4.3 GROUNDWATER

This section describes changes to groundwater conditions associated with the project alternatives, as compared to the No Action alternative. Groundwater conditions for each alternative are compared to the No Action alternative, and associated impacts are reported.

In certain alternatives, specific groundwater basins within the project area may be affected by the proposed action. However, the groundwater basins within the San Joaquin River Group Authority members' service areas are all part of the San Joaquin River Region, thus are to some extent hydraulically connected.

4.3.1 Impact Issues and Evaluation Criteria

Specific environmental impacts and concerns that were identified during the public scoping phase of this project include:

- Impacts on the Eastern San Joaquin Groundwater Basin from the acquisition of water on the San Joaquin River tributaries.

- Impacts of reductions of the use of surface water from the Stanislaus and Tuolumne Rivers in Stanislaus County on groundwater usage in Stanislaus County. Will the water acquisitions for SJRA be offset locally by increased groundwater pumping, and if so, what will be the impact on local groundwater resources?

- Extent to which San Joaquin River Agreement (SJRA) would result in additional groundwater pumping.

- Cumulative effects of the proposed project and other ongoing projects on water quality and quantity.

Groundwater impacts for each alternative are summarized as changes to groundwater overdrafting, groundwater levels, groundwater quality, subsidence, subsurface drainage, and waterlogging compared to the No Action alternative. These conditions represent the general response of the groundwater basins to potential increases in groundwater withdrawals as part of the water required for the proposed SJRA flows. Changes in groundwater storage provide a measure of associated groundwater impacts such as changes in groundwater-surface water interaction, subsidence of the ground surface, migration and upwelling of poor-quality groundwater, impairment of subsurface drainage systems in areas of poorly drained soils, and high groundwater tables adjacent to streams with known seepage-induced waterlogging problems.

Significance determinations for the impact analysis are based on the quantity of groundwater involved directly or indirectly and on the existing overdraft conditions in the basin.

4.3.2 Environmental Consequences

Within the San Joaquin River Region, approximately 2.6 million acre-feet of groundwater is extracted in a typical year (DWR 1998). The majority of the groundwater is pumped by a combination of private agricultural interests and municipalities. The approximate annual volume of groundwater utilized by the willing sellers at present ranges from 9,668 acre-feet by OID to 144,000 acre-feet utilized by the Exchange Contractors (Table 3.1-1). The willing sellers' total groundwater use annually ranges from approximately 0.4 percent to 5.5 percent of the total groundwater pumped within the basin. The following sections are by basin or service area.

4.3.2.1 Groundwater Overdrafting

Groundwater overdraft is defined by Department of Water Resources (DWR) as the condition of a groundwater basin where the amount of water extracted exceeds the amount of groundwater recharging the basin "over a period of time" (DWR 1980). To quantify overdraft, the period of time must be of sufficient duration to produce a record that can be used to approximate the long-term average hydrologic conditions in the basin. In the California Water Plan Update (Draft) (DWR 1998), DWR estimated the amount of groundwater overdraft in the Central Valley. In the San Joaquin River Basin, groundwater overdraft is estimated to be 240,000 acre-feet and occurs throughout the basin.

Because groundwater is typically used to replace much of the shortfall in surface water supplies, water delivery reductions resulting from the proposed alternative could increase groundwater overdraft within the various willing sellers' groundwater basins. Water delivery reductions for the willing sellers resulting from the proposed action are reported in Table 4.1-1. For this evaluation of groundwater storage, these quantities are assumed to be the maximum increase in groundwater pumping that would result from the different alternatives. The deficiency caused by the surface water diversion can also be made up by other water management methods including, but not limited to, tailwater recovery and water conservation.

South San Joaquin Irrigation District (SSJID) Service Area

DWR Bulletin 118 (1996) has identified the groundwater basin underlying eastern San Joaquin County as a critically overdrafted basin. Groundwater extraction in the urban area of SSJID is estimated to exceed the safe yield of one acre-foot per acre per year, while groundwater extraction in agricultural areas is significantly below the safe yield. As a result, the average extraction rate within the SSJID is less than the estimated safe yield; and, therefore, the SSJID's portion of the groundwater basins technically is not overdrafted (SSJID 1994).

SSJID estimates that the typical agricultural groundwater production rate in the service area is 32,400 acre-feet. Of this volume approximately 11,200 acre-feet per year is pumped by SSJID with the remainder pumped from private wells (SSJID 1993). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. The No Action alternative represents existing conditions plus reasonable foreseeable future conditions that would exist without the proposed action. Projected agricultural and municipal groundwater demands for the SSJID service area are 58,000 acre-feet per year. SSJID estimates their groundwater extraction rates would remain below the safe yield of one acre-foot per acre per year. Given their projected usage of groundwater, overdrafting of the SSJID groundwater basin from SSJID pumping would not increase.

Proposed Action. The proposed action, outlined in the San Joaquin River Agreement, provides water from the Authority for achieving the Vernalis Adaptive Management Plan (VAMP) pulse flow, up to 110,000 acre-feet (except in double-step years where it could be 160,000 acre-feet). The volume of water for all flows (excluding double-step years) is capped at 137,500 acre-feet in any year (see Table 2.1-3). Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. There would be no impact to the overdraft problem within eastern San Joaquin County as a result of this action.

Alternative Action. To evaluate impacts resulting from implementation of the alternative action (SWRCB Water Right Priority System), data from the *Draft Environmental Impact Report for the Implementation of the 1995 Bay/Delta Water Quality Control Plan* (SWRCB 1998) was used. In particular, the State showed 73-year period (1922-1994) and critical period (May 1928-October 1934) annual average water delivery changes for each alternative analyzed (Table V-1 and Table V-2). The total average annual change in deliveries resulting from implementing the Water Right Priority System is a minus 31,000 acre-feet. This average annual reduction is distributed across a completely different array of water users than is the proposed action (which uses specific willing sellers). Similarly, in critically dry years, implementation of the SWRCB Water Right Priority System would result in 12,000 acre-feet of delivery reduction from junior appropriators and would be imposed without regard to the consequences or willing ability of the appropriator(s) to provide the water. The SWRCB analysis does not provide information on the total water supplies available to the junior appropriators affected by this alternative.

If other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by SSJID and other water right holders to supplement reduced surface water deliveries is not known at this time

for the SSJID area; but for the entire San Joaquin River Basin, it is up to 62,000 acre-feet (Table V1-75, SWRCB 1998). The effect is considered a potentially significant impact.

Oakdale Irrigation District (OID) Service Area

Groundwater depletion within OID is estimated to be approximately 5,100 acre-feet per year (MW April 13, 1995, Memorandum). OID estimates that the typical groundwater production rate in the service area is 55,900 acre-feet. Of this volume approximately 30,000 acre-feet per year is pumped by private irrigators with the remainder pumped from District and Reclamation wells. Annual average use from OID wells is 9.668 acre-feet (Table 3.1-1). The data shows that groundwater storage within the service area is essentially in balance, with only a slight (4,000 acre-feet per year) depletion in storage over the past 20 years (MW May 8, 1995, Memorandum). On a local level, groundwater extraction rates vary throughout the basin based on factors such as location of municipalities, depth to groundwater, and crop water needs.

