SECTIONTEN

ENERGY RESOURCES

This section describes the effects of the construction and operation of each alternative on energy consumption within the project area.

10.1 AFFECTED ENVIRONMENT

The electrical energy resources utilized within the study area are delivered through the electrical transmission and distribution system operated by Pacific Gas and Electric Company (PG&E). However, the ultimate source of electrical power generation within the California energy market can be from a mix of generating assets, including hydroelectric, nuclear, and coal-fired power generation, which are owned and operated by either PG&E or some other power-generating entity. Consistent with rulings by the California Public Utilities Commission to restrict direct access, purchased power would probably be provided by PG&E.

In the current situation, the location and size of the specific energy demand, and the subsequent effect on the energy resources, vary from small, widely dispersed loads associated with multiple private consumers, to relatively large, concentrated loads associated with publicly owned pumping and water treatment facilities. It is anticipated that the future energy requirements will be relatively constant on a daily, weekly, and seasonal basis. A constant energy demand is the most easily accommodated demand profile for an electrical power generator since it is predictable. Although the new demand would increase the overall capacity requirements for the region, it would be a base-load demand that is typically fulfilled using the most efficient power generating options available within the system.

10.2 ENVIRONMENTAL CONSEQUENCES

This section describes how the construction and operation of the drainage disposal alternatives would change the existing electric power consumption patterns within the project area.

This analysis is based on reasonably expected outcomes from the implementation of each drainage disposal or action alternative. Each of the action alternatives would increase energy consumption within the project area due to construction and operation of the associated plants and equipment. Energy requirements for the construction of the alternatives would be temporary, lasting only for the duration of the construction period. However, power consumption due to the operation of each action alternative would result in a permanent, incremental increase in energy requirements.

10.2.1 Evaluation Criteria

The key issues are the energy requirements for construction and operation of the drainage disposal alternatives and how these requirements might affect local and regional energy supplies. One measure of the significance of the energy effects can be determined by comparing the size of the incremental energy utilization associated with the action alternatives to the existing local energy utilization. Another measure of the significance of the energy effects would be the extent of energy delivery infrastructure upgrades or additions that might be required to accommodate the action alternative.

10.2.2 No Action Alternative

Under No Action, farmers would pursue individual actions related to local drainage control and reuse and cropping patterns. Energy would be required for small sump pumps used to locally convey drainwater. The pumps would be located throughout the drainage study area in a dispersed manner. The evaluated drainwater reduction options are expected to result in a negligible incremental increase in local electrical energy utilization and would, therefore, have a minimal effect on the existing energy requirements.

The overall energy requirements for the limited irrigation system improvements and for ongoing drainwater reduction measures would be expected to increase within the drainage study area over time due to the general growth of the irrigation improvements program. However, because of the disbursed nature of the loads and the relatively small size of the pumps, this incremental change would be expected to have a minimal effect on the electrical power supplies in the region (i.e., project area). This minor energy demand growth could be supplied by a number of power suppliers including PG&E and the alternative generators.

10.2.3 In-Valley Disposal Alternative

The In-Valley Disposal Alternative is expected to include key components for collection, treatment, and conveyance of drainwater. Electrical energy would be required for the pumps to collect and convey the drainwater, for the chemical and biological reactors and process equipment used in the RO/Se treatment facilities, and for pumps and other equipment at evaporation basins and mitigation wetlands.

The energy requirements during the construction phase of the In-Valley Disposal Alternative would be associated with the fuel requirements of mobile construction equipment and electrical energy required for construction lighting, welders, pumps, etc. The mobile construction equipment would include diesel-powered earthmoving and lifting machinery. Fuel utilization during construction can be expected to be up to 11,000 gallons per month. This monthly consumption rate is about equal to the amount of gas a typical suburban gas station sells in 2 or 3 days. The fuel would be supplied from local, commercially available sources that typically provide fuel for the transportation and construction industries. The electrical energy requirements during construction could be up to 400,000 kWh per month. For comparative purposes, according to the US Department of Energy, a typical office building uses over 1.5 kWh of electricity every month per square foot of floor space. The energy requirements associated with construction activities would be temporary and are not expected to exert a significant strain on the regional supply of energy.

The In-Valley Disposal Alternative is expected to have four regional reuse facilities, four RO/Se treatment facilities, four evaporation basins, and mitigation wetland facilities within the drainage study area. Energy requirements during the operating phase are expected to be primarily electrical and would be associated with conveyance pumping, process equipment and reactors in the RO/Se treatment facilities, evaporation basins, and a seasonal habitat manipulation within the mitigation complexes where pumping might be required to fill or drain wetland cells. The total estimated electrical demand of 25,793,000 kWh/year is shown in Section 2.5. Table 2.5-1 provides a breakdown of the energy requirements for each major component of this alternative. This energy requirement is expected to be relatively constant and would increase the overall base-load power consumption within the drainage study area. It is estimated that the incremental load associated with the In-Valley Disposal Alternative would represent less than 0.5 percent of the total load associated with the closest electrical substation. Although the overall incremental change in energy requirements from the operation of the In-Valley Disposal Alternative is not expected to have a substantial effect on the power supplies in the region, the added demand would be measurable, and electrical distribution infrastructure modifications may be required. It is not anticipated that any modifications would be significant. In addition, critical process equipment is expected to have an emergency standby source of power, such as a diesel generator or a diesel drive motor.

10.2.4 In-Valley/Groundwater Quality Land Retirement Alternative

The In-Valley/Groundwater Quality Land Retirement Alternative is expected to include all of the key components for collection, treatment, and conveyance of drainwater that were included in the In-Valley Disposal Alternative. Electrical energy would be required for the pumps to collect and convey the drainwater, for the biological and chemical reactors and process equipment used in the RO/Se treatment facilities, and for pumps and other equipment at evaporation basins and mitigation wetlands; however, the conveyance, process treatment, and disposal flowrates would be slightly lower.

The energy requirements during the construction phase of the would be very similar to the In-Valley Disposal Alternative, since the total length of the conveyance pipeline would be approximately the same, even if the size of the pipe might be slightly smaller. As such, the fuel requirements of mobile construction equipment can be expected to be up to 11,000 gallons per month, approximately the amount consumed at a typical suburban gas station in a 2- or 3-day period, and would be supplied from local, commercially available sources that typically provide fuel for the transportation and construction industries. The electrical energy required for construction lighting, welders, pumps, etc., could be up to 400,000 kWh per month. The energy requirements associated with construction of the In-Valley/Groundwater Quality Land Retirement Alternative would be temporary and would not be expected to exert a significant strain on the regional supply of energy.

