	49.7	18.3	61.9	21.1
	10/15/2002	3	CAS	2.6 B	28.1	<0.6	<1	271		1.08	7.8	40.8	51.7	5.3	72.9	21.9

[a] Laboratory abbreviations: FGL - Fruit Growers Laboratory, Santa Paula, California; FGS - Frontier Geosciences, Seattle, Washington; CAS - Columbia Analytical Services, Kelso, Washingtor

[b] Data are expressed as total metals on a dry weight basis

[c] J or B- Result is an estimated concentration that is greater than the Method Detection Limit but less than the Method Reporting Limit.

Table 3-13. Estimated Average Waterfowl Use-Days for the Mendota Wildlife Area

Month	Waterfowl (days)	Coot (days)	Total (days)	Days in month	Use days per Month[1]
August	20,000	0	20,000	31	620,000
September	30,000	5,000	35,000	30	1,050,000
October	45,000	5,000	50,000	31	1,550,000
November	25,000	10,000	35,000	30	1,050,000
December	55,000	15,000	70,000	31	2,170,000
January	80,000	15,000	95,000	31	2,945,000
February	60,000	15,000	75,000	28	2,100,000
March	50,000	15,000	65,000	31	2,015,000
April	25,000	10,000	35,000	30	1,050,000
May	5,000	0	5,000	31	155,000
June	5,000	0	5,000	30	155,000
July	5,000	0	5,000	31	155,000
Total	405,000	90,000	495,000	365	15,015,000

[1]The average monthly use-days were approximated because the results were based on aerial census information that is primarily used for indexing waterfowl population trends.

Table 3-14. Fish Species Present During Qualitative Sampling in Mendota Pool (Dec. 6, 2001).

Common Name	Species Name	Location	Notes
Threadfin Shad	*Dorosoma petenense*	CC, DMC, WBR	Abundant (>33%)
Hitch	*Lavinia exilicauda*	CC	Uncommon (1 fish)
Brown Bullhead	*Ictalurus nebulosus*	CC	Common, only 1 fish seined, but dominant catch of anglers in area
Inland Silverside	*Menidia beryllina*	CC, DMC, WBR	Abundant (10%)
Striped Bass	*Morone saxatilis*	WBR	Uncommon (< 1% of catch)
Bluegill	*Lepomis macrochirus*	CC, DMC, WBR	Abundant (>33%)
Green Sufish	*Lepomis cyanellus*	WBR	Uncommon (< 1% of catch)
Redear Sunfish	*Lepomis microlophus*	WBR	Common (< 10% of catch)
Warmouth	*Lepomis gulosus*	WBR	Uncommon (< 1% of catch)
Black Crappie	*Pomoxis nigromaculatus*	DMC, WBR	Common (< 5% of catch)
White Crappie	*Pomoxis annularis*	DMC, WBR	Common (< 5% of catch)
Largemouth Bass	*Micropterus salmoides*	DMC, WBR	Common (< 5% of catch)
Bigscale Logperch	*Percina macrolepida*	CC, DMC, WBR	Common (< 5% of catch)
Shimofuri Goby	*Tridentiger bifasciatus*	DMC, WBR	Uncommon (< 1% of catch)
Prickly Sculpin	*Cottus asper*	DMC	Uncommon (1 fish)