No Action. Projected groundwater demands for the OID service area are 55,900 acre-feet per year. OID estimates that groundwater extraction rates within their service area would continue to slightly exceed infiltration rates. Given their projected usage of groundwater, slight overdrafting of the OID groundwater basin from pumping would continue. The groundwater budget for the OID service area suggests that current pumping rates do not appear to significantly threaten the continued long-term viability of their groundwater resources (MW 1995, Memorandum).

Proposed Action. The maximum annual surface water diversion for the flow events from the OID service area is 26,000 acre-feet. To substitute for this water, OID projects pumping between zero and 15,000 acre feet of groundwater to serve its irrigation customers using existing facilities. If the total 15,000 acre-feet is groundwater, this represents approximately 27 percent of the total groundwater pumped annually from the service area. However, groundwater levels have been historically relatively high throughout the OID service area, and the groundwater surface is hydraulically connected to the Stanislaus River water surface. The additional groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a significant negative impact to the overdraft problem within OID's service area.

Alternative Action. If other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by others to supplement reduced surface water deliveries is not known at this time for the OID service area. Since an objective determination of the magnitude of impact is not possible, the effect is considered a potentially significant impact.

Modesto Groundwater Basin

The average annual overdraft in the Modesto Basin is estimated at 15,000 acre-feet (MID 1996). DWR estimates that the typical groundwater production rate in the basin is 229,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. Projected agricultural and municipal groundwater demands for the Modesto Irrigation District (MID) service area are summarized in Table 3.3-5. Total groundwater demand in the basin is projected to increase from 108,000 acre-feet per year in 1995 to 222,000 acre-feet per year in 2030 (MID 1996). Given the projected usage of groundwater, overdrafting of the Modesto Groundwater Basin would continue to increase if other groundwater conservation methods are not implemented.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the MID is 11,000 acre-feet. MID projects that none of this water would come from groundwater and that they would make up the diverted water by reduced carryover storage in the New Don Pedro Reservoir. There would be no impact to the overdraft problem, because no additional groundwater would be pumped either directly or indirectly to accommodate the pulse flows.

Alternative Action. The modeling studies used to calculate water deliveries for the 1995 WQCP DEIR (SWRCB 1998) assumed that water right holders in the San Joaquin Basin would pump groundwater to compensate for reductions in surface water deliveries. The 1995 WQCP DEIR projects that MID would have zero reduction in surface water deliveries as a result of implementation of the alternative action (see Table VI-75, SWRCB 1998). As a result, MID would not have to pump groundwater to make up for reductions in surface water deliveries. Therefore, this action would have no impact on groundwater overdrafting in the Modesto Groundwater Basin from MID, but water obtained from other water right holders could contribute to overdraft. In the absence of specific information on these other holders and the amounts of water involved, the impact is considered potentially significant.

Turlock Groundwater Basin

The average annual overdraft in the Turlock Basin is estimated at 70,000 to 85,000 acre-feet (TID 1997). Maximum annual surface water diversion for the pulse flow event from the Turlock Groundwater Basin is 11,000 acre-feet. TID projects that none of this water would come from groundwater. DWR estimates that the typical groundwater production rate in the basin is 452,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. Projected agricultural and municipal groundwater demands for the TID service area are summarized in Appendix B, Table B1-3. Total groundwater demand in the basin is projected to increase from 447,405 acre-feet per year in 1995 to 520,100 acre-feet per year in 2030 (TID 1997). Given the projected usage of groundwater, overdrafting of the Turlock Groundwater Basin would continue to increase.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater (see Table 2.1-3). TID projects that they can make up for the diverted water by incorporating conservation measures into their water plan. There would be no impact to the overdraft problem, because no additional groundwater would be pumped either directly or indirectly to accommodate the pulse flows (Godwin 1998, personal communication).

Alternative Action. The 1995 WQCP DEIR projects that TID would have zero reductions in surface water deliveries as a result of implementation of the alternative action. Therefore, TID would have no impact on groundwater overdrafting. Other water right holders could contribute to overdraft, so the impact is potentially significant.

Merced Groundwater Basin

The average annual overdraft in the Merced Groundwater Basin is estimated at 20,000 acre-feet (Merced ID 1997). DWR estimates that the typical groundwater production rate in the basin is 555,000 acre-feet per year (DWR 1998). Based on factors such as location of municipalities, depth to groundwater, and crop water needs, on a local level, groundwater extraction rates vary throughout the basin.

No Action. Projected agricultural and municipal groundwater usage for the Merced ID service area is approximately 638,000 acre-feet per year (Merced ID 1996). Of this volume, Merced ID pumps approximately 25,000–30,000 acre-feet per year (Table 2.1-3). Total agricultural groundwater demand in the basin is projected to decrease by 12 percent over the next 40 years, from 601,800 acre-feet per year in 1996 to 529,584 acre-feet per year in 2036 (Merced ID 1997). Total groundwater demand for municipal uses, in the basin, is projected to increase by approximately 33 percent by 2030, from approximately 40,000 acre-feet per year in 1996 to 121,000 acre-feet per year in 2036 (Merced ID 1997). No estimates were given for the increase in demand for industrial uses. Given the projected usage of groundwater, overdrafting of the Merced Groundwater Basin would continue to increase.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the percentage of this water that may come from groundwater ranges from zero to 100 percent as an indirect impact due to the potential use of groundwater to substitute for reduced surface water delivery. No groundwater would be

pumped directly by Merced ID to meet SJRA flows. For the worst case, this 67,500 acre-feet represents approximately 12 percent of the typical annual groundwater production rate of 555,000 acre-feet per year from the basin (DWR 1998). This amount could result in a significant impact to the overdraft problem, if other groundwater conservation measures are not implemented.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The SWRCB DEIR assumes that Merced ID would have zero reductions in surface water deliveries that may have to be offset with groundwater. This action would have no impact on additional groundwater overdrafting from Merced ID. However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. The surface water supply is supplemented by an unreasonably high groundwater supply in dry and critical water years. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. Therefore, since an objective determination of the magnitude of impact is not possible from material provided in the DEIR, the effect is considered a potentially significant impact.

Exchange Contractors Water Authority Service Area

Data regarding the average annual overdraft in the area serviced by the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) are not available. DWR does not provide an estimate of the typical groundwater production rates in the service area; however, they provide an estimate for the Delta Mendota Basin which includes the Exchange Contractors service area. DWR estimated the groundwater production rate for the Delta Mendota Basin is 511,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. The total average annual volume of groundwater pumped by users in the Exchange Contractors service area is estimated at approximately 100,000 acre-feet. Total groundwater demand in the basin, including private water users, has fluctuated from a low of 196,167 acre-feet in 1995 to a high of 390,000 acre-feet in 1994. The average annual volume of groundwater pumped during the five year period from 1991 through 1995 is 265,000 acre-feet (SJRECWA 1997). The projected overdraft for the service area is not reported.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet (see Table 2.1-3). Of this volume, the Exchange Contractors project that the water that may come from groundwater ranges from zero to 11,000 acre-feet. For the worst case, this represents approximately 7.6 percent of the typical annual groundwater production rate of 144,000 acre-feet per year pumped by the Exchange Contractors.

