This section identifies the groundwater resources that could be affected by the 10-Year Water Transfer Program. Groundwater pumping by the Exchange Contractors is a component of the action alternatives, and the other water development components have implications for groundwater resources.

5.1 AFFECTED ENVIRONMENT/ENVIRONMENTAL SETTING

This section describes the groundwater resources in the areas where the water is developed and in the areas that may receive water transfers. The resources are described first, followed by the regulatory setting.

5.1.1 Resources

5.1.1.1 Regional Setting

The San Joaquin Valley comprises two subregions: the San Joaquin River Basin and, at the southern end, an interior drainage basin called the Tulare Basin. These basins are discussed together with respect to groundwater conditions presented below.

Groundwater resources in the San Joaquin Valley are associated with the San Joaquin Valley regional groundwater basin, a subunit of the Central Valley groundwater basin. This regional groundwater basin is the largest in California and extends approximately from the Delta south to Bakersfield. Much of the western portion of the valley is underlain by the Corcoran Clay, which generally lies at depths between 100 and 400 feet below the surface. The Corcoran Clay divides the basin sediments into unconfined to semiconfined (above the Corcoran Clay) and confined (below the Corcoran Clay) aquifers. Other local clay layers are present above and below the Corcoran Clay and have local impacts on groundwater conditions. Under predevelopment conditions, groundwater flow in the San Joaquin Valley was from the foothills of the Coast Ranges and Sierra Nevada toward the center of the valley, then north toward the Delta. Extensive groundwater development in the southern portion of the valley, however, has modified the natural flow pattern and created cones of depressions in major pumping areas.

According to DWR Bulletin 118 (*California's Groundwater, Update 2003*, October 2003), groundwater provides approximately 30 percent of the total supply for the San Joaquin River Hydrologic Region. However, the amount of groundwater use within the region varies widely, both between different areas and from one year to the next. In the Westlands Water District, for example, groundwater has accounted for between 5 and 60 percent of total supply over the last 15 years, while in the Exchange Contractors' service area groundwater supplies have accounted for between 10 and 40 percent of the total over the last 10 years.

Two primary hydrologic divisions of the San Joaquin Valley are agreed upon by DWR, the State Board, and the U.S. Geological Survey. The San Joaquin hydrologic study area comprises the northern one-third of the valley, encompasses 3,800 square miles, and includes San Joaquin, Stanislaus, Merced, and Madera counties. The Tulare Lake hydrologic study area comprises the southern two-thirds of the valley and encompasses 7,900 square miles. The Tulare Lake hydrologic study area includes Fresno, Kings, Tulare, and Kern counties.

Much of the San Joaquin Valley aquifer system is in overdraft conditions, although the extent of overdraft varies widely from region to region. In the San Joaquin Basin, overdraft conditions were estimated at approximately 224,000 acre-feet, with groundwater pumping estimated at 3,520,000 acre-feet under 1990 conditions. The Tulare Basin region has experienced a greater degree of overdraft, estimated at 630,000 acre-feet, with groundwater pumping estimated at 5,190,000 acre-feet for 1990 conditions. Groundwater pumping in the San Joaquin Valley varies seasonally. Most groundwater is withdrawn during the spring-summer growing season, although pumping in some areas may occur throughout the entire year. Currently, the Exchange Contractors are not in an overdraft condition with the exception of the lands that lie in Madera County. No groundwater pumping for transfer will occur within Madera County.

In the southern region of the San Joaquin Valley, several conjunctive use projects are operating or are in proposal stages. The purposes of each project vary and include recharge of overdrafted basins using purchased surface water, cooperative banking concepts that rely on groundwater in dry years and surface water in wet years, and temporary storage of surface water entitlements for later withdrawal.

As a result of historic groundwater overdraft, land subsidence is widespread along the western and southern parts of the San Joaquin Valley. From 1920 to 1980, almost 5,200 square miles of the San Joaquin Valley's irrigated lands registered at least 1 foot of subsidence. In parts of western Fresno County, subsidence levels have been measured as high as 30 feet. These subsidence areas are primarily associated with areas that are underlain by the Corcoran Clay layer, where pressure changes due to groundwater pumping have resulted in compaction of sediments. Importation of surface water supplies has greatly reduced the rate of groundwater pumping in these regions and, therefore, has nearly eliminated additional land subsidence except during years of water supply shortages.

The western San Joaquin Valley region has drainage problems caused by shallow clay layers of low permeability that limit recharge to groundwater. In addition, elevated concentrations of salinity, selenium, and boron exist in the semiperched aquifer zone due to leaching from naturally occurring saline deposits from the Coast Range and from accumulated salts in the root zones of irrigated cropland. The San Joaquin Valley Drainage Program, established in 1984, published its recommendations for managing the drainage problem in 1990 (SJVDP 1990), culminating in a Memorandum of Understanding (MOU) in 1991 that allows Federal and State agencies to coordinate activities for implementing the plan. East of the San Joaquin River, the valley is underlain by older sediments. The shallow groundwater quality is generally very good in this portion of the valley.

Along the valley floor, continuity between the San Joaquin River tributary streams and the underlying aquifer has been maintained. The lower reaches of the Stanislaus, Tuolumne, and Merced rivers from the edge of the valley to their confluence with the San Joaquin River are all gaining streams (i.e., groundwater discharges to the streambed). Streams in the project area include Los Banos Creek (drains from Los Banos Reservoir), San Luis Creek, and Garzas Creek. Numerous canals and drainage ditches are also present on the valley floor within the various irrigation districts.

5.1.1.2 Exchange Contractors Service Area

The Exchange Contractors is a Joint Powers Authority organized under the Joint Exercises of Powers Act. The Exchange Contractors service area lies in the western San Joaquin Valley and encompasses portions of Fresno, Stanislaus, Merced, and Madera counties. The majority of the service area is situated along the western bank of the San Joaquin River as shown on Figure 2-2; the Columbia Canal Company (in Madera County) is on the eastern bank of the San Joaquin River.

The Exchange Contractors service area is located on a broad alluvial plain at the approximate structural axis of the San Joaquin Valley formed by large coalescing alluvial fans draining the eastern slopes of the Coast Range and western slopes of the Sierra Nevada. The San Joaquin River flows along the structural axis of the valley and is generally contained between natural and artificial levees. Many shallow natural drainage channels and sloughs meander across overflow lands adjacent to the main river channel.

Subsurface geologic conditions in and near the Exchange Contractors Service area were evaluated and summarized in detail in a report prepared for the CCID (1997). This report includes numerous regional geologic cross sections and figures depicting the depth to top/thickness of the Corcoran Clay. In terms of groundwater the most important geologic factors include the extent, thickness, and permeability of the Corcoran Clay (the major confining unit separating the upper and lower aquifers); the vertical extent of fresh groundwater-bearing deposits; the general location of Coast Range-derived deposits versus those derived from the Sierra Nevada; and the extent of other important confining beds, such as the A-clay near the valley trough.

The general geologic sequence in the area consists of unconsolidated colluvial, alluvial, and floodplain deposits ranging up to 100 feet thick overlying Coast Range-derived deposits, known as the Tulare Formation (aka Diablo Range Deposits) to depths ranging from 70 to 1,000 feet. The Tulare Formation includes the upper aquifer, Corcoran Clay, and lower aquifer. Tulare Formation deposits can also interbed with thick sequences of coarse-grained deposits from the Sierra Nevada when the depositional axis of the valley was further west than at present. The bottom of the lower aquifer is generally considered to be the base of permeable freshwater-producing deposits in the Exchange Contractors service area. Groundwater in deposits below the lower aquifer (base of the Tulare Formation) have total dissolved solid (TDS) concentrations exceeding 2,000 milligrams per liter (mg/L) and have been considered unusable for drinking water supply.

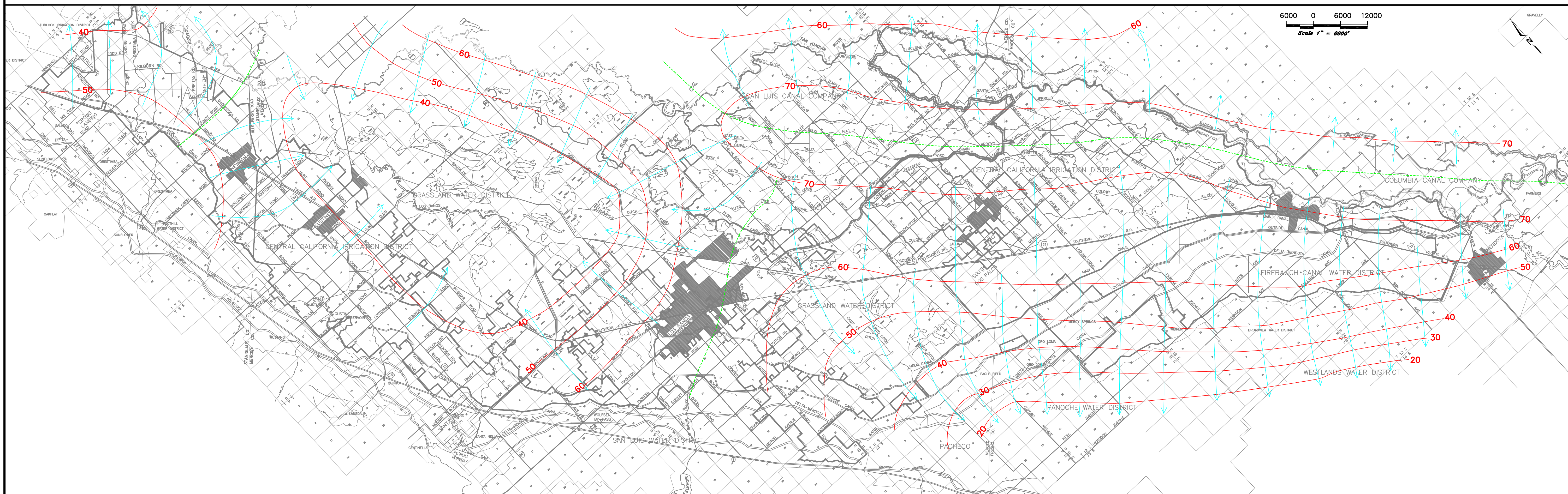
Historically, the Corcoran Clay has been used to divide the groundwater system into an upper aquifer (above) and lower aquifer (below). Generally, the Corcoran Clay lies beneath the entire Exchange Contractors service area. The top of the clay ranges in depth from 50 feet below ground surface (bgs) near the eastern Coast Range (Santa Nella area), variably increasing in depth to the northeast (to 200 to 300 feet bgs, Newman, Gustine, and Los Banos areas) and southeast (300 to 450 feet bgs, Fresno County/Mendota area). The Corcoran Clay has been deformed (altered in shape by pressure) since its deposition and generally slopes toward the Central Valley trough. The thickness of the Corcoran Clay varies from less than 20 feet in the area northwest of Newman to over 80 feet thick in areas northeast of Newman. The thickness of the Corcoran Clay averages 60 feet near Mendota and much of the San Joaquin River. The clay layer is thickest (120 feet or more) in the area northwest of Volta and south of Dos Palos, near the Delta-Mendota Canal. Another shallower blue-green clay, termed the A-clay, is important in the area south of Highway 152 and near the San Joaquin River. The A-clay is less widespread than the Corcoran Clay and averages about 80 feet deep, acting as a local confining bed, particularly in parts of the Mendota Pool area. The A-clay ranges in thickness from about 10 feet to more than 100 feet and appears to be thickest northwest of Mendota. The A-clay does not appear to be present northeast of Mendota.

In the areas west of the San Joaquin River unconfined groundwater generally flows from the southwest toward the northeast, although groundwater pumping and irrigation complicates and changes local flow directions with time. Aquifer response to pumping and irrigation is relatively rapid, resulting in local changes in groundwater flow direction as associated temporary cones of depression and recharge mounds form and dissipate.

In most parts of the Exchange Contractors service area few wells tap sediments only below the Corcoran Clay, particularly in the Madera and west of Newman and Gustine areas. A number of the wells are termed “composite” because they are perforated both above and below the Corcoran Clay. Since the water levels in the composite wells compare favorably with those with perforations only below the Corcoran Clay, they were included in the lower aquifer contour maps. Maps of groundwater elevations for three different year types representing dry, normal, and wet water years were presented in the CCID report (1997). Maps were prepared for both above and below the Corcoran Clay. The Fall 1981 (representative of a normal water year) map (Figure 5-1) of the lower aquifer indicates the presence of a groundwater divide in the area between Mendota and a point near the San Joaquin River and northeast of Los Banos. Northeast of the divide groundwater flow direction appears to be to the northeast, into the Madera area. Southwest of the divide groundwater flow directions appear to be toward the Firebaugh Canal and Panoche WDs. These lower aquifer Fall 1981 groundwater flow directions were attributed to pumping in the Madera area and in Panoche and Westlands WD areas. Another groundwater divide was also noted just south of Los Banos. Groundwater southeast of this divide had a southerly flow direction, while groundwater northwest of the divide was flowing toward an apparent cone of depression beneath the northern part of Grassland WD and adjacent areas to the west. Another groundwater divide was noted northwest of Newman. The Spring 1992 lower aquifer groundwater contour map (Figure 5-2) appeared to be similar to that of Fall 1981 with similar groundwater divides and cones of depression in response to localized pumping. The Spring 1992 map represents a year of deficient surface water supplies. The similarity in groundwater flow trends between these two very different water years suggests that the pumping practices of the Exchange Contractors are in balance with local groundwater supplies, in that large, long-term cones of depression are not seen to be increasing in size in the area.

The CCID (1997) report also included an evaluation of vertical groundwater flow components between the upper and lower aquifers. In general, groundwater elevations above the Corcoran Clay (upper aquifer) were higher than those below the clay (lower aquifer), indicating an overall downward component of flow. Water-level or head differences were reported to range from about 20 feet near Newman and the eastern edge of the northern part of Grassland WD, to about 140 feet in the Hamburg Farms area. The head difference was about 40 feet south of Gustine and near Dos Palos. The head difference was about 80 feet southwest of Los Banos. Vertically downward flow components occur beneath most of the Exchange Contractors service area.

Generally, groundwater development in the Exchange Contractors service area has not influenced shallow groundwater interaction with surface water bodies. The depth to shallow groundwater, less than 10 feet deep, has been monitored intensively since 1984. The Exchange Contractors report that no trend exists regarding a significant lowering of these groundwater levels during years of heavy pumpage (C. White, pers. comm., 2004).



LEGEND

40———	Water-level elevation contour feet above or below mean sea level (minus numbers are below)
———>	Direction of groundwater flow
———	Groundwater divide

Project No. 26814274	EIS/EIR	SAN JOAQUIN RIVER EXCHANGE CONTRACTORS WATER AUTHORITY WATER LEVEL ELEVATION CONTOURS AND DIRECTION OF GROUNDWATER FLOW BELOW THE CORCORAN CLAY FALL 1981 (MARCH 1997)	FIGURE 5-1

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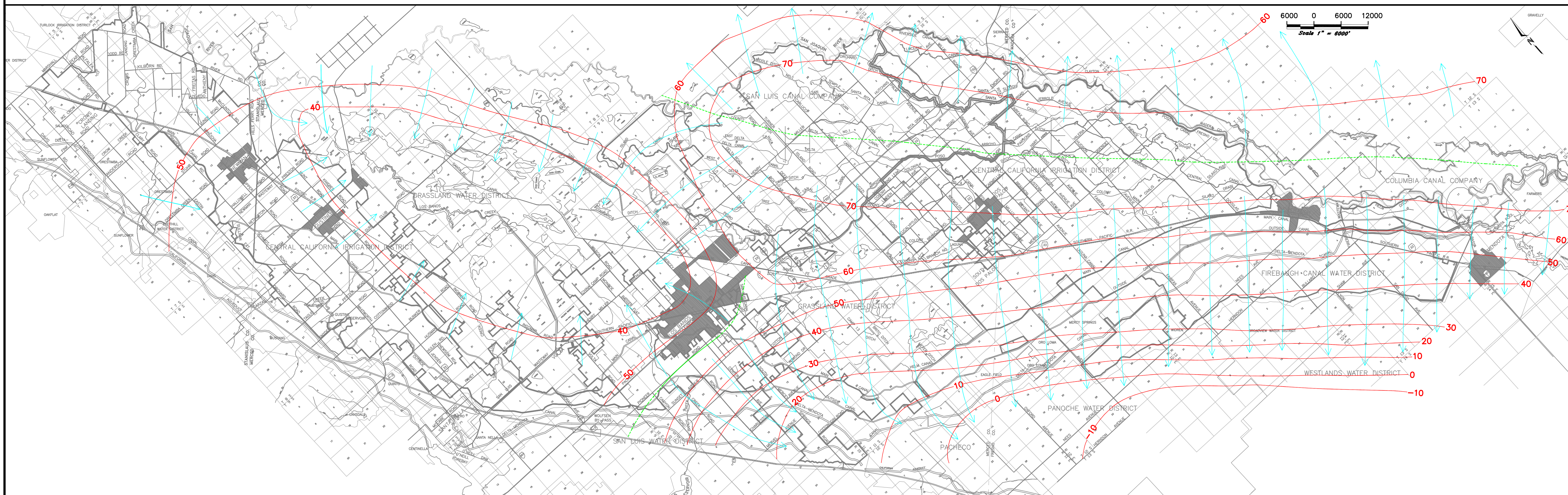
S:\Savannah\SAN JOAQUIN RIVER\FIG5-1.dwg



LEGEND

40 Water-level elevation contour feet above or below mean sea level (minus numbers are below)

Direction of groundwater flow

Groundwater divide

Project No. 26814274	EIS/EIR	SAN JOAQUIN RIVER EXCHANGE CONTRACTORS WATER AUTHORITY WATER LEVEL ELEVATION CONTOURS AND DIRECTION OF GROUNDWATER FLOW BELOW THE CORCORAN CLAY SPRING 1992 (MARCH 1997)	FIGURE 5-2

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5.1.1.3 Groundwater Balance in the Exchange Contractors Area

The groundwater system in the southern San Joaquin Valley provides a supply of irrigation water when surface deliveries to the area are reduced due to regional hydrologic conditions. The groundwater system in the Exchange Contractors service area is divided into two aquifers divided by the Corcoran Clay. Most of the groundwater used is from the upper, unconfined aquifer.