1. CC = Columbia Canal

DMC = Delta-Mendota Canal

WBR = Whites Bridge Road

Table 3-15. Summary of Special Status Animal Species within the Action Area

Species	Listing Status[1]	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding Period
WETLAND/AQUATIC ASSOCIATED SPECIES					
Agelaius tricolor - tricolored blackbird	SC	not listed	Seeks cover in emergent vegetation such as tules and cattails. Highly colonial. Nest area must be big enough for colony, near open water, and within 6.4 km from foraging area. Feed on insects, seeds, and cultivated grain.	Colonial Nest site	April to late June.
Clemmys marmorata - Western pond turtle	SC	not listed	Aquatic turtle that inhabits ponds, marshes, rivers, streams, and irrigation ditches that contain aquatic vegetation. Requires basking sites and sandy banks or grassy open fields for nesting.	NA	March to Aug.
Plegadis chihi - white-faced ibis	SC	6/15/1905	Fresh water marshes containing dense tule thickets for nesting interspersed with areas of shallow water for foraging.	Rookery site	Mating occurs from April to May. Laying occurs from May to June.
Thamnophis gigas - giant garter snake	ST, FT	5/26/1999	Aquatic snake that prefers freshwater marshes and low gradient streams. Forage and take cover in emergent vegetation. During dormant period takes shelter in small mammal burrows in upland habitat. Makes use of drainage canals and irrigation ditches.	NA	May - July peaking from May – June
Rana aurora draytonii – California red-legged frog	FT	not listed	Permanent sources of deep water with dense shrub or emergent vegetation. Require habitat under ground to remain dormant during the summer.		
Hypomesus transpacificus – delta smelt	FT	not listed	Euryhaline fish found in brackish water. Use the channels and deadened sloughs of the Delta for spawning.		
Pogonichtyhys macrolepidotus – Sacramento splittail	FT	not listed	Primarily a freshwater fish but are tolerant of moderate salinities. Have been found in slow-moving sections of rivers and sloughs.		
Oncorhynchus mykiss – Central Valley Steelhead	FT	not listed	Anadramous form of rainbow trout. They are born in freshwater, emigrate to the ocean where most of their growth occurs, and return to freshwater to spawn.		

Table 3-15. Summary of Special Status Animal Species within the Action Area

Species	Listing Status[1]	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding Period
Branchinecta lynchi – vernal pool fairy shrimp	FT	not listed	Found in vernal pools of various sizes and types. Pools can be shallow, short-lived, and grassy to very large, deep, and turbid.		
Lepidurus packardi – vernal pool tadpole shrimp	FE	not listed	Occupy a range of pool sizes and types. These can be very small, vegetated, clear water vernal pools to very large, turbid vernal lakes.		
Clemmys marmorata marmorata – northwestern pond turtle	SC	not listed	Associated with permanent or nearly permanent water like ponds, lakes, streams, irrigation ditches, or permanent pools along intermittent streams in a wide variety of habitat types. Require basking sites such as partially submerged logs, rocks, mats of floating vegetation, or open mud banks.		
Spirinchus thaleichthys – longfin smelt	SC	not listed	Adults and juveniles occupy mostly the middle or bottom parts of the water column in the salt or brackish portions of the estuary, although larval smelt are concentrated in near-surface brackish waters.		
Branchinecta mesovallensis – Midvalley fairy shrimp	SC	not listed	Inhabits vernal pools and seasonal wetlands.		
Linderiella occidentalis – California linderiella fairy shrimp	SC	not listed	Inhabits vernal pools.		
Lytta molesta – molestan blister beetle	SC	not listed	Specimens of this species have been collected from vernal pool vegetation. Very little is known about their life cycle and other requirements.		
Rana boylii – foothill yellow-legged frog	SC	not listed	Found in or near rocky streams in a variety of habitats. Adults often bask on exposed rock surfaces near streams.		
Grus canadensis tabida – greater sandhill crane	CA	not listed	Occurs in and near wet meadow, shallow lacustrine, and fresh emergent wetland habitats during the summer. Prefers open habitats with shallow lakes and fresh emergent wetlands when nesting.		
Numenius americanus – long-billed curlew	SC	not listed	Inhabits large coastal estuaries, upland herbaceous areas, and croplands. At coastal estuaries, requires high salt marsh, pastures or salt ponds for roosting.		