The 11,000 acre-feet is 2.2 percent of the Delta Medota Basin production of 511,000 acre-feet. Based on this worst case scenario, if the total amount comes from groundwater storage, groundwater overdraft in the Exchange Contractors groundwater basin could increase by a small amount. This would result in a less-than-significant impact to the basinwide overdraft problem.

Alternative Action. The 1995 WQCP DEIR projects that the Exchange Contractors would experience approximately 5,000 acre-feet increase in surface water deliveries (as the difference between Alternative 2 and Alternative 3). The groundwater overdraft in the Exchange Contractors service area would not increase. This would result in no impact to the basinwide overdraft problem from the Exchange Contractors. However, the volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not quantifiable; so the impact is potentially significant.

4.3.2.2 Water Levels

Changes in water level are the result of many factors including surface water and groundwater use, irrigation technologies, changes in crop mix and streamflow. Declining water levels can result in additional power consumption as a result of having to lift the water a longer distance as well as upwelling of saline water which reduces water quality.

South San Joaquin Irrigation District (SSJID) Service Area

Semi-annual monitoring of groundwater levels throughout San Joaquin County, including SSJID have been conducted since the fall of 1997. Measurements of the water levels are collected during the spring and fall of each year. The spring measurements reflect natural recharge that occurred during the wet season, while the fall measurements indicate the impact of groundwater pumping during the summer months.

Within the District, groundwater movement is generally from the southeast to the northwest. Since 1964, groundwater levels within the District have declined between 20 and 30 feet, with about 10 feet of this decline occurring between 1987 and 1993, as a result of the extended dry conditions at this time (SSJID 1994). The majority of this decline has occurred in the central and eastern areas of the District as a possible result of a large cone of depression located east of Stockton.

Water levels will continue to decline within the SSJID service area as a result of the overdrafting that is occurring within the eastern area of the county (Brown and Caldwell 1985). The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside SSJID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

SSJID estimates that the typical agricultural groundwater production rate in the service area is 32,400 acre-feet. Of this volume approximately 11,200 acre-feet per year is pumped by SSJID with the remainder pumped from private wells (SSJID 1993). On a local level, groundwater extraction rates vary throughout the basin (based on factors such, location of municipalities, depth to groundwater, and crop water needs).

No Action. SSJID estimates their groundwater extraction rates would remain below the safe yield of one acre-foot per acre per year. Given their projected usage of groundwater, water levels within the SSJID groundwater basin should not decline. However, as a result of the overdrafting in urban areas located within and adjacent to the SSJID service area, water levels would probably continue to decline if other conservation methods are not implemented in the SSJID service area.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the service area is 11,000 acre-feet (see Table 2.1-3). Of this volume, SSJID projects that none of this water would come from groundwater. This action would have no negative impact on water levels within the service area.

Alternative Action. If SSJID is required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries in the SSJID service area is not known at this time. Therefore, while an objective determination of the magnitude of impact is not possible, the effect is considered potentially significant.

Oakdale Irrigation District (OID) Service Area

OID has been monitoring water levels within seven wells. An analysis of water levels for spring and fall of 1992 showed that water levels ranged from more than 100 feet above mean sea level in the northern part of the service area to less than 50 feet above mean sea level in the northwest portion of the service area, indicating that groundwater generally flows from east to west. Groundwater levels decline by approximately five feet from spring to fall and appear to be a seasonal variation.

No Action. OID estimates that groundwater storage within the service area is essentially in balance, with only a slight (4,000 acre-feet per year) depletion in storage over the past 20 years (MW May 8 , 1995, Memorandum). Given projected usage of groundwater, water levels within the OID groundwater basin should not decline.

Proposed Action. OID projects that groundwater pumping to supplement instream flows could range from zero to 15,000 acre-feet per year. OID conducted an analysis in 1995 of hydrologic impacts likely to be associated with potential water transfers from their service area (MW April 13, 1995, Memorandum). The analysis simulated three levels of water level transfers from the

portion of the OID north of the Stanislaus River: 10,000 acre-feet per year, 20,000 acre-feet per year, and 30,000 acre-feet per year over a period of 70 years. The results of the simulation showed that groundwater levels would decline between two and four feet over the 70 year period for 10,000 and 20,000 acre-feet per year diversions. Conditions in the portion of the OID service area south of the Stanislaus River are considered a mirror image of northern area conditions, and similar water level declines would be expected (MW April 13, 1995, Memorandum). These results indicate that use of 15,000 acre-feet per year for the proposed action would have no significant impacts to groundwater water levels within the OID service area.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is not known at this time. An objective determination of the magnitude of impact is not possible, so the effect on groundwater levels is considered a potentially significant impact.

Modesto Groundwater Basin

Long term water level monitoring conducted by DWR indicates that the Modesto Groundwater Basin has experienced groundwater declines of 15.3 feet from the period 1970-1990 (HCI 1992). This decline represents depletion of storage of 404,000 acre-feet. The average annual water budget for 1952-1991 indicates an average annual overdraft in the basin of 2,300 acre-feet per year (MID 1996). The overdraft is indicated by water level declines of approximately 0.5 feet per year (HCI 1993).

Water levels will probably continue to decline within the MID service area as a result of the overdrafting. The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside MID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

DWR estimates that the typical groundwater production rate in the basin is 229,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

No Action. The data presented in MID's Groundwater Management Plan (MID 1996) suggests that the groundwater basin would continue to be overdrafted by approximately 15,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given projected usage of groundwater, water levels are projected to continue to decline if conservation methods are not implemented in the Modesto Groundwater Basin.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the MID is 11,000 acre-feet (see Table 2.1-3). Of this volume, MID projects that none of this water would come directly from groundwater. This would result in no impact to declining groundwater levels in the Modesto Groundwater Basin.

Alternative Action. The 1995 WQCP DEIR projects that MID would have no reduction in surface water deliveries that may have to be offset by increased groundwater pumping as a result of implementing the alternative action (Table VI-75, SWRCB 1998). Therefore, this action would have no impact on water levels in the Modesto Groundwater Basin from MID but there could be impacts from other water right holders in this basin. These impacts cannot be quantified based on information in the DEIR, so the overall impact to the basin is potentially significant.

Turlock Groundwater Basin

Water level data shows that water levels have declined between 1971 and 1991 (TID 1997). The largest water level declines have occurred within the eastern part of the Basin, where declines are as much as 90 feet. Water levels have declined approximately five feet throughout the western part of the Basin.

These declines are largely the result of pumping in excess of recharge, resulting in annual overdrafting in the Turlock Basin at an annual estimated rate of 70,000 to 85,000 acre-feet (TID 1997). DWR estimates that the typical groundwater production rate in the basin is 452,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

Water levels will probably continue to decline within the TID service area as a result of the overdrafting. The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside TID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

No Action. The data presented in TID's Groundwater Management Plan (TID 1997) suggests that the groundwater basin would continue to be overdrafted by approximately 70,000 to 85,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given the projected usage of groundwater, water levels within the Turlock Groundwater Basin are projected to continue to decline if conservation methods are not implemented.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater (see Table 2.1-3). This action would have no negative impact on water levels within the Turlock Groundwater Basin.