Similar to the In-Valley Disposal Alternative, the In-Valley/Groundwater Quality Land Retirement Alternative is expected to have four regional reuse facilities, four RO/Se treatment facilities, four evaporation basins, and mitigation wetland facilities within the drainage study area. Energy requirements during the operating phase are expected to be primarily electrical and would be associated with conveyance pumping, process equipment and reactors in the RO/Se treatment facilities, evaporation basins, and a seasonal habitat manipulation within the mitigation complexes where pumping might be required to fill or drain wetland cells. The total estimated electrical demand would be slightly less than that of the In-Valley Disposal Alternative, since the conveyed and processed flowrates are slightly smaller. This energy requirement is expected to be relatively constant and would increase the overall base-load power consumption within the drainage study area. Although the overall incremental change in energy requirements from the operation of the In-Valley/Groundwater Quality Land Retirement Alternative would not be expected to have a substantial effect on the power supplies in the region, the added demand would be measurable, and electrical distribution infrastructure modifications may be required. It is not anticipated that any modifications would be significant. In addition, critical process equipment would be expected to have an emergency standby source of power, such as a diesel generator or a diesel drive motor.

10.2.5 In-Valley/Water Needs Land Retirement Alternative

The In-Valley/Water Needs Land Retirement Alternative is also expected to include all of the key components for collection, treatment, and conveyance of drainwater that were included in the In-Valley Disposal Alternative. Electrical energy would be required for the pumps to collect and convey the drainwater, for the biological and chemical reactors and process equipment used in the RO/Se treatment facilities, and for pumps and other equipment at evaporation basins and mitigation wetlands; however, the conveyance, process treatment and disposal flowrates would be even lower than the In-Valley/Groundwater Quality Land Retirement Alternative.

The energy requirements during the construction phase of the In-Valley/Water Needs Land Retirement Alternative would also be similar to the In-Valley Disposal Alternative and the In-Valley/Groundwater Quality Land Retirement Alternative, since the total length of the conveyance pipeline for all three alternatives would approximately be the same. As such, the fuel requirements of mobile construction equipment and the electrical energy required for construction can be expected to be nearly the same. The energy requirements associated with construction of the In-Valley/Water Needs Land Retirement Alternative would be temporary and would not be expected to exert a significant strain on the regional supply of energy.

The In-Valley/Water Needs Land Retirement Alternative is also expected to have regional reuse facilities, RO/Se biotreatment facilities, evaporation basins, and mitigation wetland facilities within the drainage study area. Energy requirements during the operating phase would be primarily electrical and would be associated with conveyance pumping, process equipment and reactors in the RO/Se treatment facilities, evaporation basins, and a seasonal habitat manipulation within the mitigation complexes. The total estimated electrical demand would be measurably less than that of the In-Valley Disposal Alternative since the conveyed and processed flowrates are about two-thirds of the In-Valley Disposal Alternative flowrate. This energy requirement is expected to be relatively constant and would increase the overall base-load power consumption within the study area. Although the overall incremental change in energy requirements from the operation of the In-Valley/Water Needs Land Retirement Alternative would not be expected to have a substantial effect on the power supplies in the region, the added demand would be measurable, and electrical distribution infrastructure modifications may be required. It is not anticipated that any modifications would be significant. In addition, critical process equipment would be expected to have an emergency standby source of power, such as a diesel generator or a diesel drive motor.

10.2.6 In-Valley/Drainage-Impaired Area Land Retirement Alternative

The In-Valley/Drainage-Impaired Area Land Retirement Alternative is also expected to include all of the key components for collection, treatment, and conveyance of drainwater that were included in the other In-Valley Disposal Alternatives; however, the total conveyed and processed flowrates would be significantly lower, and the conveyance distance would be materially shorter.

The energy requirements during the construction phase of the In-Valley/Drainage-Impaired Area Land Retirement Alternative would be measurably lower than the other In-Valley Disposal Alternatives, since the total length of the conveyance pipeline for this alternative is one-seventieth the length of the other three alternatives. As such, the fuel requirements of mobile construction equipment associated with the conveyance system would be proportionally smaller and would not be expected to exert a significant strain on the regional supply of energy.

The In-Valley/Drainage-Impaired Area Land Retirement Alternative is also expected to have regional reuse, RO/Se treatment, and evaporation and mitigation wetland facilities but only within the Northerly Area. Energy requirements during the operating phase would be primarily electrical and would be associated with conveyance pumping, process equipment and reactors in the RO/Se treatment facility, evaporation basin, and a seasonal habitat manipulation within the mitigation complexes. The total estimated electrical demand would be measurably less than that of the other In-Valley Alternatives, since the conveyed and processed flowrates are smaller and the conveyance distances are significantly shorter. This energy requirement is expected to be relatively constant and would increase the overall base-load power consumption within the study area. Although the overall incremental change in energy requirements from the operation of the In-Valley/Drainage-Impaired Area Land Retirement Alternative would not be expected to have a substantial effect on the power supplies in the region, the added demand would be measurable, and electrical distribution infrastructure modifications may be required. It is not anticipated that any modifications would be significant. In addition, critical process equipment would be expected to have an emergency standby source of power, such as a diesel generator or a diesel drive motor.

10.2.7 Ocean Disposal Alternative

In addition to the common elements of a closed collection system and reuse facilities, the Ocean Disposal Alternative would include an aqueduct (211 miles of buried pipe and three tunnels) that traverses mountains and would require piping and pumping systems for successful operation. The energy requirements during the construction phase of this alternative would be associated primarily with the fuel requirements of mobile construction equipment and electrical energy required for construction lighting, welders, pumps, etc. The mobile construction equipment would include diesel powered earthmoving, tunneling, and lifting types of machinery. Fuel utilization during construction can be expected to be up to 75,000 gallons per month. This monthly consumption rate is about equal to the amount of gas a typical suburban gas station sells every 2-1/2 weeks. The fuel would be supplied from local, commercially available sources that typically provide fuel for the transportation and construction industries. The electrical energy requirements during construction could be up to 440,000 kWh per month. As noted previously, a typical office building uses over 1.5 kWh of electricity every month per foot of floor space. The energy requirements associated with construction activities would be temporary and are not expected to exert a significant strain on the regional supply of energy.