The Exchange Contractors' use of groundwater is directly related to the amount of available delivered water and precipitation in any given year. The agricultural users in the Exchange Contractors service area use groundwater to supplement delivered water and natural precipitation. The Exchange Contractors have developed an analysis of their groundwater usage between 1993 and 2002 that includes a detailed water balance for their service area that quantifies all inputs and outputs to the system.

In 1998, the Exchange Contractors developed a detailed water balance for their service area based on the method of the Irrigation Training and Research Center, California Polytechnical University, San Luis Obispo (Staker, White, and Chedester, pers. comm., 2003). Table 5-1 summarizes total inputs and outputs to and from the system, total groundwater pumping, and calculated changes in groundwater storage for the years 1993 to 2002. The 1993 to 2002 period represents a decade containing a critical water supply year under the Exchange Contract. Under a critical water supply year, the Exchange Contractors receive 75 percent of the normal year's supply. There have only been four critical water years as defined by the Exchange Contract since 1939. Table 5-1 shows that even during a period containing a critical water supply year, and even though the Exchange Contractors were transferring quantities of water similar to those proposed in this program, no significant change in groundwater storage occurred.

Table 5-1
Groundwater Balance in the Exchange Contractors Service Area, Overall Groundwater Balance, 1993–2002

Year	Total Inflows (acre-feet)	Total Outflows (acre-feet)	Groundwater Pumping (acre-feet)	Change in Groundwater Storage (acre-feet)
1993	1,205,765	1,236,292	136,388	-30,527
1994*	941,575	1,151,158	225,750	-209,580
1995	1,234,440	1,190,328	102,796	44,112
1996	1,301,032	1,201,994	121,050	99,038
1997	1,153,560	1,195,461	126,047	-49,242
1998	1,339,253	1,243,397	37,686	111,198
1999	959,686	1,090,646	99,964	-86,992
2000	1,102,669	1,081,140	120,738	40,622
2001	1,084,402	1,074,070	134,212	6,105
2002	1,008,553	1,067,654	175,894	39,808
Average 1993–2002	1,133,094	1,153,214	128,053	-3,546

Source: Exchange Contractors 2003.
* Critically dry year

The calculated change in groundwater storage shows an average annual decrease of 3,546 acre-feet over the 10-year period, representing approximately 0.31 percent of the total average yearly inflow of over 1,000,000 acre-feet. It should be noted that the change in groundwater storage is not directly measured. It is calculated from the differences in groundwater elevations measured in a network of wells. Thus, the value must be considered an approximation. In this context, a difference of 0.31 percent is less than significant.

The long-term hydrographic record for the Exchange Contractors service area was reviewed by Schmidt (CCID 1997). Schmidt's review shows that groundwater is in balance or is rising. Table 5-2 summarizes the long-term water-level trends in the Exchange Contractors service area. The predominant trend for water levels in groundwater production wells tapping strata above the Corcoran Clay in Subareas A, B, and E is long-term constancy. In Subarea C, about half of the wells have rising water levels, and the remaining wells have relatively constant water levels. In Subareas F, G, and I, the predominant long-term trend in the wells tapping strata above the Corcoran Clay is one of rising water levels. Over the long-term, water levels in most wells tapping strata below the Corcoran Clay were rising prior to 1989, except in Subarea B. In that subarea, about half of the wells surveyed had no long-term water-level change. In Subareas D, E, and G, little pumpage comes from the strata below the Corcoran Clay. A map of the AB 3030 subareas is included as Figure 5-1.

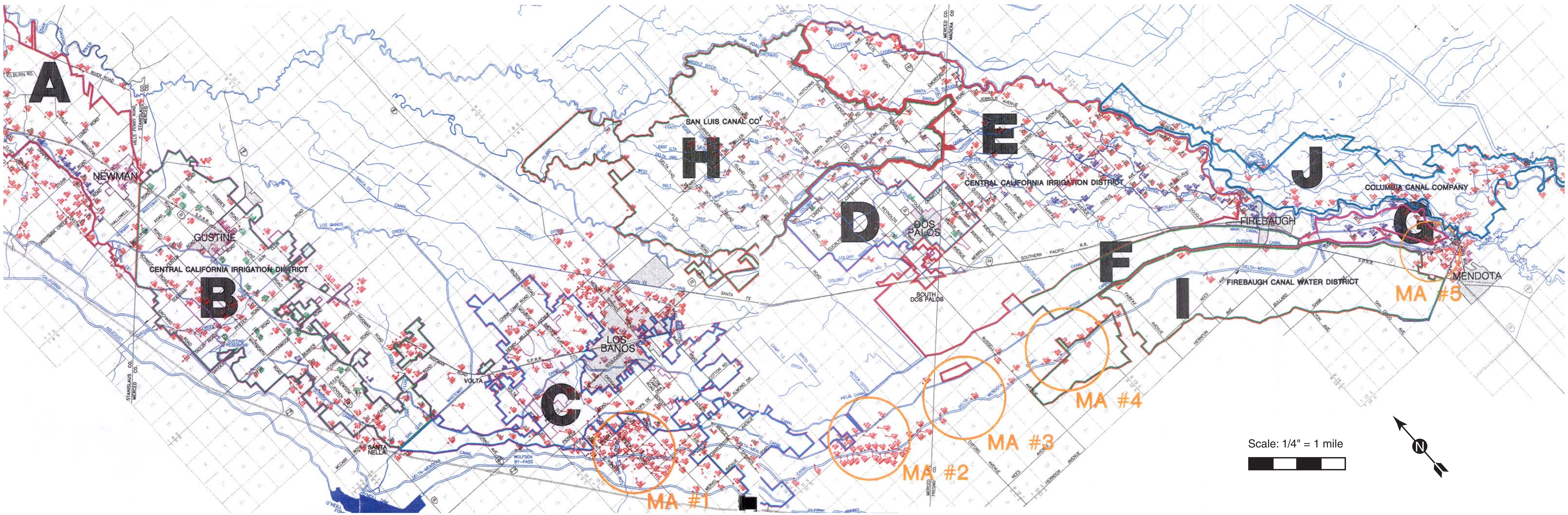
Table 5-2
Long-Term Groundwater Trends in the Exchange Contractors Service Area (Prior to 1990)

AB 3030 Subarea[1]	Above Corcoran Clay	Below Corcoran Clay
A	80% Constant 20% Rising	33% Constant 66% Rising
B	70% Constant 20% Rising 10% Falling	50% Constant 50% Rising
C	45% Constant 55% Rising	100% Rising
D	No wells with long-term hydrographs, except very shallow	
E	80% Constant 20% Rising	No hydrographs
F & I	25% Constant 75% Rising	100% Rising
G	25% Constant 75% Rising	No hydrographs
Delta-Mendota Canal Pumpers	25% Constant 25% Rising 50% Falling	100% Rising

Source: CCID 1997.

Notes: Trends are prior to 1990, and the effects of pumpage by Delta-Mendota Canal and Mendota Pool pumpers are not known.

[1] See Exchange Contractors 1997b for subarea locations.



Legend

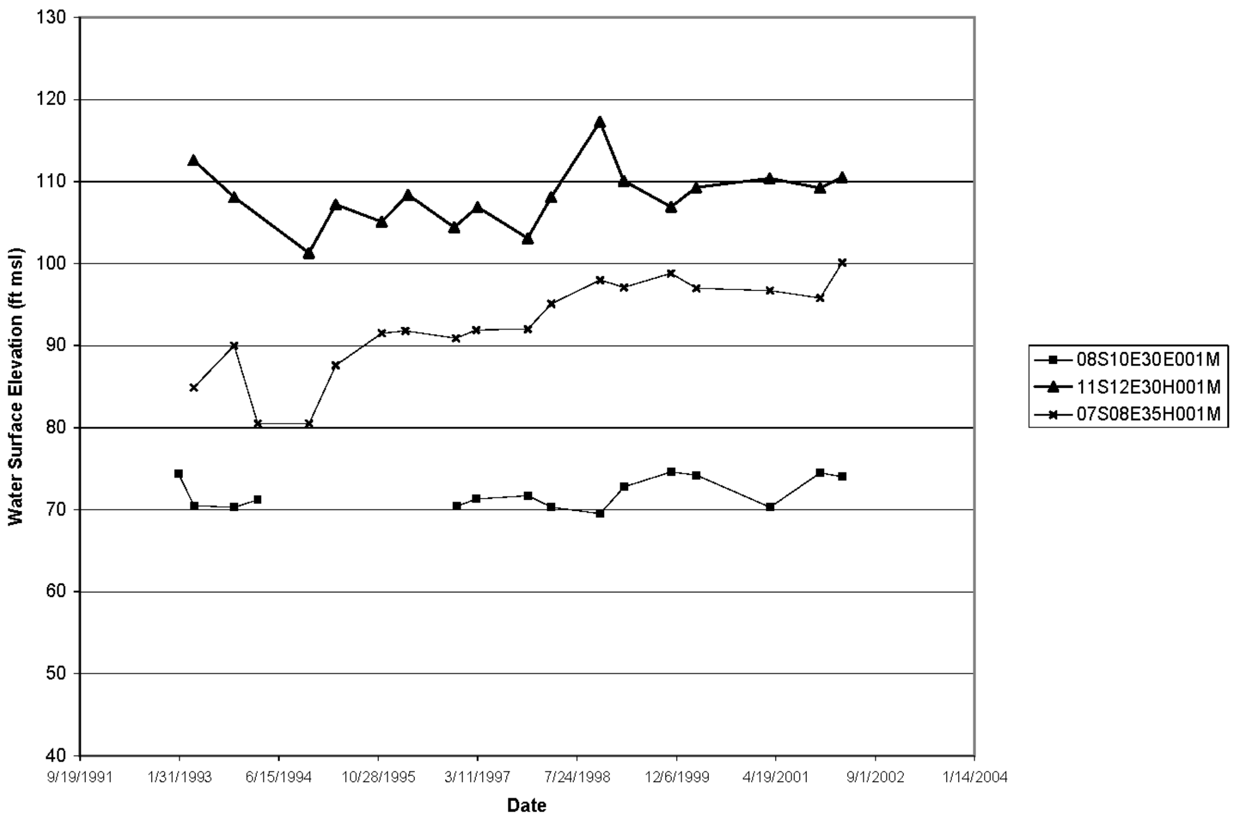
J AB 3030 Subarea Label

MA #5 AB 3030 Groundwater Pumping Management Area

Project No. 26814274	EIS/EIR	Exchange Contractors AB3030 Base Map	Figure 5-3

To verify that no long-term tendency for overdraft occurs in the Exchange Contractors service area, a sampling of wells at locations throughout the service area was made. The results verified that no long-term trend toward falling water levels occurs in the area. Figure 5-2 is a representative plot of groundwater levels over time in three wells, one each from the north, central, and southern portions of the Exchange Contractors service area. As shown in the hydrographs, none of the wells shows a trend toward declining levels over the period from 1993 to 2002. The time period encompasses the years most representative of typical water use under the Exchange Contract. Based on the combined evidence from long-term water level trends, calculated water balance, and the recent trends in water levels, it appears that the Exchange Contractors groundwater management has maintained a balance of groundwater storage in the area. This conclusion is supported by the persistence of high groundwater levels in parts of the SLCC and CCID service areas. The Exchange Contractors maintain a policy of not pumping from areas experiencing groundwater overdraft conditions.

Figure 5-4 Representative Hydrographs, Exchange Contractors Service Area, 1993–2002



5.1.1.4 Projected Basin Water Demand in the Exchange Contractors Service Area

The projected agricultural demand for groundwater in the Exchange Contractors service area is static (S. Chedester, pers. comm., 1998a,b). Over 500 agricultural wells are located in the service area, and little or no expansion of the existing groundwater production well field is projected.

The Exchange Contractors project an increased demand for municipal water supply wells over the next 20 years. Currently, the average annual groundwater production rate from municipal wells within the service area is 16,500 acre-feet. That figure is projected to double by the year 2020 (S. Chedester, pers. comm., 1998a,b).

For the proposed water transfer program for 2005–2014, the Exchange Contractors estimate pumping a maximum of 20,000 acre-feet of groundwater annually for a 10-year period, representing an increase of approximately 14,000 acre-feet over the existing condition in which approximately 6,000 acre-feet are pumped for transfer (D. Steiner, pers. comm., 2004). The 20,000 acre-feet to be pumped for transfer equals approximately 15 percent of present annual average groundwater pumpage.

5.1.1.5 Groundwater Quality in the Exchange Contractors Service Area

Groundwater quality in the Exchange Contractors service area was summarized in CCID (1997) as outlined below. In general, the natural quality of groundwater is influenced by its contact with source rocks and sedimentary deposits. The quality of subsurface recharge from the westside hills, as well as the quality of water in streams recharging the basin, can be correlated with the geologic units in the respective recharge zones or surface-water drainage basins. Streams draining areas that are underlain by rocks of Cretaceous age and Franciscan Formation (Jurassic and Cretaceous age) generally contain higher concentrations of bicarbonate. Water in westside streams in much of the area north of Los Banos is characterized by bicarbonate with dominant cations being calcium and sodium. Streams that drain basins underlain by Tertiary marine formations contain high concentrations of sulfate and/or chloride. Serpentinized formations yield higher concentrations of magnesium. The quality of groundwater along some of the eastern part of the Exchange Contractors service area is influenced by recharge from the San Joaquin River resulting in groundwater that has low salinity with bicarbonate as the major anion.

In Grassland WD, east of Gustine and around Dos Palos, chloride-type groundwater is present. In the 1960s, TDS in Grassland WD groundwater ranged from 500 to 13,000 mg/L. Sodium chloride-type groundwater extends from near Mendota northward to Dos Palos. Transitional types of water (bicarbonate-sulfate and sulfate-bicarbonate) in areas such as those near Gustine are thought to represent mixtures of water from various sources. Near Los Banos, most of the transitional type groundwater is sulfate-chloride and bicarbonate-sulfate, but near the San Joaquin River it is chloride-bicarbonate. TDS concentrations in transitional groundwater ranged from 400 to 42,000 mg/L in the 1960s. Good-quality groundwater is present in the upper aquifer near Mendota and to the east, where recharge from the San Joaquin River and Mendota Pool is significant.

The CCID (1997) report also includes a summary of water quality in the upper aquifer with respect to EC and boron (most data from 1990s). Groundwater with EC values less than 1,200 micromhos per centimeter (μmhos/cm) was found in areas recharged by the larger westside streams, from Los Banos Creek to the northern end of the CCID. Relatively low EC values were also found along the eastside study area near the San Joaquin River, from south of Highway 152 to near Mendota. An exception to the pattern of low EC is an area of high EC in the center of T10S/R13E, where a zone of relatively shallow brackish water appears to underlie a large part of the San Luis Canal Company. It is important to note, however, that most of the San Luis Canal Company water supply wells in this area are completed at depths above the brackish zone (shallower than 250 feet bgs). Intermediate ECs (1,200 to 1,800 µmhos/cm) are associated with the smaller westside drainages and an area adjacent to low EC groundwater near the San Joaquin River. ECs greater than 1,800 µmhos/cm were identified in the following areas: those recharged by creeks south of Los Banos Creek, an area southwest of Mendota, at the downslope portions of westside alluvial fans in T8S/R9E and T9S/R9E, and an area northeast of Los Banos.