Alternative Action. The 1995 WQCP DEIR projects that TID would have zero reductions in surface water deliveries as a result of implementation of the alternative action (see Table VI-75, SWRCB 1998). As a result, TID would not have to pump additional groundwater to make up for reductions in surface water deliveries. The alternative action would have no impact on groundwater levels within the Turlock Groundwater Basin from TID. However, there could be impacts from other water right holders in this basin. These impacts cannot be quantified at this time, so the impact on groundwater levels is potentially significant.

Merced Groundwater Basin

The Merced Irrigation District monitors static and high groundwater levels on a monthly basis from a total of 196 active wells within its irrigation boundaries. In addition, Merced ID monitors shallow monitoring wells, located at the section corners, to determine localized areas of high or perched groundwater table conditions. Long term water level data indicates that the Merced Groundwater Basin has experienced groundwater level declines of up to 40 feet during the period 1960-92. This decline represents depletion of storage of 404,000 acre-feet.

These declines are largely the result of pumping in excess of recharge resulting in annual overdrafting in the Merced Groundwater Basin at a estimated rate of 20,000 acre-feet (Merced ID 1997). DWR estimates that the typical groundwater production rates in the basin is 555,000 acre-feet per year (DWR 1998). On a local level, groundwater extraction rates vary throughout the basin (based on factors such as location of municipalities, depth to groundwater, and crop water needs).

Water levels will probably continue to decline within the Merced ID service area as a result of the overdrafting. The rate of groundwater decline will vary throughout the area depending on conditions including groundwater extraction rates, underflow to groundwater depressions located outside Merced ID, and recharge from sources including, irrigation seepage, precipitation, groundwater inflow and artificial recharge.

No Action. The data presented in Merced ID's Groundwater Management Plan (Merced ID 1997) suggests that the groundwater basin would continue to be overdrafted by approximately 20,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given their projected usage of groundwater, water levels within the Merced ID Groundwater Basin are projected to continue to decline if conservation methods are not implemented in the Basin.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from the Merced ID ranges is 67,500 acre-feet (see Table 2.1-3). Of this volume, Merced ID projects that the percentage of this water that may come indirectly from groundwater to substitute for reductions in surface water deliveries ranges from zero to 67,500 acre-feet. Based on the worst case, if the total amount comes from groundwater storage, this would represent less than 12 percent of the total

groundwater pumped in the basin in a typical year. This could result in a significant impact to declining groundwater levels.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The 1995 WQCP DEIR projects that Merced ID would have zero reductions in surface deliveries as a result of the alternative action and would not have to pump groundwater to make up for loss in water deliveries. Consequently, the alternative action would have no impact on groundwater levels within the Merced Groundwater Basin from Merced ID. However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. Nevertheless, there could be impacts from other water right holders which cannot be quantified at this time; therefore the impact is potentially significant.

Exchange Contractors Water Authority Service Area

Data regarding the average annual overdraft in the area serviced by the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) are not available. The *Draft Programmatic Environmental Impact Statement for the Central Valley Project Improvement Act* (USBR 1997d) reports that water level declines began occurring in the 1940s along the west side of the San Joaquin River Region, dropping more than 30 feet by 1960.

DWR does not provide an estimate of the typical groundwater production rates in the service area. However, they provide an estimate for the Delta Mendota Basin, which includes the Exchange Contractors service area, of 511,000 acre-feet per year (DWR 1998).

No Action. No data was available on water level fluctuations in response to overdrafting in the area.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet (see Table 2.1-3). Of this volume, the Exchange Contractors project that the amount that may come from groundwater ranges from zero to 11,000 acre-feet. This represents about two percent of the typical groundwater production rate in the Delta Mendota Basin. If the total amount comes from groundwater storage, groundwater overdraft in the Exchange Contractors groundwater basin could increase slightly, but this would result in a less-than-significant impact to the water level problem.

Alternative Action. If the water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. Modeling conducted to calculate water deliveries for the 1995 WQCP projects that the Exchange Contractors may have average annual reductions in

surface water deliveries of approximately 15,000 acre-feet for Alternative 3 and 20,000 acre-feet for Alternative 2 (see Table VI-75, SWRCB 1998). The difference is 5,000 acre-feet less of a delivery reduction. The alternative action would have no impact on groundwater levels in the Exchange Contractors service area. However, impacts from other water right holders are unclear; so the impact on reduced water levels is potentially significant.

4.3.2.3 Water Quality

Groundwater quality conditions in the San Joaquin River Region vary throughout the area. Only those parameters that may be problems in the groundwater basins within the San Joaquin River Authority's willing sellers' service areas are discussed here. Groundwater quality for the proposed action and alternative action are compared to the No Action alternative.

South San Joaquin Irrigation District (SSJID) Service Area

With the exception of wells owned by the cities, water quality is not monitored in the District (SSJID 1994). As a result, comparatively little long-term data is available on water quality. The cities are required by the Department of Health Services to periodically sample and test wells used as a source of potable water. Water samples from city wells in Manteca, Ripon, and Escalon contain both inorganic and organic contaminants including nitrates and DBCP. Most of the impacts are restricted to shallow groundwater and are due to seepage from surface or near surface sources.

No Action. The No Action alternative represents existing conditions plus reasonable foreseeable future conditions that would exist without the proposed action. Levels of both inorganic and organic contaminants would continue to increase.

Proposed Action. SSJID predicts that none of their annual surface water diversion for the pulse flow event would come from groundwater. This action would have no impact on groundwater water quality within the Basin.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by junior water holders from the groundwater basin underlying the SSJID service area to supplement reduced surface water deliveries is not known at this time. Therefore, an objective determination of the magnitude of impact is not possible, the effect is considered potentially significant.

Oakdale Irrigation District (OID) Service Area

Water quality is reported to be generally acceptable for most uses within the OID service area (Black and Veatch, et. al. 1995). Problem levels of some constituents, including salinity, nitrates,

radionuclides, dibromochloropropane (DBCP) and other trace organics have been detected in groundwater within the service area. Most of the impacts are restricted to shallow groundwater and are due to seepage from surface or near surface sources.

No Action. OID reports that there is no evidence of any significant threat to groundwater quality such as saline intrusion in the aquifers below their service area (MW March 31, 1995, Memorandum).

Proposed Action. OID predicts that the amount of their annual surface water delivery for instream flows that may come from groundwater ranges from zero to 15,000 acre-feet per year. Data shows that this rate of pumpage would have only limited impacts to groundwater depletion and water levels and should have no impacts on groundwater water quality within the service area.

Alternative Action. If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped by junior water right holders from the groundwater basin underlying the OID service area to supplement reduced surface water deliveries is not known at this time. Therefore, an objective determination of the magnitude of impact on water quality is not possible, and the effect is considered potentially significant.

Modesto Groundwater Basin

Groundwater quality within the Modesto Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including total dissolved solids (TDS), nitrates, radionuclides, DBCP and some other trace organics, have been found in the groundwater. In addition to the water constituents listed above, some localized areas within the area have been contaminated through spills or dumping of hazardous materials. The area includes two Superfund sites: the Norris plant located south and east of Riverbank, and Halford Cleaners located in the City of Modesto.