The Ocean Disposal Alternative is expected to have four regional water reuse facilities, and associated pumping stations, to reduce drainage flow within the drainage study area and six additional pumping stations located at multiple points along the conveyance route to the Pacific Ocean. Energy required during the operating period of the project is expected to be primarily electrical and would be associated with pumps used to convey drainwater through the collection system, aqueduct, pipes, and tunnels. The estimated incremental energy requirement for the Ocean Disposal Alternative is 81,400,000 kWh/year as shown in Section 2.6. Table 2.6-1 provides a breakdown of the energy requirements for each major energy-consuming process associated with this alternative. This energy requirement is expected to increase the overall base-load power consumption within the project area. However, it is estimated that the incremental load associated with the Ocean Disposal Alternative would represent less than 0.25 percent of the total load associated with the closest electrical substation. Although the overall incremental change in energy requirements from the operation of the Ocean Disposal Alternative is not expected to have a substantial effect on the power supplies in the region, the added demand would be measurable, and electrical distribution infrastructure modifications may be required. It is not anticipated that any modifications would be significant. In addition, critical process equipment is expected to have an emergency standby source of power, such as a diesel generator or a diesel drive motor.

10.2.8 Delta Disposal Alternatives

The key components of the Delta Disposal Alternatives would include collection, reuse, treatment, and conveyance of drainwater. Energy would be required for the pumps to collect and convey the drainwater, and for the biological and chemical reactors and process equipment used in the Se treatment facilities.

Similar to the In-Valley and Ocean Disposal Alternatives, the energy requirements during the construction phase of the Delta Disposal Alternatives would be associated primarily with the fuel requirements of mobile construction equipment and electrical energy required for construction lighting, welders, pumps, etc. The mobile construction equipment would include diesel-powered earthmoving and lifting machinery. Fuel utilization during construction can be expected to be up to 55,000 gallons per month. This monthly consumption rate is about equal to the amount of gas a typical suburban gas station sells every 2 weeks. The fuel would be supplied from local, commercially available sources that typically provide fuel for the transportation and construction industries. The electrical energy requirements during construction could be up to 650,000 kWh per month. As noted previously, a typical office building uses over 1.5 kWh of electricity every month per foot of floor space. The energy requirements associated with construction activities would be temporary, scattered along the pipeline route, and are not expected to exert a significant strain on the regional supply of energy.

Each Delta Disposal Alternative is expected to have four regional reuse facilities and one RO treatment facility within the drainage study area. In addition, each Delta Disposal Alternative has two pumping stations located outside the drainage study area. Energy required during the operating period of the project is expected to be primarily electrical and is primarily associated with pumps and process equipment. The energy loads would be concentrated at these reuse and treatment sites and pumping stations. The estimated incremental energy requirements for the Delta-Chipps Island and Delta-Carquinez Strait Disposal Alternatives are shown in Sections 2.7 and 2.8, Tables 2.7-1 and 2.8-1. This energy requirement of 15,000,000 kWh/year would be expected to be relatively constant and would increase the overall base-load power consumption within the study area and the vicinity of the pump stations. However, it is estimated that the incremental load associated with the Delta Disposal Alternatives would represent less than 0.2 percent of the total load associated with the closest electrical substation. Although the overall incremental change in energy requirements from the operation of either of the Delta Disposal Alternatives is not expected to have a substantial effect on the power supplies in the region, the added demand is expected to be measurable, and electrical distribution infrastructure modifications may be required. It is not anticipated that any modifications would be significant. In addition, critical process equipment is expected to have an emergency standby source of power, such as a diesel generator or a diesel drive motor.

10.2.9 Cumulative Effects

Cumulative effects are those that result from the incremental effects of an action added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. The increase in demand for power associated with the drainage disposal alternatives would occur in a larger region that is experiencing municipal and industrial growth. The incremental increase of energy use associated with operation of the alternatives would not result in significant cumulative adverse effects when compared with other anticipated growth in energy demand within the San Joaquin Valley.

10.2.10 Environmental Effects Summary

10.2.10.1 No Action Alternative

The No Action Alternative would include multiple, relatively small sump pumps dispersed throughout the drainage study area and is expected to have a minimal effect on energy resources within the project area.

10.2.10.2 In-Valley Disposal Alternative

Compared to both the No Action Alternative and 2001 existing conditions, the In-Valley Disposal Alternative would have higher incremental energy requirements associated with both construction activities and operating period activities. However, the incremental load would be relatively small and is not expected to require significant modifications to the existing electrical transmission infrastructure. Therefore, the In-Valley Disposal Alternative would have a minimal effect on energy resources within the drainage study area.

10.2.10.3 In-Valley/Groundwater Quality Land Retirement Alternative

Since the In-Valley/Groundwater Quality Land Retirement Alternative and the In-Valley Disposal Alternative are relatively similar with regards to energy effects, when compared to both the No Action Alternative and 2001 existing conditions, the In-Valley/Groundwater Quality Land Retirement Alternative would have higher incremental energy requirements associated with both construction activities and operating period activities. However, the incremental load would be relatively small and is not expected to require significant modifications to the existing electrical transmission infrastructure. Therefore, the In-Valley/Groundwater Quality Land Retirement Alternative would have a minimal effect on energy resources within the drainage study area.

10.2.10.4 In-Valley/Water Needs Land Retirement Alternative

Similar to the In-Valley Disposal Alternative and the In-Valley/Groundwater Quality Land Retirement Alternative, when compared to the energy effects of No Action Alternative and 2001 existing conditions, the In-Valley/Water Needs Land Retirement Alternative would have higher incremental energy requirements associated with both construction activities and operating period activities. However, the incremental load would be relatively small and is not expected to require significant modifications to the existing electrical transmission infrastructure. Therefore, the In-Valley/Water Needs Land Retirement Alternative would have a minimal effect on energy resources within the drainage study area.

10.2.10.5 In-Valley/Drainage-Impaired Area Land Retirement Alternative

Although the In-Valley/Drainage-Impaired Area Land Retirement Alternative has materially lower energy effects than the other In-Valley Disposal Alternatives when compared to the energy effects of the No Action Alternative and 2001 existing conditions, the In-Valley/Drainage-Impaired Area Land Retirement Alternative would have higher incremental energy requirements associated with both construction activities and operating period activities. However, the incremental load would be relatively small and is not expected to require significant modifications to the existing electrical transmission infrastructure. Therefore, the In-Valley/Water Needs Land Retirement Alternative would have a minimal effect on energy resources within the drainage study area.

10.2.10.6 Ocean Disposal Alternative

Compared to both the No Action Alternative and 2001 existing conditions, the Ocean Disposal Alternative would have higher incremental energy requirements associated with both construction activities and operating period activities. However, the incremental load would be relatively small and is not expected to require significant modifications to the existing electrical transmission infrastructure. Therefore, the Ocean Disposal Alternative would have a minimal effect on energy resources within the project area.

10.2.10.7 Delta Disposal Alternatives

Compared to both the No Action Alternative and 2001 existing conditions, the Delta Disposal Alternatives would have higher incremental energy requirements associated with both construction activities and operating period activities. However, the incremental load would be relatively small and is not expected to require significant modifications to the existing electrical transmission infrastructure. Therefore, the Delta Disposal Alternatives would have a minimal effect on energy resources within the project area.