Along the eastern part of the area and south of Highway 152, boron concentrations are usually less than 0.5 mg/L, which is consistent with groundwater recharge in areas from eastside streams, which have low boron concentrations. The distribution of boron in groundwater recharged by westside steams is more complex. The lowest boron concentrations were observed in groundwater to the west and are associated with recharge from the larger westside streams, such as Orestimba, Los Banos, Garzas, and Quinto creeks. Groundwater in the interfan areas between these steams generally has intermediate boron concentrations (0.5 to 1.5 mg/L). In areas recharged by streams south of Los Banos Creek groundwater has been found to contain boron at concentrations of more than 2.5 mg/L. Shallow groundwater southwest of Mendota also contains high boron concentrations.

Groundwater quality in the lower aquifer is not as well known as that in the upper aquifer. In general, TDS in groundwater below the Corcoran Clay is less than that above the Corcoran Clay in the area north and west of Los Banos. Experience in Los Banos, Dos Palos, the San Luis Canal Company service area, Firebaugh, and Mendota indicates higher-salinity groundwater is locally present below the Corcoran Clay. High concentrations of hydrogen sulfide, iron, and manganese were present in some areas of the lower aquifer, particularly where reducing conditions are present.

The Exchange Contractors report that water quality issues within their service area occur mainly in or near urban areas. In the Los Banos area, high concentrations of selenium have been found in an elongated, northwest-trending zone aligned with Orestimba Creek, which coincides with an area of high TDS and boron in groundwater. Another area of high selenium is found northeast of Los Banos. In general, concentrations of inorganic chemicals in water from the City of Los Banos wells have been below the maximum contaminant levels. In the City of Gustine, groundwater quality has been excellent for public supply. High-salinity groundwater is present northeast of Gustine. Shallow drainage wells in the upper aquifer near Gustine indicate high nitrate, boron, chloride, and TDS concentrations. In the City of Newman, groundwater quality has generally been excellent for public supply. A high-salinity area was noted northeast of Newman, and iron has been found to exceed the maximum contaminant level in two northeasternmost wells. High nitrate concentrations have been found in some well samples north and northwest of Newman and between Newman and Gustine. High manganese concentrations have been detected in groundwater samples collected from wells in Firebaugh and Mendota. The City of Dos Palos developed a surface-water supply due to poor upper and lower aquifer groundwater quality. The Exchange Contractors also report that localized areas west and southwest of their boundaries contain poor-quality groundwater.

As reported in CCID (1997), recent studies by the U.S. Geological Survey have identified high concentrations of the following inorganic chemicals in shallow groundwater that were associated with agricultural drainage: TDS, selenium, boron, nitrate, molybdenum, and several other trace metals. At present these constituents are of most concern in terms of the disposal and/or reuse of agricultural drainwater. In general, these constituents were present in Coast Range (westside) alluvial fan deposits and were leached to shallow groundwater from irrigation water recharge.

The Exchange Contractors have committed to a program of sampling every 5 years to monitor potential changes in water quality (Exchange Contractors 1997b).

5.1.1.6 Land Subsidence

Subsidence occurs in the western San Joaquin Valley where land that had been used for grazing or dry farming was converted to irrigated agriculture. Subsidence in the San Joaquin Valley results from lowered groundwater elevations and the subsequent compaction of the deterred soil interstitial spaces. Between 1920 and 1970, 5,200 square miles in the valley had subsided more than 1 foot. Land subsidence is a significant problem in the western San Joaquin Valley and in the San Joaquin River Basin. The largest of the three land subsidence areas in the San Joaquin Valley is the 2,600-square-mile Los Banos-Kettleman City area, which extends from Merced County to Kings County and lies within both the San Joaquin and Tulane basins. Groundwater production prior to completion of the California Aqueduct in 1967 caused land subsidence of 1 foot regionally and up to 29 feet locally.

Land subsidence and compaction in different zones have been measured in and adjacent to the Exchange Contractors service area since 1957. During this period, land subsidence has ranged from less than a foot under the San Luis Canal Company to over 5 feet near the Mendota Pool. The Exchange Contractors will continue the annual service area subsidence monitoring. In the years since 1970, the rate of subsidence has declined because surface water was imported to the areas. Because the shallow groundwater is of generally higher quality, most of the Exchange Contractors' groundwater supply comes from wells tapping the unconfined aquifer above the Corcoran Clay. The exception is a few "composite" wells near Newman, which is outside the zone of heightened subsidence. Further, the Exchange Contractors are conducting annual subsidence monitoring as part of their AB 3030 Groundwater Management Plan (Exchange Contractors 1997b). The Exchange Contractors are also continuously monitoring subsidence, water levels, and compaction at two extensometers located along CCID facilities in Fresno County. The sites are located near the Mendota Pool and at the intersection of Russell Avenue and the Delta-Mendota Canal. Continuously Operating Reference Stations are being installed at the sites to continuously measure total subsidence. The Continuously Operating Reference Stations are GPS stations that continuously measure both vertical and horizontal movement of land surface. The Scripps Institute will collect the data on a daily basis as part of a study to determine relative velocities of land surfaces in North America. Annual reports will be generated, supplied to the Exchange Contractors, and analyzed.

5.1.1.7 Surface/Groundwater Interaction

According to Appendix B, the San Joaquin River gains an average of approximately 10,000 acre-feet per year from groundwater within the Exchange Contractors service area. Most of this amount accretes in the northern half of the service area, where groundwater levels are nearest the surface. This amount is approximately 13 cfs. By comparison, normal base flows in the San Joaquin River at Vernalis are not less than 1,000 cfs.

Inadequate drainage and accumulating salts have been persistent problems for irrigated agriculture along the west side and in parts of the east side of the San Joaquin River region for more than a century. The most extensive drainage problems exist on the west side of the San Joaquin River and Tulare Lake regions (Reclamation 1997a).

The soils on the west side of the region are derived from marine sediments and are high in salts and trace elements. Irrigation of these soils has mobilized these compounds and facilitated their movement into the shallow groundwater. Since the 1950s, much of this irrigation has been with imported water, resulting in rising groundwater levels and increasing soil salinity. Where agricultural drains have been installed to control rising water tables, drainwater frequently contains high concentrations of salts and trace elements (SJVDP 1990). Only a small portion (approximately 28,000 acres) of the Exchange Contractors service area (240,000 acres) is located within an area experiencing subsurface drainage problems.

San Joaquin Valley agricultural areas that may receive transfer water include Plainview, Patterson, Del Puerto, San Luis, Pacheco, Panoche, and Westlands WDs (located from northwest to southeast). SBCWD and SCVWD, located outside of the San Joaquin Valley, may also receive transfer water. In general, agricultural subsurface drainage would be expected to be an issue where receiving area soil contains higher concentrations of salts and trace elements. Information prepared by SJVDP (1990) suggests that projected transfer water receptors to the northwest (Plainview, Patterson, and Del Puerto WDs, and the northwestern two-thirds of the San Luis WD) would not have subsurface drainage problems, while projected receptors to the southeast (southeastern third of the San Luis, Pacheco, Panoche, Broadview, and Westlands WDs) may have subsurface drainage problems. In general, selenium in the top 12 inches (surface) of soil in the receptor areas is within the 0.10 to 0.13 milligram per kilogram (mg/kg) range in the northwesternmost receptors as listed above. In the southeastern receptors, selenium in surface soil can range from 0.10 to 1.07 mg/kg with increased concentrations to the southeast, primarily in Westlands WD. Summary figures in the SJVDP (1990) plan indicate that salinity, selenium, and boron in shallow groundwater increase in concentration south of Los Banos (samples between 1984 and 1989).

The Exchange Contractors monitor shallow groundwater levels and quality within their service area using a network of shallow (less than 14 feet) piezometers throughout the area. Any changes in the interaction between groundwater and surface water will be detected and analyzed.

5.1.2 Regulatory Setting

The Groundwater Management Act of 1992 (AB 3030) applies to groundwater usage by the Exchange Contractors. This act establishes a voluntary program whereby local water agencies may establish programs for managing their groundwater resources. The Exchange Contractors adopted a Groundwater Management Plan in October 1997 (Exchange Contractors 1997b). The plan commits the Exchange Contractors to keeping records of groundwater pumping and conducting periodic monitoring of groundwater levels and quality throughout their service area.

Fresno County regulates the extraction and transfer of groundwater within the county under Title 14, Chapter 3 of the Fresno County Ordinance Code. Fresno County and the Exchange Contractors have an MOU that exempts the Exchange Contractors from regulation of groundwater resources within Fresno County. Fresno County and the Exchange Contractors agree that agricultural production is vital to the county and that groundwater, used conjunctively with surface water, is essential for continued agricultural production. The MOU specifically exempts the Exchange Contractors from the newly adopted Title 14, Chapter 3 of the Fresno County Ordinance Code, in accordance with Section 14.03.05E of the code. Fresno County recognizes that the Exchange Contractors' management, protection, and control of groundwater resources are consistent with Title 14, Chapter 3; therefore, the MOU exempts the Exchange Contractors from this code requirement (Fresno County and Exchange Contractors 2001).

5.2 ENVIRONMENTAL CONSEQUENCES

Key issues are effects of groundwater pumping on groundwater balance and groundwater quality in the Exchange Contractors service area, groundwater balance and groundwater quality in receiving areas, and potential for land subsidence in the Exchange Contractors service area (due to groundwater withdrawals).

5.2.1 Key Impacts and Evaluation Criteria

To address concerns about potential impacts and their significance on groundwater resources in the Exchange Contractors service area, the following issues are evaluated:

- Would significant changes occur to groundwater levels and/or flow patterns in the Exchange Contractors service area?
- Would the rate of flow of poor-quality groundwater from the south and west be measurably increased?
- Would land subsidence increase?
- Would surface water flows be reduced?

If none of the above are likely to occur, then the proposed transfer program would not be likely to have a significant impact with respect to existing groundwater resources in the Exchange Contractors service area or in receiving areas. Similarly, in the absence of the effects cited above, the proposed program would have no effects compared to the No Action/No Project Alternative.

5.2.2 Environmental Impacts and Mitigation

The focus of the following analysis is on identifying quantifiable regional effects of the action alternatives. Beneficial impacts are those where the proposed transfer program would improve the environment regardless of the threshold of significance. There would be a positive impact/beneficial effect on groundwater conditions east of the Exchange Contractors service area in Madera County. Transfers into this area would reduce groundwater pumping in the subbasin coincident with and adjacent to the Exchange Contractors service area (Madera Irrigation District, Appendix E).

5.2.2.1 No Action/No Project Alternative

Under the No Action/No Project Alternative, no water would be developed for transfer. The Exchange Contractors would continue to manage groundwater resources at levels similar to those of the last 10 years, similar to the existing conditions of groundwater resources, but no water would be made available for transfer. Currently, the amount of groundwater developed for transfer is approximately 6,000 acre-feet per year. In the absence of water transfer, groundwater pumping would be reduced by approximately the same amount, which represents less than 5 percent of total average groundwater pumping by the Exchange Contractors and approximately

0.5 percent of the total throughputs of the system. In comparison to existing conditions, the No Action/No Project Alternative is different but has no significant beneficial impact on groundwater resources within the Exchange Contractors service area.

5.2.2.2 Alternative A: 80,000 Acre-Feet

Under Alternative A, up to 80,000 acre-feet per year would be made available through a combination of water conservation, groundwater pumping, and crop idling/land fallowing. This alternative assumes that land fallowing would be done to develop up to 50,000 acre-feet per year in any year. In critical years, the only water available would be from crop idling. The impacts of conservation/tailwater recovery and groundwater source development on groundwater resources are discussed below along with the application of the water by potential transferees.

Source Area Impacts

Source area impacts are those associated with the Exchange Contractors' water development for the proposed transfer program.

Impacts of Groundwater Pumping. The Exchange Contractors have committed to a policy of no net depletion of groundwater over the 10-year life of the program. Based on a review of groundwater levels over the past 10 years, no net substantial change in groundwater storage has occurred within the Exchange Contractors service area. The average annual volume of groundwater pumped over the period from 1993 to 2002 was approximately 130,000 acre-feet per year. As discussed in the previous section on water balance, it appears that a pumping rate of 130,000 acre-feet per year can be sustained without creating an overdraft condition in the Exchange Contractors service area. The Exchange Contractors propose no more than 20,000 acre-feet per year of transfer water to be developed from groundwater in a normal year. Under current practices, approximately 6,000 acre-feet per year of transfer water is developed through groundwater pumping (D. Steiner, pers. comm., 2004). Therefore, Alternative A requires approximately 14,000 acre-feet per year of groundwater pumping over the current rate, equating to an increase of approximately 11 percent over the 130,000 acre-feet per year currently being pumped and less than 1.5 percent of the total annual inputs to the system. Given the small amount of the increase, the pumping component of the proposed program would likely have little or no direct effect on groundwater levels or flow patterns within the source area over the 10-year duration of the program. Furthermore, ongoing groundwater monitoring will detect any negative impacts that CCID pumping may have on nearby wells or the depth to water. These impacts are prohibited under the CCID's "1995 Rules Governing Pumping of Private Wells," adopted in January 1995 and revised in January 2000. The impact of groundwater pumping is less than significant or minimal.

Impacts of Water Conservation. Water conservation refers to the practice of recovering applied irrigation water after it drains from a field and before it leaves the Exchange Contractors service area. For this analysis, conserved water is the sum of four components: evaporation and seepage, recovery of tailwater discharge to Mud and Salt Sloughs, and water recovered upstream of Sack Dam. Of these, only the first two components, evaporation and seeps and operational spills, are considered to be potential sources of recharge to groundwater (D. Steiner, pers. comm., 2004). Evaporation and seeps refers to water that ponds in the low ends of fields after being applied to crops. Some of this water evaporates, some is consumptively used by vegetation other than crops, and the rest infiltrates to the groundwater basin. Operational spills refers to water that is lost in conveyance, through overflowing canals, that has the potential to accumulate in low points and infiltrate to groundwater. The quantity of groundwater recharge from these two sources is estimated based on the infiltration rate for water in the wildlife refuges, approximately 25 percent. Based on this estimate, the combined total of 29,000 acre-feet per year to be conserved from evaporation and seeps and operational spills equates to a potential reduction in groundwater recharge of 7,250 acre-feet per year. However, since these two factors are included in current practices, there is no program-related impact.

Impacts of Crop Idling. Crop idling (temporary land fallowing) would reduce the amount of water applied to acreage within the Exchange Contractors service area. Some of this water would have been lost to evaporation and consumptive use by crops, and some would have been recovered as tailwater; the balance would have contributed to groundwater recharge. Thus, a potential exists for reduced groundwater storage due to crop idling. The maximum volume of water that would be made available through land fallowing is 50,000 acre-feet, which translates to approximately 20,000 acres fallowed (D. Paul, pers. comm., 2003a). Based on the California Polytechnic University at San Luis Obispo water budget adopted by the Exchange Contractors, each acre of irrigated farmland generates approximately 0.5 acre-foot of deep percolation. Therefore, the maximum potential reduction in groundwater recharge due to crop idling is estimated to be 10,000 acre-feet per year. This impact is less than significant or minimal.

The potential reductions to groundwater due to developing the water transfer sources described above for a noncritical year are summarized in Table 5-3 for all of the action alternatives.

Table 5-3
Summary of Potential Impacts to Groundwater Recharge in Source Area from Water Development Only

Water Source	Volume Generated for Transfer under Existing Conditions	Volume Generated for Transfer under No Action/ No Project (acre-feet/year)	Maximum Volume Generated for Transfer under All Action Alternatives (acre-feet/year)	Maximum Incremental Change in Groundwater Recharge (acre-feet/year)
Groundwater Pumping	6,000	0	20,000	-14,000
Water Conservation	63,635	0	80,000	0
Crop Idling	0	0	50,000	-10,000
Total	69,635	0	130,000[a]	-24,000

[a] Maximum transfer would be 130,000 acre-feet; rows are not additive.

The total reduction in groundwater recharge in any given year could be as high as 24,000 acre-feet, which represents approximately 2 percent of the total inputs to the system as described in Section 5.1.1.3. In a critical year, only 10,000 acre-feet of reduction in groundwater discharge would occur. In both cases, the impact is less than significant or minimal.

The net effect on groundwater balance of each of the alternatives can vary according to transferee, as discussed below.

Receiving Area Impacts

This analysis reflects the combined effects of water development and water transfer, which are illustrated in Table 5-4.

All Water to Refuges. For the refuge focus scenario, some potential losses to groundwater are offset by transfer of the water to users connected to the San Joaquin River and its associated groundwater basin. According to Appendix B, the rate of deep percolation of water supplied to refuges is between 24 and 28 percent. This rate of recharge to groundwater is essentially equal to the estimated rate of percolation for ponded drainwater. Groundwater that is transferred to refuges would also infiltrate at a rate of approximately 25 percent; thus, the loss to groundwater due to pumping can be reduced by 25 percent of the total transferred for this case. Crop idling has a net positive effect (beneficial impact) on groundwater in this case, because water transferred to refuges infiltrates at a greater rate than applied irrigation water.