No Action. The No Action alternative represents existing conditions plus reasonable foreseeable future conditions that would exist without the proposed action. Groundwater quality would remain acceptable for most uses.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the MID is 11,000 acre-feet (see Table 2.3-1). Of this volume, MID projects that none of this water would come from groundwater. This would result in no impact to groundwater quality within the basin.

Alternative Action. MID is not projected to experience any surface water delivery reductions as a result of the alternative action (see Table VI-75, SWRCB 1998). As a result, additional groundwater pumping would not be required. The alternative action would have no impact on water quality in the

Modesto Groundwater Basin from MID. However, there could be impacts from other water right holders. An objective determination of the magnitude of impact is not possible based on information in the DEIR, so the effect is considered a potentially significant impact.

Turlock Groundwater Basin

Groundwater quality within the Turlock Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including TDS, nitrates, radionuclides, DBCP and some other trace organics have been found in the groundwater. DWR estimates that the typical groundwater production rate in the basin is 452,000 acre-feet per year (DWR 1998).

No Action. Groundwater quality would remain generally acceptable.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet (see Table 2.3-1). TID projects that none of this water would come from groundwater. This action would have no negative impact on water quality within the Turlock Groundwater Basin.

Alternative Action. The SWRCB (1998) projects that TID would not be required to curtail any portion of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. The alternative action would not have any impact on groundwater in the Turlock Groundwater Basin from TID. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. An objective determination of the magnitude of impact is not possible, so the effect is considered a potentially significant impact.

Merced Groundwater Basin

There are numerous constituents detected in the Merced Groundwater Basin groundwater supply. Some constituents are naturally occurring, while others have been introduced into the groundwater from man-made sources. The constituents identified in this section either currently impact groundwater usage within the Basin, or have the potential to impact the Basin's future groundwater usage. Groundwater quality within the Merced Groundwater Basin is generally acceptable for most uses. Problem levels of some constituents, including TDS, nitrates, radionuclides, DBCP and some other trace organics, have been found in the groundwater.

Maximum annual surface water diversion for the Spring and October flow events from the Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the volume of water that may come indirectly from groundwater ranges from zero to 67,500 acre-feet. DWR estimates that the typical groundwater production rate in the basin is 555,000 acre-feet per year (DWR 1998).

No Action. Existing conditions of both acceptable quality for some uses and problems with levels of some constituents would continue.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from the Merced ID is 67,500 acre-feet (see Table 2.3-1). Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater (to substitute for surface water deliveries) ranges from zero to 67,500 acre-feet. Based on the worst case, the extraction of this quantity of water from the basin may increase TDS slightly and could result in a less-than-significant impact.

Alternative Action. Projections of average annual surface water diversions required to achieve the 1995 WQCP Vernalis flow objectives show that the Merced ID reduction in surface water deliveries is zero and would not have to be supplemented by pumping groundwater (Table VI-75, SWRCB 1998). However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. Therefore, an objective determination of the magnitude of impact to water quality cannot be made and the effect is considered a potentially significant impact.

Exchange Contractors Water Authority Service Area

The San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) report in their AB3030 plan that water quality issues within their service area occurs only in urban areas. High manganese concentrations have been detected from groundwater samples collected from wells in Firebaugh and Mendota. The city of Dos Palos developed a surface water quality problem because of the poor quality of groundwater. The Exchange Contractors report that localized areas west and southwest of their boundaries contain poor quality water (SJRECWA 1997).

DWR does not provide an estimate of the typical groundwater production rates in the service area. However, they provide an estimate for the Delta Mendota Basin which includes the Exchange Contractors service area. The DWR estimated groundwater production rate for the Delta Mendota Basin is 511,000 acre-feet per year (DWR 1998).

No Action. Water quality problems may continue in the urban areas.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet (see Table 2.3-1). The Exchange Contractors project that up to 100 percent of this water could come from groundwater. This represents approximately two percent of the total groundwater pumped, so the impact on water quality is less than significant.

Alternative Action. The 1995 WQCB DEIR projects that the Exchange Contractors may experience a 5,000 acre-feet increase in surface water deliveries. This would result in no impact to the groundwater quality. However, other water right holders could be responsible for providing water. The amount of groundwater pumping that may result from reduced surface water deliveries cannot be quantified, and the impact is considered potentially significant.

4.3.2.4 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 dewatered soil interstitial spaces. A negative effect of subsidence is the permanent loss of aquifer capacity. Between 1920 and 1970, 5,200 square miles in the valley had subsided more than one foot. Land subsidence is a significant problem in the western San Joaquin Valley 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 Tulare Basins. Groundwater production, prior to completion of the California Aqueduct in 1967, caused land subsidence of one foot regionally and up to 29 feet locally. In the years since 1970, the rate of subsidence has declined because surface water was imported to the areas (DWR 1998). Recent increases in subsidence are the result of increased groundwater extraction to compensate for water supply deficiencies caused by drought, Bay-Delta export restrictions, and Central Valley Project Improvement Act (CVPIA).

South San Joaquin Irrigation District (SSJID) Service Area

No Action. Ground subsidence is not a problem within the SSJID service area. Overdrafting in urban areas located within and adjacent to the SSJID service area water levels may cause localized ground subsidence and loss of groundwater storage as groundwater levels decline.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. This action would have no impact on land subsidence within the Basin.

Alternative Action. If water right holders, including SSJID, are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is not known at this time, so the effect on subsidence is potentially significant.

Oakdale Irrigation District (OID) Service Area

No Action. Ground subsidence is not a problem within the OID service area. Overdrafting in urban areas located within and adjacent to the OID service area may cause localized ground subsidence and loss of groundwater storage as groundwater levels decline.

Proposed Action. Maximum annual water deliveries for the instream flows from the OID service area would be 26,000 acre-feet. Of this volume, OID projects that zero to 15,000 acre-feet per year of this water would come from groundwater. However, groundwater levels have been historically high throughout the OID service area, and the groundwater surface is hydraulically connected to the Stanislaus River water surface. The majority of the groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a negative impact to subsidence within OID's service area.

Alternative Action. If water right holders including OID are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is not known at this time, so there could be a potentially significant effect on subsidence.

Modesto Groundwater Basin

No Action. Ground subsidence is not reported to be a significant problem within the MID service area and the Modesto Groundwater Basin.

Proposed Action. MID projects that no water would come from groundwater to achieve the SJRA pulse flow. There would be no impact to subsidence in the Modesto Groundwater Basin.

Alternative Action. MID would not be required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, so the reduction in surface water deliveries would not be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. While an objective determination of the magnitude of impact is not possible, the effect on subsidence is considered a potentially significant impact.

Turlock Groundwater Basin

No Action. Ground subsidence is not reported to be a significant problem in the Turlock Groundwater Basin.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the TID is 11,000 acre-feet (see Table 2.3-1). Of this volume, TID projects that none of this water would come from groundwater. Consequently, this action would have no negative impact on land subsidence within the Basin.

Alternative Action. TID would not be required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not known at this time. The magnitude of impact on ground subsidence cannot be quantified at this time; therefore, the effect on subsidence is considered a potentially significant impact.