Tables 10-1 through 10-8 summarize the effects that the No Action Alternative and the action alternatives have on energy resources.

Table 10-1
Summary Comparison of Effects of
No Action Alternative

Affected Resource and Area of Potential Effect	No Action Alternative Compared to Existing Condition
Energy Use	Use of multiple small pumps throughout area. Minimal effect.
Transmission Infrastructure	No effect.

Table 10-2
Summary Comparison of Effects of
In-Valley Disposal Alternative

Affected Resource and Area of Potential Effect	In-Valley Disposal Compared to No Action	In-Valley Disposal Compared to Existing Condition
Energy Use	Higher incremental energy requirement (25.793 GWh/yr). No significant effect.	Higher incremental energy requirement (25.793 GWh/yr). Minimal effect.
Transmission Infrastructure	Less than 0.5 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.5 percent increase in incremental load of nearest substation. Minimal effect.

Table 10-3
Summary Comparison of Effects of
In-Valley/Groundwater Quality Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Groundwater Quality Land Retirement Compared to No Action	In-Valley/Groundwater Quality Land Retirement Compared to Existing Condition
Energy Use	Higher incremental energy requirement (22.05 GWh/yr). No significant effect	Higher incremental energy requirement (22.05 GWh/yr). Minimal effect.
Transmission Infrastructure	Less than 0.5 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.5 percent increase in incremental load of nearest substation. Minimal effect.

Table 10-4
Summary Comparison of Effects of
In-Valley/Water Needs Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Water Needs Land Retirement Compared to No Action	In-Valley/Water Needs Land Retirement Compared to Existing Condition
Energy Use	Higher incremental energy requirement (15.55 GWh/yr). No significant effect	Higher incremental energy requirement (15.55 GWh/yr). Minimal effect.
Transmission Infrastructure	Less than 0.5 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.5 percent increase in incremental load of nearest substation. Minimal effect.

Table 10-5
Summary Comparison of Effects of
In-Valley/Drainage-Impaired Area Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Drainage-Impaired Area Land Retirement Compared to No Action	In-Valley/Drainage-Impaired Area Land Retirement Compared to Existing Condition
Energy Use	Higher incremental energy requirement (9.307 GWh/yr). No significant effect	Higher incremental energy requirement (9.307 GWh/yr). Minimal effect.
Transmission Infrastructure	Less than 0.5 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.5 percent increase in incremental load of nearest substation. Minimal effect.

Table 10-6
Summary Comparison of Effects of
Ocean Disposal Alternative

Affected Resource and Area of Potential Effect	Ocean Disposal Compared to No Action	Ocean Disposal Compared to Existing Condition
Energy Use	Higher incremental energy requirement (81.4 GWh/yr). No significant effect.	Higher incremental energy requirement (81.4 GWh/yr). Minimal effect.
Transmission Infrastructure	Less than 0.25 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.25 percent increase in incremental load of nearest substation. Minimal effect.

Table 10-7
Summary Comparison of Effects of
Delta-Chipps Island Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Chipps Island Disposal Compared to No Action	Delta-Chipps Island Disposal Compared to Existing Condition
Energy Use	Higher incremental energy requirement (15.0 GWh/yr). No significant effect.	Higher incremental energy requirement (15.0 GWh/yr). Minimal effect.
Transmission Infrastructure	Less than 0.2 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.2 percent increase in incremental load of nearest substation. Minimal effect.

Table 10-8
Summary Comparison of Effects of
Delta-Carquinez Strait Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Carquinez Strait Disposal Compared to No Action	Delta-Carquinez Strait Disposal Compared to Existing Condition
Energy Use	Higher incremental energy requirement (15.0 GWh/yr). No significant effect.	Higher incremental energy requirement (15.0GWh/yr). Minimal effect.
Transmission Infrastructure	Less than 0.2 percent increase in incremental load of nearest substation. No significant effect.	Less than 0.2 percent increase in incremental load of nearest substation. Minimal effect.

10.2.11 Mitigation Recommendations

None of the seven action alternatives are expected to have a significant effect on energy resources. However, the use of energy efficient motors and the selection and design of energy efficient process equipment would help reduce the incremental energy requirements even further.

SECTIONELEVEN

AIR RESOURCES

This section briefly describes the air quality setting for the SLDFR project area and identifies environmental effects of the alternatives.

11.1 AFFECTED ENVIRONMENT

11.1.1 Climate and Weather

The primary factors affecting local air quality are the locations of air pollutant sources and the amounts of pollutants emitted. However, meteorological and topographical conditions are also important. Atmospheric conditions such as wind speed, wind direction, and air temperature gradients interact with the physical features of the landscape to determine the movement and dispersal of air pollutants.

As discussed in Section 2, the drainage study area is located in the western San Joaquin Valley and consists primarily of the lands lying within the boundary of the Central Valley Project's San Luis Unit. Climatologically, the summer weather pattern for this area is dominated by a semipermanent, subtropical high pressure area that covers the eastern Pacific and the majority of California. The rainfall in the study area averages 6 to 8 inches, with 90 percent of the amount falling between November and April.

11.1.2 Existing Air Quality

As noted above, topography and climate are intimately related to regional air pollution. The long and narrow San Joaquin Valley provides almost no escape for pollution. The valley setting, coupled with high temperatures and inversions that create additional natural barriers to pollution dispersion, causes the San Joaquin Valley to face a difficult battle in meeting State and Federal air quality standards. Additionally, rapid population growth, two major interstate highways, diverse urban and rural sources, geography, and climate also have a negative effect on the regional air quality. Despite these many challenges emission levels have been decreasing over the past 15 years with the exception of particulate matter less than 10 microns in diameter (PM_{10}) emissions. Based on information presented in California Air Resources Board's *2002 California Almanac of Emissions and Air Quality* (available at http:/www.arb.ca.gov/aqd/aqd.htm), it appears that the downward trend in emission levels is expected to continue. These decreases are predominately due to motor vehicle controls and reductions in evaporative and fugitive emissions.

The conveyance routes of the Delta and Ocean alternatives traverse a number of air quality management districts. The air quality attainment status of the air districts for each of the alternatives is discussed below.

11.1.3 Current Sources of Air Pollution

The air quality in the San Joaquin Valley is not dominated by emissions from one large urban area. Instead, a number of moderately sized urban areas are located throughout the valley. On-road vehicles are the largest contributor to carbon monoxide emissions, as well as a large contributor to nitrogen oxide. A large portion of the stationary source reactive organic carbon gas emissions is fugitive emissions from oil and gas production operations. PM_{10} emissions primarily result from paved and unpaved roads, agricultural operations, and waste burning.