Table 3-15. Summary of Special Status Animal Species within the Action Area

Species	Listing Status[1]	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding Period
Branta canadensis leucopareia – Aleutian Canada goose	D	not listed	Preferred habitats include lacustrine, fresh emergent wetlands, and moist grasslands, croplands, pastures, and meadows. Prefers to nest near water and may nest in marshes on mats of bulrushes or muskrat houses.		
RIPARIAN SPECIES					
Buteo swainsoni - Swainson's hawk	ST	5/23/2000	Nest in Juniper-sage flats, riparian areas and in oak savannah habitat that contains few trees. Requires suitable foraging areas such as grasslands, alfalfa fields, or grain fields that support rodent populations.	Nest site. Not in area from Sept. to Feb.	March to August with peak from April to May
Coccyzus americanus occidentalis - Western yellow-billed cuckoo	SE - possibly extirpated	7/1950	Deciduous riparian thickets or forest with willow usually being the most dominant vegetation. Nest along lower flood-bottoms of larger river systems where humidity is high. Roost in dense deciduous trees and shrubs.	Nest site	March to Aug.
Riparia riparia –bank swallow	ST	8/17/1980	Use of vertical banks and cliffs with fine textured soil to excavate nesting hole. Nest primarily in riparian and other lowland habitats near streams, rivers, lakes, and ocean.	Nest site Arrive in March	NA
Haliaectus leucocephalus – bald eagle	FT	not listed	Requires large, old-growth trees or snags in remote, mixed stands near water. Nests are usually located near a permanent water source.		
Neotoma fuscipes riparia – riparian (San Joaquin Valley) wood rat	FE	not listed	Prefers forest habitats with moderate canopy, year-round greenery, a brushy understory, and suitable nest building materials.		
Desmocerus californicus dimorphus – valley elderberry longhorn beetle	FT	not listed	Lives only in thickets of native elderberry that grows amidst other native plants along the valley's waterways.		
Melanerpes lewis – Lewis' woodpecker	SC	not listed	Suitable habitat includes open, deciduous and conifer habitats with brushy understory, and scattered snags and live trees for nesting and perching.		

Table 3-15. Summary of Special Status Animal Species within the Action Area

Species	Listing Status[1]	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding Period
Selasphorus rufus – rufous hummingbird	SC	not listed	Uses riparian areas, open woodlands, chaparral and other habitats rich in nectar-producing flowers.		
Elanus leucurus – white-tailed kite	SC	not listed	Resident of coastal and valley lowlands; rarely found away from agricultural areas. Substantial groves of dense, broad-leafed deciduous trees used for nesting and roosting.		
Empidonax traillii brewsteri – little willow flycatcher	CA	not listed	Most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows. Extensive thickets of low, dense willows edge on wet meadows, ponds, or backwaters required for nesting and roosting.		
Falco peregrinus anatum – American peregrine falcon	D	not listed	Inhabits riparian areas and coastal and inland wetlands year long, especially in non-breeding seasons. Usually breeds and feeds near water.		
Anniella pulchra pulchra – silvery legless lizard	SC	not listed	Found primarily in areas with sand or loose organic soils or where there is plenty of leaf litter. Often found where substrates are slightly moist.		
GRASSLAND SPECIES					
Athene cunicularia hypugaea - Western burrowing owl	SC	2/24/1993	Found in dry annual or perennial grasslands, desserts, and scrublands. Use burrows of small mammals especially the California ground squirrel.	Burrowing sites	March to August with peak from April to May
Dipodomys nitratoides exilis - Fresno kangaroo rat	SE, FE	11/11/1992	Grassland habitats containing bare alkaline clay-based soils subject to seasonal inundation, that also includes friable soils around mounds of shrubs and grasses. Found in Western Fresno County.	NA	December to September
Gambelia sila - blunt nosed leopard lizard	FE, SE	1981	Sparsely vegetated alkali and desert scrub habitats with low topographic relief. Uses small mammalian burrows.	NA	Mating occurs from April to May. Laying occurs from May to June.
Dipodomys ingens – giant kangaroo rat	FE	not listed	Requires fairly large areas of homogenous terrain, with only scattered shrubs, but with an open, herbaceous cover of annual forbs and grasses.		
Dipodomys nitratoides nitratoides – Tipton kangaroo rat	FE	not listed	Resident of alkali desert scrub habitat and herbaceous habitats with scattered shrubs. Uses nearly level terrain with sandy, loamy soils for		