Merced Groundwater Basin

No Action. Ground subsidence is not a problem within the Merced Groundwater Basin and the Merced ID service area. The groundwater basin is projected to continue to be overdrafted by approximately 20,000 acre-feet per year as a result of groundwater extraction rates exceeding recharge rates. Given projected usage of groundwater, water levels within the Merced ID Groundwater Basin are projected to continue to decline, which could result in a loss of aquifer storage and local land subsidence.

Proposed Action. Maximum annual surface water diversion for the SJRA flows from the Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater substitution ranges from zero to 67,500 acre-feet. Based on the worst case, if the total amount comes from groundwater, groundwater overdraft in the basin, loss of groundwater storage, and land subsidence could occur and result in potentially significant impacts to the basin.

Alternative Action. Merced ID would not be required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives. However, the SWRCB study assumes groundwater pumping values for Merced ID of 176,000 acre-feet in dry years and 269,000 acre-feet in critical years. As shown on Table 3.1-1, the average annual Merced ID groundwater use is in the range of 25,000 to 30,000 acre-feet, with a maximum historical use of 167,000 acre-feet in 1977. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from other water right holders is not quantified and may be significant. An objective determination of the magnitude of impact on land subsidence is not possible, so the effect is considered a potentially significant impact.

Exchange Contractors Water Authority Service Area

The Exchange Contractors' Water Authority have measured land subsidence annually within their service area from 1957 to 1962. During this period, land subsidence in their service area has ranged

from less than a foot under the San Luis Water District to over four feet near the Mendota Pool. The Exchange Contractors will continue the annual subsidence monitoring within their service area.

No Action. Ground subsidence is a problem with the service area. Overdrafting may cause continued ground subsidence and loss of groundwater storage as groundwater levels decline.

Proposed Action. Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors' service area is 11,000 acre-feet. Of this volume, the amount of water that may come from groundwater ranges from zero to 11,000 acre-feet. The 11,000 acre-feet is approximately 2.2 percent of the Delta Mendota Basin production of 511,000 acre-feet. This additional volume of groundwater would result in a less-than-significant impact to the basin subsidence problems.

Alternative Action. The Exchange Contractors would not be required to curtail diversions in order to achieve the 1995 WQCP Vernalis flow objectives by comparing Alternatives 2 and 3. The reduction in surface water deliveries may be supplemented by pumping groundwater. Their impact to ground subsidence would be no impact. However, the impact from other water right holders and their possible groundwater pumping cannot be quantified and must be considered potentially significant.

4.3.2.5 Agricultural Subsurface Drainage

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 (USBR 1997d).

The area of subsurface drainage problems primarily extends along the western side of the San Joaquin River and Tulare Lake Regions from the Delta on the north to the Tehachapi Mountains south of Bakersfield. In some portions of the San Joaquin River Region, natural drainage conditions are inadequate to remove the quantities of deep percolation that accrue to the water table. Therefore, groundwater levels often encroach on the root zone of agricultural crops, and subsurface drainage must be supplemented by constructed facilities for irrigation to be sustained. Few wells pump from this shallow groundwater zone because of high salinity concentrations.

South San Joaquin Irrigation District (SSJID) Service Area

No Action. Agricultural subsurface drainage is not a significant problem in the San Joaquin Irrigation District service area. Agricultural subsurface drainage or the associated problems with the subsurface drainage may be a problem in isolated areas immediately adjacent to the Stanislaus and San Joaquin Rivers.

Proposed Action. The San Joaquin River Agreement flows would raise water levels temporarily in the San Joaquin River, which has a low potential to cause additional agricultural subsurface drainage. The 31-day pulse flows would not exceed 7,000 cfs (measured at Vernalis) and are not large enough to cause a significant impact on agricultural subsurface drainage within the SSJID service area.

Alternative Action. Additional flows released to implement the Water Right Priority System alternative may raise water levels in the San Joaquin River and have an impact on agricultural subsurface drainage in areas adjacent to the river. Groundwater pumped by SSJID or other water right holders to supplement reduced surface water deliveries may have the reverse effect and locally depress water levels, reducing the potential for agricultural subsurface drainage. Assuming that both processes would occur, the effect is less than significant.

Oakdale Irrigation District (OID) Service Area

No Action. Agricultural subsurface drainage is not a significant problem in the Oakdale Irrigation District service area. Agricultural subsurface drainage or the associated problems with the subsurface drainage may be a problem in isolated areas immediately adjacent to the Stanislaus River.

Proposed Action. The San Joaquin River Agreement flows from OID would result in minor rises in water levels in portions of the Stanislaus River which flows through OID and subsequently would raise water levels temporarily in the San Joaquin River. This potential rise is insignificant and would have a very low potential to cause additional agricultural subsurface drainage. The 31-day pulse and other flows are not large enough to cause an impact on agricultural subsurface drainage within the OID service area.

Alternative Action. Additional flows released to implement the Water Right Priority System alternative may raise water levels in the Stanislaus River and subsequently result in minor rises in water levels in the San Joaquin River. This rise in water levels may have a slight, but temporary, impact on agricultural subsurface drainage in areas adjacent to the rivers. Groundwater pumped by OID or other water right holders to supplement reduced surface water deliveries may have the reverse effect and locally depress water levels, reducing the potential for agricultural subsurface drainage. Assuming that both processes would occur, the effect is less than significant.

Modesto Groundwater Basin

Drainage wells have been employed by MID to control shallow groundwater levels in the western part of the MID service area since 1918 (MID 1996). The drainage wells pump excellent quality groundwater to maintain groundwater levels below the crop root zone. Maintaining the water table below the crop root zone also maintains the salt balance within the root zone.

The area affected by shallow groundwater and quantity of shallow groundwater pumped has declined through the years because of the increased use of groundwater in the Modesto area. The use of many of the drainage wells in areas no longer affected by shallow groundwater has been discontinued or the wells are now used as irrigation wells (MID 1996).

No Action. As reported by MID, agricultural subsurface drainage in the Modesto Groundwater Basin is declining as groundwater extraction has increased in the urban Modesto area. Groundwater usage in the urban Modesto area is projected to expand in response to population growth. Agricultural subsurface drainage should continue to decline in areas that are hydraulically connected to groundwater pumping near Modesto.

Proposed Action. The Spring pulse flow would raise water levels temporarily in the San Joaquin River which has a low potential to cause additional agricultural subsurface drainage. The 31-day pulse flow is not large enough (7,000 cfs or less at Vernalis) to have a significant impact on agricultural subsurface drainage within the MID service area.

Alternative Action. MID would not be required to curtail surface water deliveries. However, other water right holders could be called upon to participate in the Water Right Priority System. This action could raise water levels in the San Joaquin River and have an impact on agricultural subsurface drainage in areas adjacent to the river. The expansion of groundwater pumping in the Modesto urban area should have the reverse effect and locally depress water levels reducing potential for agricultural subsurface drainage. Assuming that both processes would occur, the effect is considered a less-than-significant impact.

Turlock Groundwater Basin

Several areas in the western portion of the Basin experience localized high groundwater levels. The affected area varies from year to year and over the course of an irrigation season as a result of pumping, precipitation, and applied irrigation water. If left uncontrolled, groundwater levels of less than six feet from ground level would not be uncommon, resulting in agricultural subsurface drainage and potentially adverse impacts to local crop production (TID 1997).