11.1.4 Regulatory Environment

11.1.4.1 Standards

Both the State and Federal governments have established health-based Ambient Air Quality Standards for the following six air pollutants: ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead. The State of California has also established standards for hydrogen sulfide, sulfates, and visibility-reducing particles. These standards were established to assure an adequate margin of safety to protect the public health.

The California Ambient Air Quality Standards and the National Ambient Air Quality Standards, as well as the associated health effects, are listed in Table 11-1.

11.1.4.2 Attainment Status

The project area contains and the various alternatives affect three air quality districts. As such the attainment status of the affected areas varies. Table 11-2 provides the ozone and PM_{10} State and national attainment status of the various districts that appear to be potentially affected by the SLDFR alternatives. With respect to all other ambient air quality standards (i.e., sulfur oxide, nitrogen oxide, carbon monoxide, etc.), the affected areas are considered to be unclassified or in attainment.

Table 11-1
Applicable Federal and State Ambient Air Quality Standards

Air Pollutant	State Standard (Concentration/ Averaging Time)	Federal Primary Standard (Concentration/ Averaging Time)	Most Relevant Effects
Ozone	0.09 ppm, 1-hr. avg.	0.12 ppm, 1-hr avg. 0.08 ppm, 8-hr avg.	a) Short-term exposures: pulmonary function decrements and localized lung edema in humans and animals, b) and risk to public health implied by alterations in pulmonary morphology and host defense in animals c) Long-term exposures: risk to public health implied by altered connective tissue metabolism and altered pulmonary morphology in animals after long-term exposures and pulmonary function decrements in chronically exposed humans d) Vegetation damage e) Property damage
Carbon Monoxide	9.0 ppm, 8-hr avg. 20 ppm, 1-hr avg.	9 ppm, 8-hr avg. 35 ppm, 1-hr avg.	a) Aggravation of angina pectoris and other aspects of coronary heart disease b) Decreased exercise tolerance in persons with peripheral vascular disease and lung disease c) Impairment of central nervous system functions d) Possible increased risk to fetuses
Nitrogen Dioxide	0.25 ppm, 1-hr avg.	0.053 ppm, annual arithmetic mean	a) Potential to aggravate chronic respiratory disease and respiratory symptoms in sensitive groups b) Risk to public health implied by pulmonary and extra pulmonary biochemical and cellular changes and pulmonary structural changes c) Contribution to atmospheric discoloration
Sulfur Dioxide	0.04 ppm, 24-hr avg. 0.25 ppm, 1-hr. avg.	0.03 ppm, annual arithmetic mean 0.14 ppm, 24-hr avg.	Bronchoconstriction accompanied by symptoms that may include wheezing, shortness of breath, and chest tightness during exercise or physical activity in persons with asthma
Suspended Particulate Matter (PM_{10})	30 $\mu g/m^3$, annual; Geometric mean 50 $\mu g/m^3$, 24-hr avg.	50 $\mu g/m^3$, annual arithmetic mean 150 $\mu g/m^3$, 24-hr avg.	a) Excess deaths from short-term exposures and exacerbation of symptoms in sensitive patients with respiratory disease b) Excess seasonal declines in pulmonary function, especially in children

Table 11-1 (concluded)
Applicable Federal and State Ambient Air Quality Standards

Air Pollutant	State Standard (Concentration/ Averaging Time)	Federal Primary Standard (Concentration/ Averaging Time)	Most Relevant Effects
Suspended Particulate Matter ($PM_{2.5}$)	No separate standard	15g/m^3, annual arithmetic mean 65g/m^3, 24-hr avg.	Increase in respiratory disease, lung damage, cancer, premature death, reduced visibility, and surface soiling
Sulfates	25 µg/m^3, 24-hr avg.	No Federal standard	a) Decrease in ventilatory function b) Aggravation of asthmatic symptoms c) Aggravation of cardiopulmonary disease d) Vegetation damage e) Degradation of visibility f) Property damage
Lead	1.5 µg/m^3, 30-day avg.	1.5 µg/m^3, calendar quarter	a) Increased body burden b) Impairment of blood formation and nerve conduction
Hydrogen Sulfide	0.03 ppm, 1-hr. avg.	No Federal standard	Nuisance odor (rotten egg smell), headache, and breathing difficulties in higher concentrations
Visibility-Reducing Particles	In sufficient amount to reduce the visual range to less than 10 miles at relative humidity less than 70 percent, 8-hour avg. (10 am-6 pm)	No Federal standard	Visibility impairment on days when relative humidity is less than 70 percent

Sources: South Coast Air Quality Management District's *1997 Air Quality Management Plan* available at http://www.aqmd.gov/aqmp/97aqmp/m-exec.html; California Air Resources Board's *Air Quality Standards* page available at *http://www.arb.ca.gov/aqs/aaqs2.pdf*

Table 11-2
State and National Attainment Status Classifications

Air Basin	Air District	Alternative Affecting Air Quality	State Ozone Attainment Status (1-hour standard)	State PM_{10} Attainment Status	National Ozone Attainment Status (8-hour standard	National Ozone Attainment Status (1-hour standard)	National PM_{10} Attainment Status
San Joaquin Valley	San Joaquin Valley	All	Nonattainment	Nonattainment	Nonattainment	Nonattainment	Nonattainment
San Francisco Bay	San Francisco Bay Area	Delta	Nonattainment	Nonattainment	Nonattainment	Nonattainment	Unclassified
South Central Coast	San Luis Obispo	Ocean	Nonattainment	Nonattainment	Attainment	Unclassified / Attainment	Unclassified

Source: California Air Resources Board's *State and National Area Designation Maps of California* available at http://www.arb.ca.gov/desig/adm/adm.htm.

Current rulemaking in the San Joaquin Valley Air Pollution Control District (SJVAPCD) requires many owners and operators of agricultural operations in the San Joaquin Valley to develop and implement Conservation Management Practice (CMP) plans to reduce PM_{10} fugitive dust from on-farm sources such as unpaved roads and equipment yards, land preparation, and harvest activities, as well as other cultural practices (SJVAPCD 2004a). Examples of the CMP measures required under this program include activities that reduce or eliminate the need to move or disturb the soil (such as land fallowing), activities that protect the soil from wind erosion, equipment modifications, application of dust suppressants, speed reductions on unpaved roads, alternatives to burning brush/prunings, and activities that reduce chemical applications (SJVAPCD 2004b). Some operations and sites, including sites less than 11 acres in size, are exempt from these requirements.