Table 5-4
Potential Impacts on Groundwater Supply by Source and Transferee, Alternative A

Transferees	Crop Idling (acre-feet/year)	Groundwater Pumping (acre-feet/year)	Water Conservation (acre-feet/year)	Net Impact on Groundwater Supply (acre-feet/year)
All Water to Refuges	2,500	-10,365	0	-10,365 (noncritical year) 2,500 (critical year)
All Water to Agriculture	-10,000	14,000	0	-24,000 (noncritical year) -10,000 (critical year)
All Water Transferred Out of Basin	-10,000	-14,000	0	-24,000 (noncritical year) -10,000 (critical year)

All Water to Agriculture. For the agriculture focus, water transferred to agricultural users to the west and southwest of the Exchange Contractors service area would be hydraulically upgradient from the source area. Some of that water would infiltrate into groundwater and return to the Exchange Contractors as subsurface inflow. The effect would not be great enough to significantly alter groundwater gradients or flow directions over the life of the proposed program, so this factor does not offset losses to groundwater in the Exchange Contractors service area.

As indicated in Section 5.1.1.7, agricultural subsurface drainage problems may occur where receiving area soil contains higher concentrations of salts and trace elements. Management practices outlined in the SJVDP (1990) plan are being employed, where necessary, in those areas where subsurface drainage problems occur. The Grassland Bypass Project and the Grassland Area Farmers Long-Term Drainage Management Plan for agricultural subsurface drainage in the Grassland Drainage Area are being implemented for Pacheco, Panoche, Broadview, and Firebaugh Canal WDs (Grassland Area Farmers and Delta-Mendota Water Authority 1998). Westlands WD has a drainage management program they implement with local water users that includes water use efficiencies and land fallowing. Westlands WD is also involved in litigation to address their subsurface drainage problems, which occur on 298,000 acres out of a total area of 600,000 acres. Measures to control agricultural subsurface drainage and its discharge to the San Joaquin River system are being implemented, and future measures will be evaluated in separate CEQA/NEPA documents. Future measures include the San Luis Drainage Feature Reevaluation currently being developed by Reclamation. Consequently, the action alternative of up to 80,000 acre-feet of additional water for irrigation would have a less-than-significant impact on drainage management in the project area.

All Water Transferred Out of Basin. No reduction in losses to groundwater would occur due to transfers to non-San Joaquin River Basin use under the out-of-basin transfer scenario, based on the hydrologic definition of out-of-basin.

5.2.2.3 Alternative B: 50,000 Acre-Feet

Under this alternative, crop idling would be the only source of transferred water in all years. Effects are shown in Table 5-5.

Table 5-5
Potential Impacts on Groundwater Supply by Transferee, Alternative B

Transferees	Net Impacts to Groundwater (acre-feet/year)
All Water to Refuges	2,500
All Water to Agriculture	-10,000
All Water Transferred Out of Basin	-10,000

<u>All Water to Refuges</u>

The loss of 10,000 acre-feet of recharge from the fallowed lands would be offset by recharge of up to 12,500 acre-feet through the refuges, assuming that the refuges are within the San Joaquin River basin.

<u>All Water to Agriculture</u>

Water transferred to agricultural users to the west and southwest of the Exchange Contractors service area would be hydraulically upgradient from the source area. Some of that water would infiltrate into groundwater and return to the Exchange Contractors as subsurface inflow. The effect would not be great enough to significantly alter groundwater gradients or flow directions over the life of the proposed program, so this factor does not offset losses to groundwater in the Exchange Contractors service area.

<u>All Water Transferred Out of Basin</u>

No reduction in losses to groundwater would occur due to transfers to non-San Joaquin River Basin use.

5.2.2.4 Alternative C: 130,000 Acre-Feet

This alternative is composed of the maximum amounts of water from all sources. Effects are summarized in Table 5-6.

Table 5-6
Potential Impacts on Groundwater Supply by Source and Transferee, Alternative C

Impact on Groundwater for All Sources and Transferees				
Transferees	**Crop Idling (acre-feet/year)**	**Groundwater Pumping (acre-feet/year)**	**Water Conservation (acre-feet/year)**	**Net Impact on Groundwater recharge (acre-feet/year)**
All Water to Refuges	2,500	-10,365	0	-7,865 (normal year) 2,500 (critical year)
All Water to Agriculture	-10,000	-14,000	0	-24,000 (normal year) -10,000 (critical year)
All Water Transferred Out of Basin	-10,000	-14,000	0	–24,000 (normal year) -10,000 (critical year)

<u>All Water to Refuges</u>

Some potential losses are mitigated by transfer of the water to users connected to the San Joaquin River and its associated groundwater basin. According to Appendix B, the rate of deep percolation of water supplied to refuges is between 24 and 28 percent. This rate of recharge to groundwater is essentially equal to the estimated rate of percolation for ponded tailwater. In that case, the net loss to groundwater within the Exchange Contractors service area from tailwater recovery is zero. Groundwater and water that is made available through land fallowing that is transferred to refuges within the San Joaquin River basin would also infiltrate at a rate of approximately 25 percent; thus, those losses to groundwater can be reduced by 25 percent of the total transferred for this case.

<u>All Water to Agriculture</u>

Water transferred to agricultural users to the west and southwest of the Exchange Contractors service area would be hydraulically upgradient from the source area. Some of that water would infiltrate into groundwater and return to the Exchange Contractors as subsurface inflow. The effect would not be great enough to significantly alter groundwater gradients or flow directions over the life of the proposed program, so this factor does not offset losses to groundwater in the Exchange Contractors service area.

<u>All Water Transferred Out of Basin</u>

No reduction in losses to groundwater would occur due to transfers to non-San Joaquin River Basin use.

5.2.3 Cumulative Effects

Although the impacts of the proposed transfer program appear to be less than significant for all alternatives, changes in the practices of other water users in the San Joaquin River basin could affect groundwater. Increased groundwater pumping by water users other than the Exchange Contractors, who are within the San Joaquin River basin, could alter groundwater supply and flow patterns. If users to the west of the Exchange Contractors service area greatly increased their use of groundwater, the total inflow available to the Exchange Contractors could be reduced to the point where the current pumping practices are no longer sustainable. This situation would create an overdraft condition, which in turn would reduce the amount of subsurface outflow leaving the service area. Because groundwater in some areas to the east of the Exchange Contractors service area is already in an overdraft condition, reducing the supply from subsurface inflow available to those users could have significant negative effects. Similarly, if users to the east increase their groundwater pumping, groundwater gradients and, therefore, flow rates to the east would increase, which in turn would increase the rate of subsurface flow leaving the Exchange Contractors service area and the amount of groundwater available for pumping. Regionally, the water districts' AB 3030 groundwater management plans combined with county plans would minimize the potential for a cumulative significant effect on groundwater supply, and the incremental impact of the transfer program action alternatives is insignificant or not cumulatively considerable.

The cumulative impact of subsurface agricultural drainage from the Exchange Contractors' transfer program, specific drainage management projects, and the long-term CVP contract renewals will be addressed in separate NEPA (and CEQA) documents. The incremental impact is insignificant because the additional water would cover, in part, projected deficits in CVP water deliveries.

5.2.4 Impact and Mitigation Summary

5.2.4.1 No Action/No Project Alternative

Compared to existing conditions, the No Action/No Project Alternative has an insignificant beneficial impact on groundwater resources in the Exchange Contractors service area.

5.2.4.2 Impacts on Groundwater Supply

Impacts for all action alternatives were summarized previously in Tables 5-4 through 5-6.

The maximum impact to groundwater resources occurs under Alternative C in a normal year. Even under these conditions, the loss of 24,000 acre-feet of recharge represents approximately 2 percent of the total inputs to the system. A decrease of this magnitude should not significantly alter groundwater elevations or flow patterns; therefore, all action alternatives would have a less-than-significant impact on groundwater levels and flow patterns in the Exchange Contractors service area, and no mitigation is required.

5.2.4.3 Impacts to Groundwater Quality

The principal threat to groundwater quality is the migration of poor-quality groundwater from the west and southwest. The action alternatives would not alter groundwater flow rates or directions significantly; therefore, the impact on groundwater quality is less than significant. No mitigation is required.

5.2.4.4 Impacts on Land Subsidence

Land subsidence in the Exchange Contractors service area is primarily caused by pumping from beneath the Corcoran Clay. The majority of the Exchange Contractors pumping is done in the unconfined zone above the Corcoran Clay. In addition, the volume of additional water to be pumped is unlikely to create an overdraft condition; therefore, the additional pumping under the action alternatives would have no significant impact on ground subsidence. No mitigation is required.

5.2.4.5 Impacts on Surface Water Flows

Groundwater accretion adds approximately 13 cfs of water to the San Joaquin River, which is less than 8 percent of San Joaquin River base flows. Groundwater levels and flow directions would not be significantly altered from the present condition. The Exchange Contractors program of shallow groundwater monitoring will detect changes in interactions between surface water and groundwater. Therefore, the proposed program would have no significant impact on surface water flows due to groundwater accretion.

5.2.4.6 Significance Determinations

Tables 5-7 through 5-10 summarize the effects of the No Action/No Project Alternative and the action alternatives on groundwater supply and associated issues.

Table 5-7
Summary of Effects of the No Action/No Project Alternative

Affected Resource and Area of Potential Effect	No Action/No Project Compared to Existing Conditions
Groundwater Supply	Less-than-significant impact
Groundwater Quality	Less-than-significant impact
Land Subsidence	No adverse impact
Surface Water Flows	Less-than-significant impact

Table 5-8
Summary of Effects of Alternative A: 80,000 Acre-Feet

Affected Resource and Area of Potential Effect	CEQA	NEPA
Groundwater Supply	Less-than-significant impact	Minimal effect
Groundwater Quality	Less-than-significant impact	Minimal effect
Land Subsidence	No adverse impact	Neutral effect
Surface Water Flows	Less-than-significant impact	Minimal effect

Table 5-9
Summary of Effects of Alternative B: 50,000 Acre-Feet

Affected Resource and Area of Potential Effect	CEQA	NEPA
Groundwater Supply	Less-than-significant beneficial impact	Minimal effect
Groundwater Quality	Less-than-significant impact	Minimal effect
Land Subsidence	No adverse impact	Neutral effect
Surface Water Flows	Less-than-significant impact	Minimal effect

Table 5-10
Summary of Effects of Alternative C: 130,000 Acre-Feet

Affected Resource and Area of Potential Effect	CEQA	NEPA
Groundwater Supply	Less-than-significant impact	Minimal effect
Groundwater Quality	Less-than-significant impact	Minimal effect
Land Subsidence	No adverse impact	Neutral effect
Surface Water Flows	Less-than-significant impact	Minimal effect

Section 6 evaluates the potential for the water transfer program to affect wetlands, special-status species, and aquatic habitat in the project area.

6.1 AFFECTED ENVIRONMENT/ENVIRONMENTAL SETTING

Sensitive biological resources in the project area include wetlands, special-status species, and nonwetland aquatic habitats. These biological resources are defined as follows:

- Wetlands – habitats that are inundated or saturated frequently and for sufficient duration to support specialized hydrophytic plants that tolerate these conditions (hydrophytic plants)
- Special-status species – species that are formally listed, proposed for listing, or candidates for listing under the Federal or California Endangered Species Acts; designated "species of concern" identified by the Service or the DFG; and special-status plants identified in the California Native Plant Society's 2001 Inventory (CNPS 2001)
- Nonwetland aquatic habitats – habitats that lack wetland vegetation but are characterized by seasonal or perennial inundation

This section describes the environmental setting associated with these sensitive biological resources and their distribution in the project area.

The description of the affected environment is based on the following environmental documents that address the wildlife refuges, water districts, and irrigation districts in the San Joaquin Valley:

- *Temporary Water Transfer Program for the San Joaquin River Exchange Contractors Water Authority 2000–2004, Environmental Assessment and Initial Study* (Reclamation 2000c)
- *Friant Division Long-Term Contract Renewal Regional Biological Assessment* (Reclamation 2001m)
- *Refuge Water Supply Long-Term Water Supply Agreements FONSI* (Reclamation 2000d)
- *Report on Refuge Water Supply Investigations* (Reclamation 1989)
- *Grassland Bypass Project EIS/EIR* (Reclamation 2001n)

These documents address many of the issues identified for the proposed 10-Year Water Transfer Program and, in some cases, provide additional detail regarding the affected environment.

6.1.1 Regulatory Setting

6.1.1.1 Federal Endangered Species Act

The Federal Endangered Species Act (FESA) defines "endangered" species as those in danger of extinction throughout all or a significant portion of their range. A "threatened" species is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Additional special-status species include "candidate" species and "species of concern." Candidate species are those for which the Service, or NOAA Fisheries if applicable, has enough information on file to propose listing as endangered or threatened. "Species of concern" are those for which listing is possibly appropriate, but for which the Service or NOAA Fisheries lacks sufficient information to support a listing proposal. A species that has been "delisted" is one whose population has met its recovery goal target and is no longer found to be in jeopardy of extinction.

Federally listed species may be addressed for a proposed project in one of two ways: (1) a non-Federal government entity may resolve potential adverse impacts to species protected under FESA Section 10, or (2) a Federal lead agency regulates the proposed project in accordance with FESA Section 7. Section 7 defines a process for the Federal lead agency to consult with the responsible Federal resource agency (the Service or NOAA Fisheries), to determine whether the proposed water transfer program is likely to adversely affect species that are listed or proposed for listing. The Section 7 process typically requires the preparation of a Biological Assessment by the Federal lead agency followed by the preparation of Biological Opinion by the responsible Federal resource agency. Consultation under Section 7 is limited to projects with a Federal nexus. Other projects that may result in take or harm of a Federally listed species require a Section 10 permit from the Service and/or NOAA Fisheries. The Section 10 process typically requires the project proponent to prepare a Habitat Conservation Plan (HCP). A permit is issued by the Service and/or NOAA Fisheries once the HCP is approved.

6.1.1.2 California Endangered Species Act

The California Endangered Species Act (CESA) and the Native Plant Protection Act authorize the California Fish and Game Commission to designate endangered, threatened, and rare species and to regulate the taking of these species (Sections 2050–2098, Fish and Game Code). CESA defines "endangered" species as those whose continued existence in California is jeopardized. State-listed "threatened" species are those not presently threatened with extinction but which may become endangered if their environments change or deteriorate. Protection of special-status species is detailed in Sections 2050 and 2098 of the Fish and Game Code. In addition to recognizing three levels of endangerment, DFG can provide interim protection to candidate species while they are being reviewed by the Fish and Game Commission. Formal consultation must be initiated with DFG for projects that may have an adverse effect on a State-listed species in accordance with the State lead agency.

Section 2080 of the California Fish and Game Code prohibits the taking of State-listed plants and animals. DFG also has the authority to designate State endangered and rare plants and provide specific protection measures for identified populations under the Native Plant Protection Act of 1977. DFG also designates "fully protected" or "protected" species as those that may not be taken or possessed without a permit from the Fish and Game Commission and/or DFG. Species designated as fully protected or protected may or may not be listed as endangered or threatened.

DFG also maintains a list of animal "Species of Special Concern," most of which are species whose breeding populations in California may face extirpation. Although these species have no legal status, DFG recommends consideration of them during analysis of the impacts of proposed projects to protect declining populations and avoid the need to list them as endangered in the future.

DFG's implementation of CESA has created a program that is similar in structure to, but different in detail from, the Service program implementing FESA.

6.1.1.3 Fish and Wildlife Coordination Act

This act authorizes the Service, NOAA Fisheries, and State agencies responsible for fish and wildlife resources to investigate all proposed Federal undertakings and non-Federal actions needing a Federal permit or license that would impound, divert, deepen, or otherwise control or modify a stream or waterbody and to make mitigation and enhancement recommendations to the involved Federal agency. According to the act, "Recommendations … shall be as specific as practicable with respect to features recommended for wildlife conservation and development, lands to be utilized or acquired for such purposes, the results expected, and shall describe the damage to wildlife attributable to the project and the measures proposed for mitigating or compensating for these damages."

6.1.1.4 Magnuson-Stevens Fisheries Act

The Amended Magnuson-Stevens Fishery Conservation and Management Act, also known as the Sustainable Fisheries Act (Public Law 104-297), requires all Federal agencies to consult with the Secretary of Commerce on activities, or proposed activities, authorized, funded, or undertaken by that agency that may adversely affect Essential Fish Habitat (EFH) (Office of Habitat Conservation 1999). The EFH provisions of the Sustainable Fisheries Act are designed to protect fisheries habitat from being lost due to disturbance and degradation.