To minimize these potentially adverse impacts on crops, TID provides groundwater control or drainage pumping in areas where groundwater levels are within six feet of the ground surface. TID owns and operates approximately 170 drainage wells within their service area. In recent history subsurface drains have also been utilized to control groundwater levels. Water pumped for drainage is typically discharged into the District's canal system where it is utilized, as much as possible, for irrigation (TID 1997).

No Action. TID reports that several areas in the western portion of the Basin experience localized high groundwater levels that are controlled by drainage pumping. Localized areas with the Turlock

Groundwater Basin should continue to experience subsurface drainage in areas where groundwater levels approach the ground surface.

Proposed Action. The pulse flow would raise water levels temporarily in the Tuolumne and San Joaquin Rivers which have a low potential to cause additional agricultural subsurface drainage. The 31-day pulse flow is not large enough to have an impact on agricultural subsurface drainage within the TID service area.

Alternative Action. While TID would not be required to curtail surface water deliveries, other water right holders could be responsible for releasing additional flows to implement the Water Right Priority System, and this action may raise water levels in the San Joaquin River and subsequently have an impact on agricultural subsurface drainage in areas adjacent to the river. Increased groundwater pumping to offset reductions in deliveries would help to depress water levels. Assuming both processes occur, the effect is expected to be less than significant.

Merced Groundwater Basin

The area of the Basin located generally between the cities of Atwater and Livingston, south of State Highway 99 and north of State Highway 140, has experienced localized high groundwater levels (Merced ID 1997). Groundwater levels have varied from year to year and over the course of an irrigation season as a result of pumping, precipitation, and applied irrigation water. If left uncontrolled, groundwater levels of less than six feet below the ground surface would not be uncommon, resulting in potentially adverse impacts to local crop production (Merced ID 1997).

To minimize these potentially adverse impacts, Merced ID provides groundwater control in areas where groundwater levels were within six feet of the ground surface. This condition within Merced ID has declined steadily over the last 10 years. As a result, many of the drainage wells are now used exclusively for irrigation during periods when insufficient surface water is available. Water pumped from these wells is typically discharged in to District's water distribution system where it is utilized, as much as possible, for irrigation (Merced ID 1997).

No Action. Merced ID reports that an area in the northwestern portion of the basin experiences localized high groundwater levels that are controlled by drainage pumping. However, agricultural subsurface drainage in the Merced Groundwater Basin has continually declined over the past ten years. Agricultural subsurface drainage should continue to decline in areas that are overdrafted.

Proposed Action. The SJRA flows would raise water levels in the Merced and San Joaquin Rivers which have the potential to locally increase the occurrence of local agricultural subsurface drainage. The small increase in flows and water levels would have a less-than-significant impact on agricultural subsurface drainage within the Merced ID service area.

Alternative Action. Merced ID would not be required to release water to implement the Water Right Priority System, but other water right holders could be affected. The additional flows could raise water levels in the San Joaquin River and have an impact on agricultural subsurface drainage in areas adjacent to the river. With existing drainage control wells and potential increases in groundwater pumping to offset reductions in surface water deliveries, the overall impact to subsurface drainage would be less than significant.

Exchange Contractors Water Authority Service Area

No Action. Approximately ten percent of the Exchange Contractors Water Authority service area experiences some subsurface drainage problems. To minimize these potentially adverse impacts, the Exchange Contractors maintain a system of groundwater control wells in areas where groundwater levels may rise to within six feet of the ground surface (SJRECWA 1997).

Proposed Action. The addition of up to 11,000 acre-feet to the San Joaquin River at a rate of 7,000 cfs or less at Vernalis would not raise water levels significantly. The 31-day pulse flow period would not have an impact on agricultural subsurface drainage within the Exchange Contractors service area.

Alternative Action. Additional flows released to implement the Water Right Priority System may raise water levels in the San Joaquin River and could be large enough to have an impact on agricultural subsurface drainage in areas adjacent to the river. With problems occurring in very limited areas and existing groundwater control wells, the impact would be less than significant.

4.3.3 Impact Summary and Mitigation of Impacts

4.3.3.1 Groundwater Overdrafting

Proposed Action

- Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. There would be no increase in overdrafting within the SSJID service area as a result of this action. No mitigation is necessary.

- Maximum annual water diversion for instream flows event from the OID service area is 26,000 acre-feet. Of this volume, OID projects that zero to 15,000 acre-feet of this water may come from groundwater. The additional groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a significant negative impact to the overdraft problem within OID's service area. No mitigation is necessary.

- Maximum annual surface water diversion for the pulse flow event from MID is 11,000 acre-feet. MID projects that none of this water would come from groundwater. There would be no additional overdrafting within the Modesto Groundwater Basin as a result of this action. No mitigation is necessary.

- Maximum annual surface water diversion for the pulse flow event from TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater. There would be no impacts to the overdraft problem, because no additional groundwater would be pumped either directly or indirectly to accommodate the pulse flow.

- The maximum annual surface water diversion for the flows from the Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater to substitute for reduced surface water deliveries ranges from zero to 67,500 acre-feet. For the worst case, this represents approximately 12 percent of the typical annual groundwater production rate of 555,000 acre-feet per year from the Merced Groundwater Basin (DWR 1998). This could result in a significant impact to the groundwater basin. Mitigation could include implementing a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, or supplementing groundwater with treated water to replace groundwater.

- Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet. Of this volume, the Exchange Contractors project that the amount of this water that may come from groundwater ranges from zero to 11,000 acre-feet. For the worst case, this represents approximately 2.2 percent of the Delta Mendota Basin production rate of 511,000 acre-feet per year. This amount would result in a less-than-significant impact to the basinwide overdraft problem. No mitigation is necessary.

Alternative Action

- If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is approximately 62,000 acre-feet for the San Joaquin River Basin. While an objective determination of the magnitude of impact for service areas or sub-basins is not possible, the effect is considered a potentially significant impact. Mitigation measures which could be implemented include instituting a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping in highly overdrafted areas, importing water to

supplement the loss of groundwater, or supplementing groundwater with treated water to replace groundwater. Mitigation would reduce the impacts to less than significant.

4.3.3.2 Water Levels

Proposed Action

- Maximum annual surface water diversion for the pulse flow event from the SSJID service area is 11,000 acre-feet. Of this volume, SSJID projects that none of this water would come from groundwater. This action would have no impact on water levels within the service area. No mitigation is necessary.

- Maximum annual water diversion for instream flows from the OID service area is 26,000 acre-feet. Of this volume, OID projects that zero to 15,000 acre-feet per year may come from groundwater. The additional groundwater pumped from the service area should be recharged by inflow from the Stanislaus River. Extracting an additional 15,000 acre-feet per year of groundwater should not result in a negative impact to the water levels within OID's service area as a result of this action. No mitigation is necessary.

- Maximum annual surface water diversion for the pulse flow event from MID is 11,000 acre-feet. MID projects that none of this water would come from groundwater. This action would result in no impact to the water levels in Modesto Groundwater Basin. No mitigation is necessary.

- Maximum annual surface water diversion for the pulse flow event from TID is 11,000 acre-feet. Of this volume, TID projects that none of this water would come from groundwater. This action would have no impact on water levels within the Turlock Groundwater Basin. No mitigation is necessary.