11.2 ENVIRONMENTAL CONSEQUENCES

The implementation of the action alternatives would affect the air quality in San Joaquin Valley and certain surrounding air districts. The overall air quality effects due to the emissions generated by the project are classified into two phases: construction and operation (including odor).

- **Construction Emissions.** Construction-related emissions are generally short term in duration but may still cause adverse air quality effects. Fine particulate matter (PM_{10}) is the pollutant of greatest concern with respect to construction activities. Construction period activities such as demolition, excavating and grading operations, construction vehicular traffic, utility extensions and improvements, and roadway reconstruction generate exhaust emissions and fugitive particulate matter emissions that can affect local air quality.
- **Operation Emissions.** The term "operations" refers to the full range of activities that can or may generate pollutant emissions when the development is functioning in its intended use. Operational emissions primarily result from three main source categories:

- *Indirect sources* – Sources that are not directly related to the project, but result from activities that would not occur but for the project, e.g., motor vehicle trips associated with the project.
- *Area sources* - Sources that individually emit fairly small quantities of air pollutants, but which cumulatively may represent significant quantities of emissions, e.g., lawn maintenance equipment, painting, etc.
- *Point sources* – Certain projects also may generate stationary, or "point," source emissions. Although most area sources discussed above are usually stationary, the terms stationary or point source usually refer to equipment or devices operating at industrial and commercial facilities.

Operation activities often have the potential to result in odor emissions. The objectives of odor control for the SLDFR action alternatives are to meet the State standards of 0.03 ppm or less at the nearest receptors based on a 1-hour averaging period. Meeting this objective would assure that the facility does not cause an off-site odor nuisance.

11.2.1 Evaluation Criteria

Determining whether or not a project may result in a significant adverse environmental effect is a fundamental objective of the NEPA process. Evaluation criteria for the effect determinations are referred to as thresholds of significance. Thresholds of significance are qualitative or quantitative evaluation criteria that are principally used to determine whether a project may have a significant environmental effect. For a given environmental effect, the threshold of significance is simply that level at which the lead agency finds the effects of the project to be significant, providing a rational basis for significance determinations in compliance with CEQA guidelines (in the absence of such special guidelines in NEPA).

The following standards of significance are based on Appendix G of the CEQA Guidelines, as well as standards presented in the SJVAPCD's *Guide for Assessing and Mitigating Air Quality Impacts* (SJVAPCD 2002) and the Bay Area Air Quality Management District's *CEQA Guidelines to Assessing the Air Quality Impacts of Projects and Plans* (BAAQMD 1999). For the purposes of this EIS, an effect is considered significant if the implementation of the SLDFR would:

- Conflict with or obstruct implementation of the applicable air quality plan,
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation,
- Result in a cumulatively considerable net increase of any State or Federal nonattainment pollutant or precursor of a nonattainment pollutant,
- Expose sensitive receptors to substantial pollutant concentrations, or
- Create objectionable odors affecting a substantial number of people.

11.2.1.1 Construction Emissions

The previously mentioned air quality reference documents indicate that the preferred approach to CEQA analyses of construction effects is to require implementation of effective and comprehensive control measures rather than to require quantification of emissions. As such, this document does not attempt to quantify construction emissions.

11.2.1.2 Operation Emissions

For many types of land use development (e.g., office parks, shopping centers, residential subdivisions, etc.), motor vehicles traveling to and from the projects represent the primary source of air pollutant operational emissions associated with project operations. The SLDFR alternatives contained within this EIS are not proposed such that increased vehicular traffic would result from project operations. Since it is not expected that the total vehicle miles traveled from the operation of the facilities would be greater than that anticipated under the original land use designation, the action alternatives are not expected to have a significant effect. Furthermore, according the BAAQMD guideline document, the quantification of those anticipated vehicle miles traveled (i.e., future air pollutant emissions) is not a necessary part of this EIS.

However, for other types of projects, equipment operation can be of concern from an air emissions standpoint. This is the case for the SLDFR. Emissions of air pollutants are expected, albeit minimal, from the infrequent operation of emergency generators located at pumping stations. While the pumping stations for the alternatives would receive their power from the existing electrical grid, these generators are in place for use during times of emergencies when the grid cannot supply the required power for the pumping stations. Sources of air pollution complying with all applicable regulations generally would not be considered to have a significant air quality effect. Additionally, stationary sources that are exempt from permit requirements because they fall below emission thresholds or are an exempted category of sources would not be considered to have a significant air quality effect.

As for odor, according to the SJVAPCD guidance document, there are no specific requirements to provide for its control. Because offensive odors rarely cause any physical harm and no requirements for their control are included in State or Federal air quality regulations, the SJVAPCD has no rules or standards related to odor emissions, other than its nuisance rule. Any actions related to odors are based on citizen complaints to local governments and the SJVAPCD. A significant odor problem is defined as more than one confirmed complaint per year averaged over a 3-year period or three unconfirmed complaints per year averaged over a 3-year period. In most cases, the most effective mitigation strategy for odor control is to provide a sufficient distance, or buffer zone, between the source of the odor and the receptor(s).

11.2.2 No Action

The No Action Alternative evaluates the effects of not conveying drainwater out of the basin for disposal, thus providing a benchmark against which action alternatives may be evaluated. No new construction would occur as part of the No Action Alternative. The only operational emissions would result from maintenance of existing facilities. Therefore, no effects beyond existing conditions would occur due to the No Action Alternative with regard to construction or operations and maintenance.

Land retirement is defined as the removal of lands from irrigated agricultural production to other forms of land management by means of land purchase or lease. Nonirrigated (retired) lands would be tilled to control weeds approximately twice a year. Lands could also be grazed or sprayed for weed management. This level of dust-generating activity is less than what would occur under many commercial/irrigated agricultural operations. The land retirement component of this alternative would be used for wildlife habitat, dry pasture, and dryland summer fallow grain operations on 109,106 acres. Compared to the existing condition's retirement of only 20,518 acres, the reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's increased land retirement/fallowing activities would result in an overall air quality benefit and reduction in PM_{10} fugitive dust emissions from the affected agricultural lands.

The SJVAPCD requires owners and operators of agricultural operations in the valley to reduce PM_{10} fugitive dust from on-farm sources. CMPs are to be identified for each agricultural operation by December 2004 and implemented in 2005. See Table 11-3 below for specific management practices. Land fallowing is identified as one measure that reduces land preparation and cultivation activities.

Table 11-3 presents conservation measures (including land fallowing) that are taken from SJVAPCD's Rule 4550 list of conservation management practices, prepared in cooperation with the U.S. Department of Agriculture (SJVAPCD 2004b).