6.1.1.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (16 United States Code 703–711) makes it unlawful to take, possess, buy, sell, purchase, or barter any migratory bird listed in 50 CFR Part 10, including feathers or other parts, nests, eggs, or products, except as allowed by implementing regulations (50 CFR 21). Disturbance that causes nest abandonment and/or loss of reproductive effort (e.g., killing or abandonment of eggs or young) may be considered a "take" and is potentially punishable by fines and/or imprisonment.

6.1.1.6 Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 (Protection of Wetlands) requires Federal agencies to take actions to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands when undertaking Federal activities and programs. Any agency considering a proposal that might affect wetlands must evaluate factors affecting wetland quality and survival. These factors should include the proposal's effects on the public health, safety, and welfare due to modifications in water supply and water quality; maintenance of natural ecosystems and conservation of flora and fauna; and other recreational, scientific, and cultural uses.

6.1.2 Resources

The environmental settings for the wetland habitat and agricultural areas are described separately. Appendix C provides a comprehensive list of the special-status species with the potential to occur in the project area. Appendix D provides lists of special-status species known or likely to occur in the Exchange Contractors service area (Table D-1), in the refuges within the project area (Table D-2), and in agricultural and M&I areas within the project area (Table D-3).

Included in these tables is a determination of whether each species would be affected by the action alternatives.

6.1.2.1 Exchange Contractors Service Area

The following irrigation water service providers are in the Exchange Contractors service area:

- CCID
- Colombia Canal Company
- Firebaugh Canal WD
- San Luis Canal Company

Agricultural habitats in the service area are composed of irrigated pasture and croplands (Reclamation 2000c). Croplands include 75 different crops including the following crop types: pasture, orchard-vineyard, row crops, and cotton. Many wildlife species have adapted to particular crop types and now use them for foraging and nesting. Cropland is the most extensive cover type in the San Joaquin Valley and most cropland is irrigated.

From 1999 to 2002, the primary crops grown in the Exchange Contractors service area were cotton (28.7 percent), alfalfa/hay/seed (25.5 percent), other field crops (sugar beets and beans – 14.7 percent), grain crops (9.7 percent), vegetables (8.3 percent), permanent crops (orchards and grapes – 4.1 percent), melons (3.2 percent), pasture (3.6 percent), and idled (2.1 percent).

Up to 8 percent of the Exchange Contractors service area, approximately 20,000 out of 240,000 acres, could be idled. Crops that are cultivated in the areas that might be idled include cotton (60 percent), alfalfa (15 percent), sugar beets (15 percent), melons (5 percent), and wheat (5 percent). No rice is grown in the area. Some of the idled areas could be adjacent to or very near wildlife refuges (D. Paul, pers. comm., 2003b).

Pastures provide foraging opportunities for black-bellied plover, killdeer, long-billed curlew, and white-faced ibis. Small mammals occupying pasture habitat include California vole, Botta's pocket gopher, and California ground squirrel. Raptors, including red-tailed hawk, white-tailed kite, and prairie falcon, prey upon rodents. Ground-nesting birds, including ring-necked pheasant, waterfowl, and western meadowlark, occupy pasture habitat if adequate residual vegetation is present (Reclamation 2000c). Pasture and row crops provide moderate quality habitat due to limited cover and foraging opportunities (Reclamation 2001m).

Orchard-vineyard habitat includes cultivated fruit or nut-bearing trees and grape vines, and is intensively managed. Understory vegetation is usually sparse. However, in some areas, grasses are allowed to grow between vineyard rows to reduce erosion. Wildlife species associated with vineyards include deer mouse, mourning dove, and black-tailed hare. The nut orchards provide foraging opportunities for American crow, scrub jay, northern flicker, Lewis' woodpecker, and California ground squirrel. The fruit orchards provide additional food for yellow-billed magpie, American robin, northern mockingbird, black-headed grosbeak, gray squirrel, raccoon, and mule deer (Reclamation 2000c). Orchard-vineyard and cotton crops provide low-quality habitat due to the limited foraging opportunities and lack of cover (Reclamation 2001m).

Row crops include a wide variety of plants used in the production of vegetable and berry produce. The intensive management of row crops limits use by wildlife. Rodent species that forage in row crops include the California vole, deer mouse, and California ground squirrel. These rodent populations are preyed upon by foraging raptors, including Swainson's hawk, red-tailed hawk, and white-tailed kite (Reclamation 2000c).

Grain crops include barley, wheat, corn, and oats. Crops that supply food and cover and that have low tillage requirements have a higher wildlife habitat value than those that lack any of these characteristics (Reclamation 2001m). Cereal grains and hay crops such as alfalfa are perhaps the most valuable as wildlife food and provide some cover to ducks, pheasant, nongame birds, and small mammals (Reclamation 2001m). The presence of potential prey attracts raptors that feed in these fields (Reclamation 2001m). Many of these crops are planted in fall and harvested in spring. In some areas, the crops provide foraging opportunities to waterfowl, greater white fronted goose, tundra swan, red-winged blackbird, Brewer's blackbird, ring-necked pheasant, and western harvest mouse (Reclamation 2000c).

6.1.2.2 Central Valley Project Agricultural Service Contractors

The following nine water districts are CVP Agricultural Service Contractors that could purchase water under any of the action alternatives: Plainview, Pacheco, Del Puerto, Panoche, Patterson, Westlands, San Luis, San Benito County, and Santa Clara Valley. All of these except SBCWD and SCVWD are located in westside San Joaquin Valley. Natural communities within the nine water districts include ruderal/nonnative grasslands, chaparral, oak woodlands, redwood forests, riparian woodland, salt and brackish marsh, and freshwater marsh.

Agricultural habitats in the westside San Joaquin Valley areas listed above are similar to those discussed for the Exchange Contractors service area. Table 9 in Appendix A shows the specific distributions of a variety of crop types, including pasture, orchard-vineyard, row crops and cotton, within each district.

SCVWD provides water for all of Santa Clara County. While much of the county is urbanized, agriculture and natural areas are also present. In 2002, 25,677 acres were irrigated, and the most abundant crops in the county were nursery crops, mushrooms, bell peppers, and grapes. Additionally, 4,210 of these acres were farmed for grains and alfalfa, 3,890 acres were utilized as pasture, and 190,000 acres were used as rangeland (Santa Clara County 2002).

The County of Santa Clara, SCVWD, Valley Transportation Authority, and City of San Jose agreed to participate in a countywide HCP in 2001. This HCP is still in the planning stages. Since no additional or new lands would be brought into production, the additional water that may be provided on these lands would not conflict with this plan.

6.1.2.3 Friant Unit Central Valley Project Agricultural Service Contractors

The Friant Division contract service area includes 23 agricultural service contractors in portions of Fresno, Kings, Kern, Madera, and Tulare counties on the eastern side of the San Joaquin River and extending into the Tulare Lake Basin. These contractors represent 15 IDs, seven WDs, and the South San Joaquin Municipal Utility District (MUD). The contractors are listed below and were shown previously on Figure 2-4:

- Arvin-Edison WSD
- Chowchilla WD
- Delano-Earlimart ID
- Exeter ID
- Fresno ID
- Garfield WD
- Gravelly Ford WD
- International WD
- Ivanhoe ID
- Lewis Creek WD
- Lindmore ID
- Lindsay-Strathmore ID
- Lower Tule River ID
- Madera ID
- Orange Cove ID
- Porterville ID
- Saucelito ID
- Shafter-Wasco ID
- Southern San Joaquin MUD
- Stone Corral ID
- Tea Pot Dome WD
- Terra Bella ID
- Tulare ID

Habitats in the Friant Division include riverine and lacustrine environments, annual grasslands, nonnative grassland, alkali desert, scrub and seep communities, valley foothill riparian communities, and woodland communities (Reclamation 2001m). Areas that are seasonally wet may also support freshwater aquatic environments including vernal pools and fresh emergent wetland communities. The majority of the land consists of agricultural lands similar to those described above.

Riverine and lacustrine environments provide feeding and loafing areas for a variety of birds including the eared grebe, Clark's grebe, American white pelican, double-crested cormorant, and American coot. Waterfowl using open ponds include the canvasback, lesser scaup, mallard, northern pintail, northern shoveler, and Canada goose.

Valley and foothill grasslands provide cover and foraging areas for species such as the black-tailed hare, California ground squirrel, California vole, and coyote. These areas also provide nesting areas for the burrowing owl, horned lark, western kingbird, and western meadowlark as well as important foraging areas for the turkey vulture, northern harrier, American kestrel, white-tail kite, prairie falcon, and barn owl.

Animal species that are vernal pool dependent include special-status species such as the vernal pool fairy shrimp, longhorn fairy shrimp, vernal pool tadpole shrimp, California tiger salamander, western spadefoot, and California linderiella.

Some terrestrial vertebrates that utilize alkali scrub and alkali grassland habitats are now protected as special-status species due to substantial declines of this habitat. These species include the San Joaquin kit fox, blunt-nosed leopard lizard, San Joaquin whipsnake, western burrowing owl, western spadefoot, and Fresno and Tulare kangaroo rats.

Riparian communities usually consist of one or more deciduous tree species plus an assortment of shrubs and herbs that border streams, rivers, lakes, and springs. The value of riparian habitats to wildlife depends on their structural diversity, but birds such as red-shouldered hawks and great horned owls hunt and roost here. Nuttall's woodpecker, northern flicker, western bluebird, whitebreasted nuthatch, and western screech owl nest in riparian areas. Other songbirds found in this habitat include western scrub-jay, northern oriole, and Bewick's wren. Amphibians include western toad and Pacific tree frog, and reptiles include western fence lizard.

Valley oak woodlands provide important food and cover for many species of wildlife. Oak trees provide food resources, shelter, and nesting and denning habitat important to a variety of avian and mammalian species. Avian species expected in a valley oak community include the red-tailed hawk, California quail, oak titmouse, western scrub-jay, spotted towhee, Bewick's wren, and acorn woodpecker. Mammalian species include the mule deer, western gray squirrel, bobcat, coyote, western harvest mouse, Botta's pocket gopher, California vole, and deer mouse.

Freshwater marshes are among the most productive wildlife habitats in California, providing a diversity of habitats for a wide variety of wildlife species. This habitat provides foraging, loafing, and cover for species such as the mallard, northern pintail, gadwall, green-winged teal, cinnamon teal, Canada goose, white-fronted goose, American coot, American bittern, green heron, great egret, snowy egret, great blue heron, northern harrier, red-tailed hawk, dowitcher, least sandpiper, western sandpiper, black-bellied plover, killdeer, dunlin, American avocet, and black-necked stilt. Mammals include the California vole, muskrat, raccoon, coyote, striped skunk, and long-tailed weasel. Amphibians and reptiles that depend on or utilize freshwater marshes include the western toad, Pacific tree frog, western pond turtle, and common garter snake (Reclamation 2001m).

Agricultural habitats based on crop type are shown in Table 9, Appendix A.

6.1.2.4 San Joaquin River Ecological Zone

Within the project area, the San Joaquin River Ecological Zone is subdivided into two ecological units that could be affected by the proposed transfer program:

- Vernalis Station to Merced River Ecological Unit
- Merced River to Mendota Pool Ecological Unit

The first unit, Vernalis to the mouth of the Merced River, is the most significant from the standpoint of the proposed transfer program and from the perspective of the anadromous fish (salmon, steelhead, and striped bass) that use the San Joaquin River for migration or spawning. This 43-mile reach includes the confluence of the Merced, Tuolumne, and Stanislaus rivers, the main tributaries to the San Joaquin River, entering on the east side of the drainage. Levees confine the river on both sides and have limited the extent of available floodplain, wetland, or shaded riverine habitat. On the west side, broad alluvial river channels and floodplains connect to the San Joaquin, but water from these rivers rarely reaches the San Joaquin. Virtually all land adjacent to the river is under intensive agricultural development (Reclamation 1999a).

The Merced River to Mendota Pool Ecological Unit is 87 miles long and includes Salt and Mud sloughs, the Chowchilla River, and the Fresno River. It receives some flow from the Delta-Mendota Canal into the Mendota Pool. Flow also comes from agricultural drainage via Salt and Mud sloughs. This reach is also used as a conduit for deliveries of irrigation water (Reclamation 1999a).

Shad and striped bass migrate from the Pacific Ocean via the Delta into the San Joaquin River to spawn in the spring. Splittail, squawfish, and other native species are also found in the San

Joaquin River. However, this ecological zone is dominated by introduced species such as largemouth bass, silversides, green sunfish and brown bullhead. Introduced species dominate in terms of total numbers and biomass (Reclamation 1999a).

6.1.2.5 Wetland Habitat

Prior to the 20th century, large portions of the San Joaquin Valley were floodplains of the San Joaquin River and supported vast expanses of permanent and seasonal marshes, lakes, and riparian areas. Almost 70 percent of the San Joaquin Valley has been converted to irrigated agriculture. Federal, State, and private wetlands in the San Joaquin Valley comprise the largest contiguous block of wetland habitat remaining in the Central Valley. Natural and managed wetlands of the San Joaquin Valley support more than 30 percent of the waterfowl that winter along the Pacific Flyway. These wetlands provide habitat for more than 25 percent of the Central Valley wintering waterfowl and shorebird populations.

San Joaquin Valley wetland habitats include valley sink scrub, valley riparian forest, freshwater marsh, brackish marsh, and vernal pools. Most of the wetland habitats in the Federal and State wildlife areas are managed seasonal wetlands that are dominated by freshwater and brackish marsh habitats. The other wetlands include vernal pools and alkali sink scrub habitat. Nonwetland aquatic habitats include rivers, streams, and sloughs. Special-status species that utilize the wetland and aquatic habitats in the project area are identified in Table D-2 in Appendix D.

The NWRs, WMAs, and resource conservation districts (RCDs) listed in Table 6-1 are located in the project area.

Table 6-1
State and Federal Wildlife Refuges in the Project Vicinity

Federal	State
San Luis NWR Complex Kesterson Unit Freitas Unit Blue Goose Unit West Bear Creek Unit East Bear Creek Unit* San Luis Unit	North Grasslands WMA China Island Unit Salt Slough Unit Gadwall Unit
Merced NWR* Arena Plains Unit*	Los Banos WMA Los Banos Unit Mud Slough Unit
Pixley NWR Kern NWR	Mendota WMA Volta WMA

*East side of San Joaquin River

Grassland RCD comprises more than 74,700 acres within the northern San Joaquin Valley. Approximately 55,870 acres of Grassland RCD are privately owned; however, public lands in this RCD include the Kesterson Unit of the San Luis NWR Complex, Volta WMA, and Los Banos WMA. Grassland WD is the largest land unit within Grassland RCD.

The Grassland RCD management objectives are the production of natural food plants and wetland habitat protection. Habitats in Grassland RCD include seasonal marshes, grasslands, alkali sink scrub, riparian forest, permanently irrigated pasture, seasonally flooded pasture, and agricultural crops (Reclamation 2000d).

Approximately 26,192 acres of the San Luis NWR Complex overlaps the project area. The complex is divided into three refuges: (1) San Luis NWR, which includes the Kesterson Unit (10,621 acres), East Bear Creek Unit (4,000 acres), and West Bear Creek Unit (3,892 acres); (2) Merced NWR (8,234 acres), and (3) San Joaquin River NWR. Kesterson Unit includes the original Kesterson Unit (4,466 acres, excluding Kesterson Reservoir), Freitas Ranch (5,600 acres), and the Blue Goose property (555 acres). The Blue Goose property and San Joaquin River NWR are not included in the project area.

Vegetation within the San Luis NWR Complex is a complex of perennial and seasonal marsh, moist soil areas, and extensive uplands and riparian woodlands.

Merced NWR consists of 2,562 acres. Water is used for management of seasonal marshes and croplands. Seasonal marshes are disked and seeded with wild millet every 3 to 5 years and flooded in the fall. Grain and forage corps are grown on this NWR as wildlife food crops.

Kern NWR Complex is made up of two refuges: Pixley and Kern. Together, they encompass 16,810 acres, with Pixley NWR consisting of 6,192 acres of grassland and wetland habitats and Kern NWR consisting of 10,618 acres of grasslands, riparian corridor, and developed marsh.

DFG manages the WMAs in the project area. North Grasslands WMA includes the China Island, Salt Slough, and Gadwall units. All of these areas except the Gadwall units are in the project vicinity. Los Banos WMA encompasses approximately 5,586 acres of the San Joaquin River floodplain and maintains seasonal and permanent wetlands and alkali sink habitat. Volta WMA consists of approximately 3,000 acres of large alkali ponds with permanent wetland habitat. These areas are managed for waterfowl.

Mendota WMA is also in the project area and comprises 12,105 acres. Habitats present include seasonal marsh, row crops such as millet and cereal grains, alkali sink habitat, and idled agricultural land.