- The maximum annual surface water diversion for the flow events from Merced ID is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater ranges from zero to 67,500 acre-feet. For the worst case, this represents approximately 12 percent of the typical annual groundwater production rate of 555,000 acre-feet per year from the basin (DWR 1998). This could result in a significant impact to water levels within the groundwater basin. Mitigation includes implementing groundwater management programs to reduce pumpage or increase recharge. Measures could include a proposed conjunctive groundwater use program, programs to improve conservation of surface water, restrictions or limitations to groundwater pumping in highly overdrafted areas, importation of water to supplement the loss of groundwater, or supplementation of groundwater with treated water.

- Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre-feet. Of this volume, the amount that may come from groundwater ranges from zero to 11,000 acre-feet. This represents approximately 2 percent of the typical annual groundwater production rate of 511,000 acre-feet per year in the Delta Mendota Basin, a less-than-significant impact to groundwater levels within the Exchange Contractors service area. No mitigation is required.

Alternative Action

- If water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is approximately 62,000 acre-feet for the entire San Joaquin River Basin. Therefore, while an objective determination of the magnitude of impact for service areas or sub-basins is not possible, the effect is considered a potentially significant impact. Mitigation measures which could be implemented include instituting a conjunctive groundwater use program, implementing programs to improve conservation of surface water, restricting or limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, or supplementing groundwater with treated water.

4.3.3.3 Water Quality

Proposed Action

- SSJID projects that no groundwater would be pumped to provide water for achieving the VAMP pulse flow. This action would have no impact on groundwater water quality within the SSJID service area. No mitigation is required.

- OID projects that a maximum annual water diversion for the instream flows from their service area is 26,000 acre-feet. Of this volume, OID projects that the amount of this water that may come directly from groundwater ranges from zero to 15,000 acre-feet. This increase in groundwater extraction is projected to be balanced by additional inflow into the OID service area. There should be no impact to water quality as a result of this action. No mitigation is necessary.

- No groundwater would be pumped by MID from the Modesto Groundwater Basin, so there would be no impact to groundwater quality within the basin. No mitigation is required.

- TID projects that no groundwater would be pumped to provide water for achieving the SJRA pulse flow. This action would have no impact on water quality within the Turlock Groundwater Basin. No mitigation is required.

- The Merced ID projects that a maximum annual surface water diversion for the SJRA flows is 67,500 acre-feet. Of this volume, Merced ID projects that the amount of this water that may come indirectly from groundwater ranges from zero to 67,500 acre-feet. Based on the worst case, if the total amount comes from groundwater(to replace surface water reductions), this may increase TDS slightly and could result in a less-than-significant impact to groundwater quality. No mitigation is required.

- The Exchange Contractors project that the maximum annual surface water diversion for the pulse flow event from the service area is 11,000 acre feet. Of this volume, the amount of water that may come from groundwater ranges from zero to 11,000 acre feet. DWR does not provide an estimate of the typical groundwater production rates in the service area. However, they provide an estimate for the Delta Mendota Basin which includes the Exchange Contractor's service area. The DWR estimated groundwater production rate for the Delta Mendota Basin is 511,000 acre feet per year (DWR 1998). Based on the worst case, if the total amount comes from groundwater storage, this could amount to approximately two percent of the total groundwater pumped from the basin. The impact on groundwater quality in the service area is less than significant. No mitigation is required.

Alternative Action

- If individual members of the San Joaquin River Authority and other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries is approximately 62,000 acre-feet for the entire San Joaquin River Basin. Therefore, while an objective determination of the magnitude of impact for service areas or sub-basins is not possible, the effect is considered a potentially significant impact on groundwater quality. Mitigation measures could include limiting or restricting groundwater pumping in affected areas to improve groundwater quality, implementing a conjunctive use program, and implementing programs to improve conservation of surface water supplies to lessen future demands for groundwater.

4.3.3.4 Subsidence

Proposed Action

- SSJID projects that no water would come from groundwater for achieving the SJRA pulse flow. This action would have no impact on land subsidence within their service area. No mitigation is necessary.

- OID projects that the amount of water that may come from groundwater to achieve the instream flows ranges from zero to 15,000 acre-feet per year. However, groundwater levels have been historically high throughout the OID service area, and the groundwater surface is hydraulically connected to the Stanislaus River water surface. The majority of the groundwater pumped from the service area would be recharged by inflow from the Stanislaus River. These actions should not result in a negative impact to subsidence within OID's service area. No mitigation measures are required.

- MID projects that no groundwater would be pumped to achieve the SJRA pulse flow. There would be no impact on subsidence in the Modesto Groundwater Basin. No mitigation is required.

- TID projects that no water would come from groundwater for achieving the SJRA pulse flow. This action would have no impact on land subsidence within the Turlock Groundwater Basin. No mitigation is required.

- The maximum annual surface water diversion for the SJRA flows from Merced ID is 67,500 acre-feet. Merced ID projects that the amount of water that may come indirectly from groundwater to substitute for reduced surface water deliveries ranges from zero to 67,500 acre-feet per year. Based on the worst case, if the total amount comes from groundwater storage, groundwater overdraft in the basin, loss of groundwater storage, and land subsidence could occur which are potentially significant impacts to the Merced Groundwater Basin. Mitigation measures include limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, and developing new or expanding existing groundwater recharge areas in areas with high recharge potential.

- Maximum annual surface water diversion for the pulse flow event from the Exchange Contractors service area is 11,000 acre feet. Of this volume, the amount of this water that may come from groundwater ranges from zero to 11,000 acre feet. Based on the worst case, if the total amount comes from groundwater storage, this could amount to approximately two percent of the total groundwater pumped from the area. This is a less-than-significant impact on subsidence in the service area. No mitigation is required.

Alternative Action

- If individual members of the San Joaquin River Authority and other water right holders are required to curtail portions of their diversions in order to achieve the 1995 WQCP Vernalis flow objectives, the reduction in surface water deliveries may be supplemented by pumping groundwater. The volume of groundwater that may have to be pumped to supplement reduced surface water deliveries from all of these districts is approximately 62,000 acre-feet for the entire San Joaquin River Basin. Therefore, an objective determination of the magnitude of impact on land subsidence for each service area or sub-basin is not possible; the effect is considered a potentially significant impact. Mitigation measures include limiting groundwater pumping in highly overdrafted areas, importing water to supplement the loss of groundwater, and developing new or expanding existing groundwater recharge areas in areas with high recharge potential.

4.3.3.5 Agricultural Subsurface Drainage

Proposed Action

- The pulse flow may temporarily raise water levels within the San Joaquin River and its tributaries as it flows along the boundaries of the San Joaquin River Group Authority willing sellers' service areas. However, the 31-day pulse flow period and other identified flows would have no impact on agricultural subsurface drainage within the willing sellers' service areas. No mitigation is required.

Alternative Action

- The action would raise water levels in the San Joaquin River and affect agricultural subsurface drainage in areas adjacent to the river. Groundwater pumped to replace reductions in surface water deliveries would have a reverse effect and locally depress water levels. Assuming that both processes would occur, the effect is less than significant. No mitigation is required.