Table 11-3
Agricultural Operations-Related PM_{10} Control Measures

Land Preparation/Cultivation PM_{10} Fugitive Dust Control Measures
• Alternate Till - Rotate tillage leaving residue on soil. • Bed-row size or spacing - Increase or decrease the size of the planting area bed (can be done for field and permanent crops). • Chemigation/Fertigation - Application of chemicals through an irrigation system. • Combined operations - To combine equipment in order to perform several operations during one pass. • Conservation irrigation - To conserve the quantity of water use, e.g.: drip, sprinkler, buried/underground line. Conserves water, reduces weed population, which in turn reduces the need for tillage and reduces soil compaction. • Conservation tillage (e.g.: no tillage, minimum tillage) - Types of tillage that reduce loss of soil and water in comparison to conventional tillage. Reduces the number of passes and soil disturbance. • Cover crops - Use seeding or natural vegetation/re-growth of plants to cover soil surface. Reduces soil disturbance due to wind erosion and entrainment. • Equipment changes/Technological improvements - To modify the equipment such as combines, cotton pickers, tilling, and harvesting equipment, increase equipment size, modify land planning and land leveling, matching the equipment to row spacing, grafting to new varieties or technological improvements. Reduces the number of passes during an operation, thereby reducing soil disturbance. • Fallowing land - Temporary or permanent removal from production. (e.g.: vineyard pullout, Raisin Industry Diversion program, wildlife/wetlands conservation program). Eliminates entire operation/passes or reduces activities. • Floor management - Smoothing and flattening the soil surface after nut harvest to remove post-harvest residue. Maintain clean, smooth, firm floor throughout season by elimination of disking. Reduces passes through elimination of disking. • Integrated Pest Management - A decision process which uses a combination of techniques including organic, conventional, and biological farming practices to suppress pest problems. Reduces use of herbicide/pesticide in order to reduce the number of passes for spraying, thereby reducing soil compaction and the need for additional tillage. • Mulching - Applying or leaving plant residue or other material to soil surface. Reduces entrainment of PM due to winds and reduces weed competition thereby reducing tillage passes and compaction.

Table 11-3 (continued)
Agricultural Operations-Related PM_{10} Control Measures

• Night farming - Operate at night where practical when moisture levels are higher and winds are lighter. Decreases the concentration of PM emissions during daytime. Increased ambient humidity reduces PM during high emissions periods. • Nontillage / Chemical tillage - Use flail mower, low volume sprayers, and heat delivery system (as harvest pre-conditioner). Reduces soil compaction and stabilizes soil through elimination or reduction of soil tillage passes. • Organic Practices - Use biological or nonchemical control methods. Reduces chemical use, thereby reducing passes. • Precision farming (GPS) – GPS satellite navigation to calculate position in the field. Reduces overlap and allows operations during inclement weather conditions and at night. • Time of planting - Modify the time of planting. Assists in distributing PM emissions to a period when there's less PM concentration. • Transgenic crops - Use of GMO or Transgenic crops. Reduces need for tillage or cultivation operations and reduces soil disturbance. • Transplanting - Planting plants already in a growth state. Reduces soil disturbance and number of passes compared to using seeding.
Harvest PM_{10} Fugitive Dust Control Measures
• Baling/Large Balers - Using balers to harvest crop. Reduce PM emissions from chopping, truck passes, and residue burning. • Combined operations - To combine equipment, performing several operations during one pass. Reduction in number of passes necessary to harvest the crop will result in fewer disturbances to the soil and reduced soil compaction. • Equipment changes/Technological improvements - To modify the equipment such as combines, cotton pickers, tilling, and harvesting equipment, increase equipment size, modify land planning and land leveling, matching the equipment to row spacing, and technological improvements. Reduces the number of passes during an operation, thereby reducing soil disturbance. • Fallowing land - temporary or permanent removal from production. (e.g.: vineyard pullout, Raisin Industry Diversion program, wildlife/wetlands conservation program). Eliminates entire operation/passes or reduces activities. • Floor management - Smoothing and flattening the soil surface after nut harvest to remove post-harvest residue. Maintain clean, smooth, firm floor throughout season by elimination of disking. Allows for proper calibration of harvest equipment to reduce soil surface disturbance. • Green Chop - The harvesting of a forage crop without allowing it to dry in the field. Reduces multiple equipment passes in-field, reduces soil disturbance, reduces soil compaction, and reduces dust emissions from dry materials. • Hand harvesting - Harvesting crop by hand. Reduces soil disturbance due to machinery passes. • Night Harvesting - Implementing cultural practices at night, or at times of high humidity. Reduces PM by operating when ambient air is moist, thereby reducing emissions. • No burning - Switching to a crop/system that would not require waste burning. Reduces emissions associated with burning. • Pre-Harvest soil preparation - Applying a light amount of water or stabilizing material to soil prior to harvest (when possible). Reduces PM emissions at harvest. • Shed Packing - Packing commodities in a covered or closed area. Reduces field traffic, thereby reducing PM emissions. • Shuttle system/larger carrier - Multiple bin/trailer. Haul multiple or larger trailers/bins per trip, thereby reducing emissions through reduced passes. • Alternate Till - Rotate tillage, leaving residue on soil. Tilling alternate rows for weed management allows for approximately 50% reduction in field activity. Stabilizes soil surface, reduces soil compaction, and reduces windblown dust.

Table 11-3 (concluded)
Agricultural Operations-Related PM_{10} Control Measures

• Application Efficiencies - Use compact, low volume, or concentrate quantity with spray equipment, aerial applications, micro-heads, infrared spot sprayers, or electrostatic sprayers. Reduces soil compaction, passes, and chemical usage. • Baling/Large Balers - Using balers to harvest crop. Reduce PM emissions from chopping, truck passes, and residue burning. • Bulk materials control - Minimize visible dust emissions from bulk materials. Reduces entrainment of fugitive dust.
Cropland Unpaved Roads PM_{10} Fugitive Dust Control Measures
• Chips/Mulches, Organic Materials, Polymers, Road Oil, Sand - Application of any nontoxic chemical or organic dust suppressant which meets any specification required by the federal, state, or local water agency and is not prohibited for use by any applicable regulations. Reduces entrainment of fugitive dust. • Gravel - Placing a layer of gravel with enough depth to minimize dust generated from vehicle movement and to dislodge any excess debris which can become entrained. Reduces entrainment of fugitive dust. • Mechanical Pruning - Using a machine instead of hand labor to prune. Reduced vehicle trips, thereby reducing PM emissions. • Paving - To pave currently unpaved roads. Prevent dust from vehicular traffic. • Restricted Access - To restrict public access to private roads. Reduces vehicular traffic and thus reduces associated fugitive dust. • Speed Limits - Enforcement of speeds that reduce visible dust emissions. Dust emissions from unpaved roads are a function of speed. Reducing speed reduces dust. • Track out control - Minimize any and all material that adheres to and agglomerates on vehicles and equipment from unpaved roads and falls onto a paved public road or the paved shoulder of a paved public road. Reduces entrainment of fugitive dust. • Water - Application of water to unpaved roads and traffic areas. Reduces entrainment of fugitive dust. • Wind barrier - Artificial or vegetative wall/fence that disrupts the erosive flow of wind over unprotected land. Reduces entrainment of fugitive dust due to winds.