The refuges in the Central Valley are a critical component of the Pacific Flyway, which is the westernmost of four migratory waterfowl routes transecting the North American continent. Maintenance of the Pacific Flyway for waterfowl depends on maintaining critical wintering habitat in the Central Valley. Waterfowl migration to the Central Valley begins in August with the arrival of the first birds from the north. In addition, the Central Valley provides migration habitat for waterfowl en route to Mexico. The numbers of wintering waterfowl rapidly increase over the late summer and fall, and by late December, as many as 10 to 12 million waterfowl have migrated to or through the Central Valley. Maintenance of the Pacific Flyway for waterfowl depends on maintaining critical wintering habitat in the Central Valley, about one-third of which is composed of Federal and State wildlife areas. Other wildlife that utilize upland and wetland habitats in the refuges include sandhill cranes, coyotes, badgers, raccoons, northwestern fence lizards, California tiger salamanders, western spadefoot, vernal pool fairy shrimp, slender salamanders, and terrestrial garter snakes (Reclamation 2000d).

Salt and Mud Sloughs

Salt Slough and its tributary, Mud Slough South, are perennial streams that flow along the western refuge boundary into the San Joaquin River (Merced River to Mendota Pool Ecological Unit). Most of the water in Salt Slough originates from operational spills, waste, and return flow from the adjacent wildlife refuges, San Luis Canal Company, and CCID. Mud Slough (South) flows into Salt Slough immediately upstream of the refuge (Reclamation 1989). The natural habitat and water quality of Mud and Salt sloughs is highly modified by the addition of canals, agricultural drainwater, and seasonal regulation of main-stem riverflows. These additions have resulted in poorer quality water (accumulations of salt, trace elements, and nutrients) downstream to the Merced River (Reclamation 2001n).

During a normal water year, flows in Salt Slough vary between 8,910 and 21,622 acre-feet per month, and Mud Slough has flows ranging from 875 to 10,602 acre-feet per month (Table 6-2). During critical years, the flows entering Salt Slough range from 3,118 to 7,589 acre-feet per month and flows entering Mud Slough range between 367 and 3,922 acre-feet per month (based on the factors contained in Table 6-3).

Table 6-2
Flows for Above Normal Water Year Types (Acre-Feet per Month)

Month	Mud Slough	Salt Slough	Mud and Salt Sloughs
October	9,564	10,719	20,283
November	8,376	10,566	18,942
December	7,773	8,945	16,718
January	8,824	15,572	24,396
February	10,602	20,511	31,113
March	10,145	21,622	31,767
April	5,080	10,731	15,811
May	3,029	9,886	12,915
June	1,966	10,262	12,228
July	936	11,679	12,615
August	875	12,522	13,397
September	1,835	8,910	10,745
Total	69,005	151,924	220,929

Source: Grassland Bypass Project refuge model (Reclamation 2001n).

Table 6-3
Multiplication Factors for Dry/Below Normal, Critical, and Wet Year Types

	Dry/Below Normal	Critical	Wet
Month	**Ratio of Water Year 1985 to Water Year 1999**	**Ratio of Water Year 1992 to Water Year 1999**	**Ratio of Water Year 1993 to Water Year 1999**
October	0.55	0.10	1.12
November	0.78	0.30	0.82
December	1.15	0.26	0.73
January	0.82	0.29	0.68
February	0.32	0.34	1.54
March	0.63	0.37	3.21
April	0.62	0.25	1.05
May	0.76	0.20	2.11
June	1.29	0.36	1.67
July	1.51	0.40	1.47
August	1.48	0.42	1.47
September	1.67	0.35	1.54

Source: Grassland Bypass Project refuge model (Reclamation 2001n).

Between 2001 and 2009, flows to Mud Slough are expected to diminish due to implementation of the Grassland Bypass Project. The Grassland Bypass Project redirects drainage flows from discharge to Mud Slough via the San Luis Drain onto reuse areas and into treatment systems. However, the San Luis Drain also conveys drainage from the upper watershed into Mud Slough (uncontrolled flow). Agricultural drainage flows from the Grassland Area Farmers are projected to decline by approximately 17,000 acre-feet by September 2009 when their use agreement for the San Luis Drain expires (Reclamation 2001n). The upper watershed flows are uncontrolled and are likely to continue to reach Mud and Salt sloughs.

6.1.2.6 Special-Status Species

Special-status species that have the potential to occur in the project area and vicinity are summarized in Appendix C. Appendix D summarizes the locations within the project area where special-status species may occur (e.g., service areas of the Exchange Contractors and the water districts that might receive water under the proposed transfer program). The tables in Appendix D include an evaluation of the potential for each special-status species to be affected by the Proposed Action. Species that are not likely to be affected are included in the appendices but are not discussed further in the EIR. Appendix D identifies the following special-status species that have the potential to be affected by the Proposed Action:

- Giant garter snake (*Thamnophis gigas*) (Federal threatened and State threatened)
- Swainson’s hawk (*Buteo swainsoni*) (State threatened)
- Hardhead (*Mylopharodon conocephalus*) (State species of special concern)

Giant Garter Snake

The giant garter snake is known to occur in Mud and Salt sloughs and some of the refuges that could receive water transferred from the Exchange Contractors as part of the Proposed Action. In addition, Mud and Salt sloughs are suitable habitat for two nonlisted special-status species, the Sacramento splittail and the hardhead.

The giant garter snake utilizes agricultural wetlands, drainage channels, irrigation canals, sloughs, ponds, small lakes and low-gradient streams in the Central Valley (USFWS 1999). Essential habitat components for this species consist of the following:

- Adequate water during the snake's active season (early spring through mid-fall) to maintain dense populations of food organisms
- Emergent, herbaceous wetland vegetation for escape cover and foraging habitat during the active season
- Upland habitats that provide basking habitat and refugia from flood waters during the winter (USFWS 1999).

Seasonal fluctuations of water depth do not generally affect this species as long as its prey base remains present and the water is perennial (C. Rocco, pers. comm., 2004). Typical prey includes tadpoles, mosquitofish, and other species that can survive in shallow water.

Swainson's Hawk

Swainson's hawk is listed as threatened under CESA. It is also protected by the Federal Migratory Bird Treaty Act and the California Fish and Game Code, which prohibit the take, possession, or destruction of birds and their nests or eggs.

Swainson's hawk is an open-country bird that nests in California's Central Valley. Nests are typically found in scattered trees or along riparian corridors, adjacent to agricultural fields or pastures that provide foraging habitat (DFG 1994). Swainson's hawks nest throughout most of the floor of the Central Valley, but nesting habitat is fragmented and unevenly distributed. Swainson's hawks forage in native grasslands, pastures, alfalfa, and other crop fields. Major prey includes invertebrates, small mammals, and birds.

Hardhead

Hardhead, a DFG species of concern, is a large minnow that can grow to 2 feet in length. Hardhead are omnivorous, feeding on bottom-dwelling invertebrates, aquatic plants, and small fish (McGinnis 1984). This fish spawns in the spring, although exact spawning behavior has not been studied. It prefers clearer foothill streams and is probably sensitive to high levels of suspended sediment in the water. Although it is presently under heavy competition from introduced bottom feeders, this species is still relatively abundant in the San Joaquin-Sacramento drainage and in several other isolated drainage basins.

Other Special-Status Species With Potential to Occur in the Project Area

Although Mud and Salt sloughs are within the historic range of chinook salmon and steelhead, DFG has installed a fish barrier that diverts spawning salmon up the Merced River and prevents these species from migrating south into the project area. The Central Valley steelhead evolutionarily significant unit (ESU), a Federal threatened species, and the fall and late-fall run chinook ESU, a Federal candidate for listing, utilize portions of the San Joaquin River and its tributaries below the confluence with the Merced River downstream of the project area. NOAA Fisheries designated this reach of the San Joaquin River as critical habitat for the Central Valley steelhead ESU in February 2000. However, this designation was withdrawn by a Consent Decree on April 30, 2002. No designated critical habitat currently exists within the project area.

6.2 ENVIRONMENTAL CONSEQUENCES

6.2.1 Key Impact and Evaluation Criteria

Key impact and evaluation criteria are based on the CEQA guidelines for biological resources and the State and Federal laws that regulate impacts to special-status species and wetlands.

6.2.1.1 Wetlands

Adverse impacts on wetlands (including Federally protected wetlands) are considered significant if project construction or operation would:

- Result in a substantial long-term (more than 5-year) or permanent reduction of wetlands in the project area.
- Substantially reduce the quality or utilization of wetlands in the project area by migratory waterfowl or other wildlife.

6.2.1.2 Special-Status Species

Adverse impacts to listed species are considered significant if project construction or operation would:

- Reduce the size of listed plant, fish, or wildlife populations.
- Result in long-term or permanent loss or alteration of habitat important for one or more listed species.
- Result in temporary loss or alteration of habitat important for one or more listed species that could result in increased mortality or lowered reproductive success.
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.
- Conflict with local policies or ordinances protecting biological resources.
- Conflict with the provisions of an adopted HCP, Natural Community Conservation Plan, or other approved local, regional, or State HCP.

Adverse impacts to candidate or sensitive species are considered significant if project construction or operation results in the following:

- Direct or indirect impacts on candidate or sensitive species population or habitat that would contribute or result in the Federal or State listing of the species, e.g., by substantially reducing species numbers or by resulting in the permanent loss of habitat essential for the continued existence of a species.

6.2.1.3 Aquatic Habitat

Adverse impacts on aquatic habitats are considered significant if project construction or operation would:

- Disturb a substantial portion of a particular aquatic habitat within a local region and natural processes could not restore this aquatic habitat to its preconstruction condition within 3 to 5 years.
- Result in long-term (more than 5 years) substantial reduction or alteration of unique, rare, or sensitive aquatic habitats.
- Fill or alter aquatic habitats, resulting in long-term change in hydrology or species composition.

Aquatic habitat is defined in this document to include all nonwetland habitats that are seasonally or perennially inundated or saturated, such as sloughs and rivers.

6.2.2 Environmental Impacts and Mitigation

Potential impacts of the No Action/No Project Alternative and three action alternatives are evaluated in the following sections. Mitigation for water quality impacts to the San Joaquin River are discussed in Section 4.2.2 and Section 13. Additional mitigation is not proposed because impacts to biological resources are determined to be less than significant.

6.2.2.1 Existing Conditions and No Action/No Project Alternative

Under the No Action/No Project Alternative, no transfer or exchange of water would occur from the Exchange Contractors to either Interior or to any of the other potential water users. However, it is assumed that Interior's WAP would purchase water from other suppliers and would deliver refuge water quantities similar to deliveries of 2002–2003 (averaging 75,700 acre-feet). Under the existing conditions, the Exchange Contractors would recover and reuse the same amount of tailwater flows that have recently been transferred (28,500 acre-feet). For the purposes of analysis, the No Action/No Project Alternative and existing conditions are considered to be the same. Furthermore, existing conditions reflect reasonably foreseeable future conditions without the proposed transfer program for most of the affected habitats.

Under the No Action/No Project Alternative, refuge water deliveries would remain the same in quantity as existing conditions, and no physical changes to the refuges would occur. Therefore, no adverse effects to sensitive biological resources would occur under this alternative.

6.2.2.2 Alternative A: 80,000 Acre-Feet

Up to 80,000 acre-feet of water would be available in noncritical years from conservation/tailwater recovery and groundwater sources, similar to the existing transfer program implemented in recent calendar years 2000–2003, which delivered on average 69,000 acre-feet of water. None of these years was a critical year. However, the proposed program would make up to 50,000 acre-feet available from crop idling (temporary land fallowing) during critical years, which has not occurred in recent years. Under existing conditions, the transfer water has been delivered predominantly to the refuges (57,800 acre-feet).

Three scenarios are evaluated for Alternative A:

- **All Water to Refuges:** Under this **refuge focus** scenario, Interior would acquire for the refuges all of the available water from the Exchange Contractors, up to 80,000 acre-feet in a noncritical year, which represents up to 65 percent of full Level 4 increment (123,617 acre-feet) for each water service year. This amount is higher than the average amount of water that refuges have received under the current transfer program under existing conditions (48 percent or 57,800 acre-feet). In a critical year, up to 50,000 acre-feet would be available.
- **All Water to Agriculture:** Under this **agriculture focus** scenario, up to 80,000 acre-feet of transfer water would be provided to CVP agricultural contractors. This water could be delivered to contractors within the drainage of the San Joaquin River.
- **All Water Transferred Out of Basin:** Under this **out-of-basin focus** scenario, up to 80,000 acre-feet of water would be transferred to uses (any combination of wildlife areas, agriculture, and urban) occurring outside the drainage of the San Joaquin River. These uses could include deliveries to the two refuges that are not hydraulically connected to the San Joaquin River (Pixley and Kern NWRs, located in the Tulare Lake Basin), SCVWD and SBCWD (located in the San Felipe Division), and CVP water contractors of the Friant Division.

Potential impacts of these scenarios are evaluated below for each category of sensitive biological resources.

Wetlands

The **refuge focus** scenario would increase slightly the amount of water provided to the wildlife refuges compared to existing conditions and No Action/No Project. Table 4-7 in Section 4 lists the current water supplies for the San Joaquin Valley refuges. Therefore, this alternative would result in minimal or less-than-significant beneficial impacts to refuge wetlands.

The **agriculture focus** and **out-of-basin focus** scenarios would maintain the current water deliveries to the refuges. Therefore, these scenarios would not significantly impact refuge wetlands.

Special-Status Species Outside of the Exchange Contractors Service Area

During noncritical water years, the Exchange Contractors propose to recapture 16,365 acre-feet of additional tailwater under all three of the Alternative A scenarios. This tailwater recovery would potentially decrease the amount of water that would otherwise discharge into Mud and Salt sloughs by 15,465 acre-feet. Estimates of the baseline flows entering Mud and Salt sloughs during a dry/below normal year are presented in Table 6-4. The largest decrease would be 2,285 acre-feet each month during the period of May through August (Table 6-4). The proposed tailwater recapture would be as large as 23 percent of the total available water during the month of May in a dry/below normal year, the greatest reduction estimated in the two sloughs. Additional tailwater recapture would not occur during critical years.

A 23 percent flow reduction would not substantially change the extent or quality of the aquatic or upland habitats in Mud and Salt sloughs since it is within the normal range of fluctuation that occurs during normal water years and dry/below normal years (Table 6-3). It is assumed that these flows would provide sufficient water for giant garter snakes to move and forage within Mud and Salt sloughs. The predicted reductions in flow are not expected to reduce prey populations or affect upland refugia utilized by the giant garter snake.

Reduced flows in Mud and Salt sloughs are not likely to affect the Sacramento splittail and hardhead because these species are known to occur in other waterways with substantial seasonal fluctuations (e.g., the Yolo Bypass and the lower reaches of the Cosumnes River). Therefore, the three Alternative A scenarios would result in a less-than-significant adverse effect to these three special-status species.

Table 6-4
Flows in Mud and Salt Sloughs for Dry/Below Normal Year Types and Percentage Change Due to Tailwater Recovery

Month	Dry/Below Normal Baseline Flows (Acre-Feet)	Reduction in Flow	
		Acre-Feet	Percent
October	11,156	914	8
November	14,775	0	0
December	19,226	0	0
January	20,005	141	1
February	9,956	1,054	11
March	20,013	1,054	5
April	9,803	1,757	18
May	9,815	2,285	23
June	15,774	2,285	14
July	19,049	2,285	12
August	19,828	2,285	12
September	17,944	1,406	8
All Months	187,344	15,466	NA

Source: Grassland Bypass Project refuge model (Reclamation 2001n).
NA = Not applicable

The **refuge focus** scenario would provide improved habitat quality and availability of seasonal wetlands that would benefit special-status species that utilize the refuge wetlands. These improvements would also have beneficial effects for other wetland-associated wildlife, including a variety of invertebrates, reptiles, amphibians, mammals, and shorebirds, by providing foraging and resting areas. A number of special-status species would benefit from the habitat diversity and stability provided under optimal habitat management of wetland units (Reclamation 2000d). These species include American white pelican, black tern, California gull, Cooper's hawk, double-crested cormorant, fulvous whistling-duck, greater sandhill crane, least bittern, little willow flycatcher, long-billed curlew, marbled godwit, northern harrier, short-eared owl, whimbrel, tricolored blackbird, white-faced ibis, yellow-breasted chat, yellow-breasted warbler, northwestern pond turtle, southwestern pond turtle, and giant garter snake. Raptors such as the golden and bald eagles and the American peregrine falcon could indirectly benefit from an increase in their seasonal food supply of wintering waterfowl. Therefore, the **refuge focus** scenario would result in a less-than-significant beneficial impact to special-status species that utilize seasonal wetlands in the wildlife refuges.