Table 3-15. Summary of Special Status Animal Species within the Action Area

Species	Listing Status[1]	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding Period
			excavation of burrows.		
Vulpes macrotis mutica – San Joaquin kit fox	FE	not listed	Lives in annual grasslands or grassy open stages of vegetation dominated by scattered brush, shrubs, and scrub. Cover provided by dens they dig in open, level areas with loose-textured, sandy and loamy soils.		
Buteo regalis – ferruginous hawk	SC	not listed	Frequents open grasslands, sagebrush flats, desert scrub, low foothills surrounding valleys, and fringes of pinyon-juniper habitats. Roosts in open areas.		
Scaphiopus hammondii – western spadefoot toad	SC	not listed	Mostly inhabits grasslands with shallow, temporary pools. Rarely found on the surface. Spends most of the year in underground burrows which they construct themselves. Some individuals also use mammal burrows.		
Myotis ciliolabrum – small-footed myotis bat	SC	not listed	Found in arid uplands. Prefers open stands in forests and woodlands as well as brushy habitats. Uses streams, ponds, springs and stock tanks for drinking and feeding.		
Ammospermophilus nelsoni – San Joaquin (Nelson's) antelope squirrel	SC	not listed	Suitable habitat includes widely scattered shrubs, annual forbs and grasses and is distributed over broken terrain with small gullies and washes. They dig burrows or use kangaroo rat burrows.		

1. The listing status of each species is coded S = State, F = Federal, E = Endangered, T = Threatened and C = Concern

Table 3-16. Summary of Special Status Plant Species within the Action Area

Species	Listing	Most Recent Sighting In Project Area Recorded In CNDDB	Habitat	Site Use	Breeding
WETLAND/AQUATIC ASSOCIATED PLANTS					
Sagittaria sanfordii – valley sagittaria (= Sanford's arrowhead)	SC	not listed	A freshwater marsh species which occurs in small ponds and sluggish waters of creeks, ditches and canals.		
Atriplex minuscula – lesser saltscale	SC	not listed	Grows on sandy soils in alkaline areas, often in association with slough systems and river floodplains. However, it is found only in microhabitats that are inundated year-round.		
Cordylanthus palmatus – palmate-bracted bird's beak	FE, SE	9/26/1996	Restricted to seasonally-flooded, saline-alkali soils in lowland plains and basins. Grows primarily along the edges of channels and drainages.	NA	mid-June to mid-July
Monolopia congdonii – San Joaquin woolly-threads	FE	not listed	Grows on sandy soils in alkali sinks.		
GRASSLAND SPECIES					
Atriplex depressa – brittlescale	SC	not listed	Grows on alkaline clay, often in association with vernal pools or within scrub or annual grasslands.		
Atriplex vallicola – Lost Hills crownscale	SC	not listed	Typically grows in the dried beds of alkaline pools within scrub or annual grassland communities.		
Delphinium recurvatum – recurved larkspar	SC	not listed	Grows on alkaline clay in low-lying scrublands and on hillsides in grasslands		
Cordylanthus mollis ssp. Hispidus – hispid bird's beak	SC	not listed	Grows in alkaline areas, often in association with grasslands.		
Layia munzii – Munz's tidy-tips	SC	not listed	Grows on alkaline clay in low-lying scrublands and on hillsides in grasslands.		
Atriplex cordulata – heartscale	SC	not listed	Grows in alkaline areas, often in association with scrublands and grasslands.		
Eriastrum hooveri – Hoover's eriastrum (=wooly-star)	FT	not listed	Found in the Central Valley of California in "Valley grassland" with saltbrush, annual grasses, and goldfields, in areas where there is sparse covering of annual grass.		