Special-status species such as the burrowing owl and the loggerhead shrike could occur within areas of Santa Clara County that would receive water under the **out-of-basin focus** scenario of Alternative A. However, these species would not be impacted by an increase of water to these areas because the water would be utilized for existing cultivated or developed lands and would not be used for new development or cultivation. Therefore, the **out-of-basin focus** scenario would not significantly impact special-status species in areas outside of the Exchange Contractors service area.

The **agriculture focus** and **out-of-basin focus** scenarios under Alternative A would have no effects or minimal effects on San Joaquin River flows and water quality or on New Melones Reservoir operations on the Stanislaus River. However, the **refuge focus** scenario would have a significant impact on water quality in the San Joaquin River in nonwet years due in part to flows returning to the river from the refuges. To mitigate this impact, Reclamation proposes to reduce storage and increase releases from New Melones Reservoir on the Stanislaus River during nonwet years by approximately 3,000 acre-feet to over 5,000 acre-feet (Table 4-18). The proposed increased flows in the Stanislaus River combined with the increased refuge return flows into the San Joaquin River would result in minimal flow changes in the San Joaquin at Vernalis. These changes are much less than 1 percent of the range of interannual variation in monthly river flow shown in Table 4-1. Therefore, these Alternative A scenarios would not have a significant adverse impact on the listed anadromous fish that utilize the lower San Joaquin River or designated critical habitat for these species.

Special-Status Species Within the Exchange Contractors Service Area

Proposed land fallowing included as a water development option in Alternative A would potentially impact foraging habitat for the State-listed Swainson's hawk and other special-status raptors. Swainson's hawks are known to forage in alfalfa and grain crops, and these crop types are considered to be the highest-quality foraging habitat in the Exchange Contractors service area. Approximately 25 percent, or 61,200 of the 240,000 acres, of agricultural land in the Exchange Contractors service area is currently farmed with alfalfa, and 9.7 percent, or 23,380 acres, is currently farmed with grain crops. Together, they make up 35.2 percent of the farmed land in the service area (84,580 acres).

Up to 20,000 acres of cultivated lands could be idled under Alternative A. Of the land that would be fallowed temporarily, approximately 15 percent (up to 3,000 acres) would be alfalfa crops and approximately 5 percent (up to 1,000 acres) would be grain crops. Therefore the combined total loss of potential foraging habitat could be as great as 4,000 acres. The highest-quality foraging habitat for Swainson's hawk that could be idled makes up 5 percent of the total acreage of alfalfa in production and 5 percent of the total acreage of grains in production. The reduction in foraging habitat proposed under Alternative A would be a less-than-significant impact on

Swainson's hawk, because the reduction would be relatively small compared to the total area of habitats available for foraging Swainson's hawks in the service area and vicinity.

In addition to the alfalfa and grain crops in the Exchange Contractors service area, other agricultural land in the project vicinity also provides foraging habitat for Swainson's hawk. The newly idled land would provide additional foraging opportunities for species such as long-billed curlew, white-faced ibis, marbled godwit, prairie falcon, and white-tailed kite. Therefore, the three scenarios proposed under Alternative A would result in a less-than-significant impact to other nonlisted foraging raptors in the Exchange Contractors service area.

Aquatic Habitats

Tailwater recovery proposed under Alternative A would potentially reduce the amount of water reaching Mud and Salt sloughs, as discussed above for special-status species. However, this reduction would not significantly degrade or reduce the amount of aquatic habitats in Mud and Salt sloughs compared to existing conditions because the reduced volumes are within the range of flows observed during historic dry/below normal water years (e.g., 1985 and 2001). During May 1985, Salt Slough had a total flow volume of 19,815 acre-feet. During another dry year, 2001, the May flow volume was 7,498 acre-feet, a reduction of more than 50 percent compared to 1985. Therefore, the anticipated reduction of up to 23 percent during dry/below-normal water years is not a significant impact compared to existing conditions.

Water transfers to agricultural and out-of-basin water users would not significantly impact aquatic resources in those areas because water would be used for existing agricultural and M&I uses.

6.2.2.3 Alternative B: 50,000 Acre-Feet

Under this alternative, up to 50,000 acre-feet of water would be made available from crop idling/temporary land fallowing during noncritical and critical years. Assuming 2.5 acre-feet per acre, the maximum amount of land to be idled or fallowed is approximately 20,000 acres, 8.3 percent of the irrigable land (240,000 acres) in the Exchange Contractors service area. This amount of water is slightly less than the current transfer previously implemented in recent calendar years under existing conditions, although it would be an increase of 50,000 acre-feet of available water compared to No Action. No water from tailwater recovery is proposed as part of this alternative. Water made available under this alternative is only from crop idling.

Three scenarios are evaluated for Alternative B:

- **All Water to Wildlife Refuges:** Under this **refuge focus** scenario, up to 50,000 acre-feet of water would be transferred to wildlife areas in all years, generally from an irrigation delivery pattern to one consistent with wildlife habitat area requirements. Water would be delivered to the San Joaquin Valley wildlife areas through the Delta-Mendota Canal, SWP facilities, local conveyance facilities, or delivery exchange agreements.
- **All Water to Agriculture:** Under this **agriculture focus** scenario, up to 50,000 acre-feet of transfer water would be provided to CVP agricultural contractors that drain to the San Joaquin River. The water transferred to agricultural users would essentially exchange the delivery of water from the Exchange Contractors to a CVP agricultural contractor. For water transferred to in-basin agricultural users, the San Joaquin River, New Melones Reservoir, and

Delta inflows would be affected as the result of changes in return flows from the Exchange Contractors and the transferees. Indirect effects would also occur due to Reclamation acquiring water for delivery to wildlife areas from entities other than the Exchange Contractors.

- **All Water Transferred Out of Basin:** Under the **out-of-basin focus** scenario, up to 50,000 acre-feet of water would be provided each year to water users (any combination of wildlife areas, agriculture, and urban) occurring outside the drainage of the San Joaquin River. These uses could include deliveries to the two refuges that are not hydraulically connected to the San Joaquin River (Pixley and Kern NWRs, located in the Tulare Lake Basin), SCVWD and SBCWD (located in the San Felipe Division), and CVP water contractors of the Friant Division.

Potential impacts of these scenarios are evaluated below.

Wetlands

The **refuge focus** scenario proposed under Alternative B would not change existing water deliveries to refuges. Therefore, this scenario would not significantly impact the area or quality of wetlands in wildlife refuges.

The **agriculture focus** and **out-of-basin focus** scenarios would eliminate the existing water transfers to the refuges; however, this would be partially offset by the absence of additional tailwater recovery under these scenarios. It is assumed that Reclamation would acquire additional water as needed to provide existing levels of water supplies to the refuges in noncritical years. These assumed deliveries and anticipated increases in tailwater flows would reduce the impacts to refuge wetlands to a less-than significant level under these two scenarios.

The **agriculture focus** and **out-of-basin focus** scenarios would not significantly affect wetlands in areas that receive the water, because the agricultural and M&I areas that would receive additional water would utilize the water for existing uses and would not use the water to modify existing land uses. Therefore, these scenarios would not significantly impact wetlands in areas that would receive water.

Special-Status Species Outside the Exchange Contractors Service Area

No tailwater recovery is proposed; therefore, the flows to Mud and Salt sloughs would not be reduced. In addition, proposed fallowing for water development would make an additional 3,026 acre-feet of water available to flow into the sloughs, an increase of approximately 1 to 2 percent compared to other dry and below-normal water years. Increased flows to Mud and Salt sloughs would not have a significant impact to giant garter snake or other special-status species such as the Sacramento splittail or the hardhead because these flows would be within the range of current flow variations. Total annual flows in 1985 and 2001 varied by more than 90,000 acre feet, although both years were considered dry/below normal water years.

Reduced water deliveries to refuge wetlands under the **agriculture focus** and **out-of-basin focus** scenarios could affect special-status species such as the giant garter snake, fulvous whistling duck, least bittern, long-billed curlew, marbled godwit, whimbrel, yellow-breasted chat, and yellow warbler that utilize these areas. However, Reclamation has committed to supplying adequate water to the refuges to maintain existing deliveries. In addition, the elimination of tailwater recovery would further offset any changes in deliveries. Therefore, these scenarios would not have a significant impact on special-status species that utilize the refuge wetlands.

All scenarios under Alternative B would have only minimal effects on flows at Vernalis (less than 1 percent during the period from April to October [Table 4-28]). Therefore, Alternative B would have a less-than-significant impact on special-status salmonids that utilize the lower reaches of the San Joaquin River. This alternative would not impact any designated critical habitats.

Special-Status Species within the Exchange Contractors Service Area

Crop idling proposed under all three scenarios of Alternative B would result in less-than-significant impacts to special-status species that utilize the cultivated areas in the Exchange Contractors service area. For a more detailed discussion, see the All Water to Wildlife Refuges scenario for Alternative A.

Aquatic Habitats

No tailwater recovery is proposed, and water deliveries to the refuges would not change under the three scenarios proposed for Alternative B. Therefore, flows to Mud and Salt sloughs would not be affected. Alternative B would have a less-than-significant impact to aquatic habitats in the refuges or in Mud and Salt sloughs.

6.2.2.4 Alternative C: 130,000 Acre-Feet

Alternative C provides up to 130,000 acre-feet in noncritical water years and up to 50,000 acre-feet in critical years and is the Proposed Action. During critical years, only crop idling water (50,000 acre-feet) would be available. This alternative would supply from 50,000 to 130,000 additional acre-feet/year of water, respectively, and includes tailwater recovery in noncritical years.

Three scenarios are evaluated for Alternative C:

- **All Water to Wildlife Refuges:** Under this **refuge focus** scenario, up to 80,000 acre-feet of water would be transferred to wildlife areas during noncritical water years. Water would be delivered to the San Joaquin Valley wildlife habitat areas through the Delta-Mendota Canal, local conveyance facilities, or delivery exchange agreements. The remainder of the transfer (50,000 acre-feet) is assumed to be delivered to other CVP contractors. During critical years, 50,000 acre-feet of water would be developed through crop idling/temporary land fallowing. During these years, 40,000 acre-feet (50,000 acre-feet of developed water reduced 20 percent for conveyance losses) would be delivered to the wildlife areas.
- **All Water to Agriculture:** Under this **agriculture focus** scenario, up to 130,000 acre-feet of water would be transferred to CVP agricultural contractors within the drainage basin of the San Joaquin River. Potential CVP shortages to contractors within the drainage of the San Joaquin River substantiate the potential need for the entire 130,000 acre-feet of transfer to those entities. The direct effects of the Exchange Contractors developing transfer water are combined with the additional effects of the CVP contractors producing increased runoff to the San Joaquin River. Additional indirect effects could occur due to Reclamation acquiring

additional water for delivery to the wildlife areas from entities other than the Exchange Contractors.

- **All Water Transferred Out of Basin:** Under this **out-of-basin focus** scenario, up to 130,000 acre-feet of water would be transferred to users (any combination of wildlife areas, agriculture, and urban) located outside the watershed of the San Joaquin River. Potential users could include two refuges that are not hydraulically connected to the San Joaquin River (Pixley and Kern NWRs, located in the Tulare Lake Basin), SCVWD and SBCWD (located in the San Felipe Division), CVP water contractors of the Friant Division, and the Cross-Valley Contractors of the CVP.

Potential impacts of these scenarios are evaluated below.

Wetlands

The **refuge focus** scenario would result in improvements in wetland habitat quality and the development of food sources for waterfowl. These improvements would be possible because the additional water would provide the ability and flexibility to more effectively manage existing wetland units with reliable, year-round water supplies of acceptable quality. Improved habitat management would include:

- Earlier and expanded fall flooding of seasonal wetlands to allow increased wildlife use
- Additional maintenance of summer water, wetland/moist soil, riparian, and irrigated pasture habitat types for wildlife use and vegetation improvement
- Increased management of moist soil impoundments through more frequent irrigations, to provide a high-quality carbohydrate food source for waterfowl and other water birds, while easing potential waterfowl crop depredation problems on nearby agricultural lands
- Maintenance of water depths that provide optimum foraging conditions for the majority of avian species
- Use of flow-through management rather than stockpiling water to improve water quality, reduce disease outbreaks, and maintain optimal water depths for waterfowl foraging
- Control of undesirable vegetation species using deep irrigation and maintenance for periods of 2 to 4 weeks during the summer

With these improved management capabilities, optimal habitat conditions could be maintained under drought conditions and during flood/storm conditions to provide suitable and stable habitat conditions for resident and migratory wildlife. Reliable Level 4 water supplies would ensure that wetland habitat units could be flooded throughout the fall and winter and that water levels could be maintained at optimal depths for waterfowl foraging. In addition, water would be available for spring/summer irrigation and maintenance of semipermanent/permanent wetlands through the summer months. Overall, high-quality wetland habitat would be available at the appropriate times of the year to benefit resident and migratory waterfowl. This scenario would have a significant beneficial impact to wetlands.

Habitats present in the refuges other than the wetland habitats described above would not be affected by Alternative C.

Under the **agriculture focus** and **out-of-basin focus** scenarios, Interior would maintain at least the current water deliveries to the refuges. Therefore, these scenarios would not significantly impact refuge wetlands.

Areas that would receive additional water under the **agriculture focus** and **out-of-basin focus** scenarios are currently under cultivation or currently developed. Therefore, these scenarios would not significantly impact wetland habitats in the Exchange Contractors service area or other areas that could receive water developed under these scenarios.

Special-Status Species Outside the Exchange Contractors Service Area

Alternative C includes tailwater recovery discussed in the **refuge focus** scenario for Alternative A. However, crop idling proposed under Alternative C would further reduce the amount of water potentially reaching Mud and Salt sloughs by an additional 2,285 acre-feet compared to Alternative A. The combined loss of runoff to these sloughs would be approximately 4,570 acre-feet during a dry/below normal year compared to the baseline, as shown in Table 6-5.

Table 6-5
Volume of Water Entering Mud and Salt Sloughs During Dry/Below Normal Water Years and the Percentage Change Due to Tailwater Recovery and Crop Idling

Month	Dry/Below Normal Baseline Flows (Acre-Feet)	Reduction in Flow	
		Acre-Feet	Percent
October	11,156	1,828	17
November	14,775	0	0
December	19,226	0	0
January	20,005	281	1
February	9,956	2,109	21
March	20,013	2,109	11
April	9,803	3,515	36
May	9,815	4,569	47
June	15,774	4,569	29
July	19,049	4,569	24
August	19,828	4,569	23
September	17,944	2,812	16
All Months	187,344	30,930	NA

Source: Grassland Bypass Project refuge model (Reclamation 2001n).
NA = Not applicable

A 47 percent flow reduction would not substantially change the extent or quality of the aquatic or upland habitats in Mud and Salt sloughs because it is within the normal range of fluctuation that occurs during normal water years and dry/below normal years (Table 6-3). It is assumed that the predicted dry/below-normal water year flows would provide sufficient water for giant garter snakes to move and forage within Mud and Salt sloughs. The predicted reductions in flow are not expected to reduce prey populations or affect upland refugia utilized by the giant garter snake. Therefore, the **refuge focus** scenario under Alternative C is not likely to have a significant impact to the giant garter snake.

Reduced flows in Mud and Salt sloughs are not likely to affect the Sacramento splittail and hardhead because these fish species are known to occur in other waterways with substantial seasonal fluctuations (e.g., the Yolo Bypass and the lower reaches of the Cosumnes River). Therefore, the three Alternative C scenarios would result in a less-than-significant adverse effect to these three species.

As discussed under Alternative A, the refuge focus scenario would have a less-than-significant beneficial impact to special-status species that utilize seasonal wetlands in the refuges.

Water deliveries to refuge wetlands would not change under the **agriculture focus** and **out-of-basin focus** scenarios. Therefore, these scenarios would not affect special-status species such as the giant garter snake, fulvous whistling duck, least bittern, long-billed curlew, marbled godwit, whimbrel, yellow-breasted chat, and yellow warbler that utilize the wetland habitats in the refuges.

Proposed water deliveries outside of the Exchange Contractors service area under the **agriculture focus** and **out-of-basin focus** scenarios would be utilized by existing agricultural and commercial users and would not change existing land uses. Therefore, these scenarios would not significantly impact special-status species in agricultural and M&I areas.

The three scenarios evaluated under Alternative C would not have a significant adverse impact on the listed steelhead and special-status chinook salmon that utilize the lower San Joaquin River or designated critical habitat for these species. All three scenarios under Alternative C would reduce flows into the San Joaquin River via Mud and Salt sloughs, which would result in minimal flow changes in the San Joaquin at Vernalis. These reductions would vary from 0 to 11 percent. During the important late spring out-migration period for anadromous fish, flows would be reduced by 3 to 8 percent (Table 4-44). Summer flow reductions would be as high as 11 percent in July. Smaller (2 percent) reductions are predicted in the fall when salmonids begin to migrate upstream in the San Joaquin. These reductions are still within the range of interannual variations in monthly river flow, as shown in Table 4-1. For more details, see the special-status species discussion for Alternative A.

Special-Status Species Within the Exchange Contractors Service Area

Crop idling proposed under all three scenarios of Alternative C would reduce the availability of foraging habitat for some special-status species within the Exchange Contractors service area. However, the loss of foraging habitat is not significant in the context of the amount of foraging habitat that is available in the project area. Therefore, this scenario would have a less-than-significant adverse impact to special-status species in the Exchange Contractors service area. For a more detailed discussion, see the discussion of special-status species within the Exchange Contractors service area under Alternative A.

Aquatic Habitats

Water deliveries to the refuges would not change under the three scenarios proposed for Alternative C. However, proposed tailwater recovery and crop idling would reduce the amount of water flowing into Mud and Salt sloughs. The largest reductions would occur during April (36 percent) and May (47 percent), as shown in Table 6-5. However, reductions in the amount of water flowing to Mud and Salt sloughs would occur under existing conditions and are within the range of flows that occur under existing conditions during dry or below normal water years. Therefore, the reduced flows are not likely to significantly impact sensitive aquatic habitats in Mud and Salt sloughs.

6.2.3 Cumulative Effects

The action alternatives would result in less-than-significant adverse impacts to special-status species and aquatic habitats. The following sections evaluate potential cumulative effects of these impacts. Impacts to wetlands under all of the action alternatives are considered neutral and would not contribute to cumulative effects. Therefore, cumulative impacts to wetlands are not evaluated in this section.

6.2.3.1 Special-Status Species Within the Exchange Contractors Service Area

In critical years, approximately 20,000 acres of Exchange Contractors land could be idled under each of the action alternatives to provide up to 50,000 acre-feet of water. In noncritical years, some land could be idled as well for part of the water supply, but the majority of the water would come from conservation or groundwater supplies. During the project timeframe, however, it is not known whether the water year type would be critical or noncritical, and land that could be idled one year may be brought back into production the next year. However, substantial acreage in the San Joaquin Valley could be idled permanently due to water supply shortages and subsurface drainage problems:

- Under the CVPIA, Reclamation has a land retirement program that has retired 2,091 acres in Westlands WD, and a total of 7,000 acres could be permanently removed from production by 2007.
- Westlands WD has a proposal to retire up to 200,000 acres.

Adopted and proposed land retirement programs would reduce habitat for foraging Swainson's hawks and other special-status raptors; however, not all of the retired land would be foraging habitat for these species. The estimated area of each crop type in Westlands WD is provided in Appendix A, Table 9. The area of crop types that are utilized by Swainson’s hawks and other special-status raptors is approximately 26,636 acres, or 5 percent of the total crop acreage in Westlands WD. More than half of the total crop acreage in the Westlands WD is cultivated for cotton, which is not typically utilized by foraging Swainson’s hawks (CDFG 1994). Salt-tolerant crops such as grains and alfalfa are less likely to be eliminated as land is retired. If an additional 7,000 acres of high-quality foraging habitat (35 percent of 20,000 acres) were idled under this project, even on a temporary basis, the effects on special-status raptors would not be cumulatively considerable and significant because the land fallowing under consideration by Westlands WD is not likely to substantially reduce crop types that are utilized by the foraging raptors.

6.2.3.2 Special-Status Species in Mud and Salt Sloughs and the San Joaquin River

Water development activities proposed under Alternatives A and C would reduce flows to Mud and Salt sloughs, which in turn would reduce flows to the San Joaquin River. These reductions would be less-than-significant impacts. However, during the period from 2001 to 2009, the Grassland Bypass Project will also reduce flows to Mud and Salt sloughs (via Mud Slough

South). The Grassland Bypass Project redirects drainage flows that currently discharge to Mud Slough via the San Luis Drain onto reuse areas and into treatment systems. The San Luis Drain also conveys drainage from the upper watershed into Mud Slough (uncontrolled flow). Agricultural drainage flows from the Grassland Area Farmers are projected to decline by approximately 17,000 acre-feet by September 2009, when their use agreement for the San Luis Drain expires. The upper watershed flows are uncontrolled and are likely to continue to reach Mud and Salt sloughs. The combined effect of these flow reductions on aquatic habitats in Mud and Salt sloughs utilized by the giant garter snake, Sacramento splittail, and hardhead could be cumulatively considerable, because the transfer program's contribution is not cumulatively significant. In other words, the proposed program would not likely cause the sloughs to dry up entirely, especially if some of the water is transferred to the refuges.

The combined effects of the proposed water transfers on flows in the San Joaquin River between the Stanislaus River and the Merced River would be less than 15 percent of the total flow during dry/below normal water years (Reclamation 2001n) and less during critical or normal water years. Therefore, the potential impact on special-status salmonids that utilize this reach of the San Joaquin River would not be cumulatively considerable or significant. Flows in the San Joaquin River below the confluence with the Stanislaus River would not be affected by the combined reductions because any change in San Joaquin River flows upstream of the Stanislaus River are assumed to be counteracted by a change in New Melones Reservoir releases to maintain water quality at Vernalis (see Section 4.2).

6.2.3.3 Aquatic Habitats

The combined effect of flow reductions from the proposed project and other activities on aquatic habitats in Mud and Salt sloughs could be cumulatively considerable and significant. Refer to the special-status species cumulative effects evaluation above for additional discussion of combined flow reductions in Mud and Salt sloughs.

6.2.4 Impact and Mitigation Summary

The following sections and Tables 6-6 through 6-10 summarize effects to biological resources for each of the action alternatives. The analysis focuses on direct impacts from water development transfers and indirect impacts due to water quality mitigation identified in Section 4.2.4.

No significant adverse impacts to wetlands, special-status species, or aquatic habitats are anticipated under any of the action alternatives.

6.2.4.1 Existing Conditions and No Action Alternative

For the purposes of analysis, the No Action/No Project Alternative and existing conditions are considered to be effectively the same. Refuge water deliveries would remain the same as existing conditions and no physical changes to the refuges, associated wetlands, aquatic habitats or special-status species would occur. Therefore, no adverse effects from No Action/No Project to sensitive biological resources would occur under this alternative.

6.2.4.2 Alternative A: 80,000 Acre-Feet

Wetlands

- **Refuge Focus Scenario:** This scenario would increase slightly the amount of water provided to the wildlife refuges compared to existing conditions and No Action/No Project. Therefore, this alternative would result in minimal or less-than-significant beneficial impacts to refuge wetlands.
- **Agriculture Focus** and **Out-of-Basin Focus Scenarios:** These scenarios would maintain the current water deliveries to the refuges. Therefore, these scenarios would not significantly impact refuge wetlands.

Special-Status Species

- **All Scenarios:** During noncritical water years, proposed tailwater recapture under all three of the Alternative A scenarios would reduce the amount of water that would otherwise flow into Mud and Salt sloughs. However, the amount of water in Mud and Salt sloughs under this alternative would be within the range of flows recorded in Mud and Salt sloughs under existing or baseline conditions. Therefore, the three Alternative A scenarios would result in a less-than-significant adverse effect to special-status species that potentially utilize Mud and Salt sloughs.
- **Out-of-Basin Focus Scenario:** Transfers of water to agricultural and M&I water users under this scenario of Alternative A would be utilized for existing cultivated or developed lands. The transferred water would not be used to develop new lands for M&I or agricultural land uses. Therefore, this scenario would not significantly impact special-status species that may occur in areas outside the Exchange Contractors service area.
- **All Scenarios:** All three scenarios under Alternative A would result in minimal flow changes in the San Joaquin at Vernalis. These changes are much less than 1 percent of the range of inter-annual variation in monthly river flow. Therefore, these scenarios would not have a significant adverse impact on listed anadromous fish that utilize the lower San Joaquin River or designated critical habitat for these species.
- **All Scenarios:** Proposed land fallowing under all three scenarios included in Alternative A would potentially reduce foraging habitat for the State-listed Swainson’s hawk and other special-status raptors. Therefore, Alternative A would result in a less-than-significant impact to Swainson’s hawk and other nonlisted foraging raptors in the Exchange Contractors service area.
- **Agriculture Focus Scenario:** This scenario of Alternative A would potentially expand production of crops that provide foraging habitat for the State-listed Swainson’s hawk and other special-status raptors. Therefore, this scenario would result in a less-than-significant beneficial impact to special-status species in agricultural lands within the Exchange Contractors service area.

Aquatic Habitats

- **All Scenarios:** Tailwater recovery proposed under all three scenarios under Alternative A would reduce the volume of water that would reach Mud and Salt sloughs compared to existing conditions. However, amount of water in the sloughs would be within the range of flows observed during historic dry/below normal water years (e.g., 1985 and 2001). Therefore, the anticipated reduction would not significantly impact aquatic habitats. Water transfers to agricultural and out-of-basin water users would not significantly impact aquatic resources those areas because water would be used for existing agricultural and M&I uses.

6.2.4.3 Alternative B: 50,000 Acre-Feet

Wetlands

- **Refuge Focus Scenario:** This scenario included under Alternative B would not change existing water deliveries to refuges. Therefore, this scenario would not significantly impact the area or quality of wetlands in wildlife refuges.
- **Agriculture Focus and Out-of-Basin Focus Scenarios:** These scenarios would eliminate the existing water transfers to the refuges; however, this would be partially offset by the absence of tailwater recovery under these scenarios. It is assumed that Reclamation would acquire additional water as needed to provide existing levels of water supplies to the refuges. These assumed deliveries and anticipated increases in tailwater flows would reduce the impacts to refuge wetlands to a less-than significant level under these two scenarios.
- **Agriculture Focus and Out-of-Basin Focus Scenarios:** These scenarios would not significantly affect wetlands in areas that receive the water, because the water would be used for existing uses and would not result in land use changes that would affect the area or quality of existing wetlands. Therefore, these scenarios would not significantly impact wetlands in areas that would receive water under Alternative B.

Special-Status Species

- **Refuge Focus Scenario:** No tailwater recovery is included under this scenario, and temporary land fallowing would make an additional 3,026 acre-feet of water available to flow into Mud and Salt sloughs. Increased flows to Mud and Salt sloughs would not have a significant impact to giant garter snake or other special-status species that potentially utilize the sloughs because these flows are within the range of existing annual flow variations.
- **Agriculture Focus and Out-of-Basin Focus Scenarios:** Reduced water deliveries to refuge wetlands would not significantly affect special-status species because Reclamation has committed to maintaining existing deliveries and the elimination of additional tailwater recovery would partially offset reduced deliveries. Therefore, these scenarios would not have a significant impact on special-status species that utilize the refuge wetlands.
- **All Scenarios:** All scenarios under Alternative B would have only minimal effects on flows at Vernalis. Therefore, Alternative B would have a less-than-significant impact on special-status salmonids that utilize the lower reaches of the San Joaquin River.

- **All Scenarios:** As with Alternative A, crop idling proposed under all three scenarios of Alternative B would result in less-than-significant impacts to special-status species that utilize the cultivated areas in the Exchange Contractors service area.
- **Agriculture Focus and Out-of-Basin Focus Scenarios:** These scenarios would result in the transfer of less than 50,000 acre-feet of water to agricultural and M&I uses. As discussed under Alternative A, potential transfers to these uses would have a less-than-significant impact on special-status species.

Aquatic Habitats

- **All Scenarios:** No tailwater recovery is proposed under this alternative, and water deliveries to the refuges would not change under the three scenarios proposed for Alternative B. Therefore, this alternative would not impact aquatic habitats in the refuges or in Mud and Salt sloughs.

6.2.4.4 Alternative C: 130,000 Acre-Feet

Wetlands

- **Refuge Focus Scenario:** This scenario would result in improvements in wetland habitat quality and the creation of new wetland habitat in the existing wildlife refuges. Therefore, this scenario would have a significant beneficial impact to wetlands in the wildlife refuges.
- **Agriculture Focus and Out-of-Basin Focus Scenarios:** These scenarios would maintain the current water deliveries to the refuges. Therefore, these scenarios would not impact refuge wetlands.
- **Agriculture Focus and Out-of-Basin Focus Scenarios:** These scenarios would provide water to existing agriculture, municipal, and industrial uses. Therefore, these scenarios would have no impact on wetland habitats.

Special-Status Species

- **All Scenarios**. Alternative C includes tailwater recovery and land fallowing that would reduce the amount of water potentially reaching Mud and Salt sloughs by approximately 47 percent during a dry/below normal year. These reductions are not likely to have a significant impact to giant garter snake or other special-status species that utilize Mud and Salt sloughs, because the reduced flows are within the normal range of variation recorded in these sloughs under existing conditions.
- **Agriculture Focus and Out-of-Basin Focus Scenarios:** Water deliveries to refuge wetlands would not change under these scenarios. Therefore, these scenarios would not significantly affect special-status species that utilize the wetland habitats in the refuges.
- **Agriculture Focus and Out-of-Basin Focus Scenarios:** Water deliveries outside the Exchange Contractors service area under these scenarios would be utilized by existing agricultural and commercial users and would not change existing land uses. Therefore, these

scenarios would not significantly impact special-status species in agricultural and M&I areas that receive water under these scenarios.

- **All Scenarios:** All three scenarios under Alternative C would reduce flows into the San Joaquin River. However, these scenarios would not have a significant adverse impact on the listed steelhead and special-status chinook salmon that utilize the lower San Joaquin River because these reductions are within the range of inter-annual variations in monthly river flow as discussed in Section 4.
- **All Scenarios:** Crop idling proposed under all three scenarios of Alternative C would result in less-than-significant impacts to special-status species that utilize the cultivated areas in the Exchange Contractors service area.

Aquatic Habitats

- **All Scenarios:** Water deliveries to the refuges would not change under the three scenarios proposed for Alternative C. However, proposed tailwater recovery and crop idling under this alternative would reduce the amount of water flowing into Mud and Salt sloughs. However, the amount of water in Mud and Salt sloughs would be within the range of flows that occur under existing conditions during dry or below normal water years. Therefore, the reduced flows are not likely to significantly impact sensitive aquatic habitats in Mud and Salt sloughs.

Table 6-6
Summary of Effects of the No Action/No Project Alternative

Affected Resource and Area of Potential Effect	No Action/No Project Compared to Existing Conditions
Wildlife Refuges	No adverse impact
Special-Status Species	
Aquatic Resources	

Table 6-7
Summary of Effects of Alternative A: 80,000 Acre-Feet

Affected Resource	Scenario	CEQA	NEPA
Wetlands	All Water to Refuges	Less-than-significant beneficial impact	Positive effect
	All Water to Agriculture	No significant impact	Neutral effect
	All Water Out of Basin	No significant impact	Neutral effect
Special-Status Species	All Water to Refuges	Less-than-significant impact	Minimal effect
	All Water to Agriculture	Less-than-significant beneficial impact	Positive effect
	All Water Out of Basin	Less-than-significant adverse impact	Minimal adverse effect
Aquatic Resources	All Water to Refuges	Less-than-significant impact	Minimal effect
	All Water to Agriculture	Less-than-significant adverse impact	Minimal adverse effect
	All Water Out of Basin	Less-than-significant adverse impact	Minimal adverse effect

Table 6-8
Summary of Effects of Alternative B: 50,000 Acre-Feet

Affected Resource	Scenario	CEQA	NEPA
Wetlands	All Water to Refuges	Less-than-significant adverse impact	Minimal effect
	All Water to Agriculture	Less-than-significant adverse impact	Minimal effect
	All Water Out of Basin	Less-than-significant adverse impact	Minimal effect
Special-Status Species	All Water to Refuges	Less-than-significant adverse impact	Minimal effect
	All Water to Agriculture	Less-than-significant adverse impact	Minimal effect
	All Water Out of Basin	Less-than significant adverse impact	Minimal effect
Aquatic Resources	All Water to Refuges	No adverse impact	Neutral effect
	All Water to Agriculture	No adverse impact	Neutral effect
	All Water Out of Basin	No adverse impact	Neutral effect

Table 6-9
Summary of Effects of Alternative C: 130,000 Acre-Feet

Affected Resource	Scenario	CEQA	NEPA
Wetlands	All Water to Refuges	Significant beneficial impact	Positive effect
	All Water to Agriculture	No impact	Neutral effect
	All Water Out of Basin	No impact	Neutral effect
Special-Status Species	All Water to Refuges	Less-than-significant adverse impact	Minimal adverse effect
	All Water to Agriculture	Less-than-significant adverse impact	Minimal adverse effect
	All Water Out of Basin	Less-than-significant adverse impact	Minimal adverse effect
Aquatic Resources	All Water to Refuges	Less-than-significant adverse impact	Minimal adverse effect
	All Water to Agriculture	Less-than-significant adverse impact	Minimal adverse effect
	All Water Out of Basin	Less-than-significant adverse impact	Minimal adverse effect