11.2.3 In-Valley Disposal Alternative

11.2.3.1 Construction Emissions

Construction activities for the In-Valley Disposal Alternative would occur mostly in central San Joaquin Valley. Emissions associated with the construction of four large evaporation basins, totaling approximately 3,290 acres, Se treatment facilities, and RO plant(s), as well as the subsequent land filling requirements of this alternative, would be significant when compared to the No Action Alternative. However, the application of the various mitigation recommendations discussed in Section 11.2.11.1 would reduce the In-Valley Disposal Alternative's effect to not significant during the construction phase.

11.2.3.2 Operation Emissions

Utilization of the evaporation basins is not anticipated to cause any microclimate change to the region. The region already has a foggy season, which lasts from November to February. Since vehicular traffic is not expected to increase significantly as a result of general project operations, the only indirect emissions expected would be from employee trips to and from the reuse, Se treatment, RO plant, evaporation basin, and mitigation facilities. The main pollutants of concern from these indirect sources would be carbon monoxide and nitrogen oxide emissions and possibly PM_{10} emissions if the trips require travel over unpaved roads. As a result of the minimal amount travel associated with this alternative, vehicular traffic would not contribute to a significant effect for the In-Valley Disposal Alternative.

General lawn and building maintenance at the treatment facilities would make up the area source emission contribution. The products of combustion would be expected from any lawn maintenance, which would be required on the pumping plant sites. Additionally, volatile organic compounds and small quantities of hazardous air pollutants might be expected from solvents and paints used for the building maintenance. Compared to No Action, the effects are not significant.

Finally, energy consumption for the conveyance of the water and the operation of 16 pumping plants and sumps would be point source contributions. It is assumed that the energy used for this alternative, while coming from an existing electric generating facility, would increase the local baseline demand at an existing facility. The only products of combustion directly associated with the operation of this alternative would be from the use of emergency generators located at pumping stations along the conveyance route. These generators would be used only in the case that power from the existing electrical grid is not present or sufficient to drive the pumps. As emergency generators are already subject to permitting regulations (i.e., already "complying with all applicable regulations"), they would have no significant effect under this alternative compared to No Action.

11.2.3.3 Odor Control

The bioreactors may generate sulfide during the treatment process. For a detailed description and schematic of the bioreactor process see Section 2.4.1.2. Odor control will be incorporated in the final design. As an example, iron salt chemicals would be added downstream of the bioreactors. The iron reacts with the sulfide in the liquid phase to prevent the escape of odorous hydrogen sulfide. When compared to the No Action Alternative, the effect is not significant.

11.2.3.4 Permit/Regulatory Effects

Based on current information it does not appear that any alternative would require compliance with any New Source Performance Standards, or Maximum Achievable Control Technology requirements. However, if the project construction requires any building demolition, compliance with 40 CFR 61 Subpart M (National Emission Standard for Asbestos) may be required if the building has any asbestos containing materials.

11.2.3.5 Agricultural Operations

The land retirement component of this alternative would employ three types of land management activities, including dryfarming, livestock grazing, and fallowing on 44,106 acres. Compared to existing conditions and the No Action Alternative's planned retirement of 20,518 and 109,106 acres, respectively, the reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement/fallowing activities would result in an overall air quality benefit and reduction in PM_{10} fugitive dust emissions relative to existing conditions. However, compared to the No Action Alternative, the In-Valley Disposal Alternative would result in an overall increase in air quality effects from agricultural operations, as nearly 2.5 times less land would be retired/fallowed.

The land retirement operations of this alternative would result in an overall quality benefit relative to existing conditions and have a significant adverse effect relative to the No Action Alternative. The adverse effect could be mitigated by the application of SJVAPCD Rule 4550 conservation management practices (SJVAPCD 2004c) to lands remaining in agricultural production, in addition to those approved in existing CMP plans.

11.2.4 In-Valley/Groundwater Quality Land Retirement Alternative

11.2.4.1 Construction Emissions

Construction activities for the In-Valley/Groundwater Quality Land Retirement Alternative would occur mostly in central San Joaquin Valley. Emissions associated with the construction of four large evaporation basins (totaling approximately 2,890 acres), Se treatment facilities, and RO plant(s), as well as the subsequent land filling requirements of this alternative, would be significant compared to No Action. The application of the various mitigation recommendations discussed in Section 11.2.11 would reduce significant effects of the In-Valley/Groundwater Quality Land Retirement Alternative to not significant during the construction phase.

11.2.4.2 Operation Emissions

Use of the evaporation basins is not anticipated to cause any microclimate change to the region. The region already has a foggy season, which lasts from November to February. Since vehicular traffic is not expected to increase significantly as a result of general project operations, the only indirect emissions expected would be from employee trips to and from the reuse, Se treatment, RO plant, evaporation basin, and mitigation facilities. The main pollutants of concern from these indirect sources would be carbon monoxide and nitrogen oxide emissions and possibly PM_{10} emissions if the trips require travel over unpaved roads. As a result of the minimal amount travel associated with this alternative, vehicular traffic would not contribute to a significant effect for the In-Valley/Groundwater Quality Land Retirement Alternative.

General lawn and building maintenance at the treatment facilities would make up the area source emission contribution. The products of combustion would be expected from any lawn maintenance, which would be required on the pumping plant sites. Additionally, volatile organic compounds and small quantities of hazardous air pollutants might be expected from solvents and paints used for the building maintenance. Compared to No Action, the effects are not significant.

Finally, energy consumption for the conveyance of the water and the operation of 16 pumping plants and sumps would be point-source contributions. It is assumed that the energy used for this alternative, while coming from an existing electric generating facility, would increase the local baseline demand at an existing facility. The only products of combustion directly associated with the operation of this alternative would be from the use of emergency generators located at pumping stations along the conveyance route. These generators would be used only in the case that power from the existing electrical grid is not present or sufficient to drive the pumps. As emergency generators are already subject to permitting regulations (i.e., already “complying with all applicable regulations”), they would have no significant effect under this alternative compared to No Action.

11.2.4.3 Agricultural Operations

The land retirement component of this alternative would include 92,592 acres. Compared to existing conditions and the No Action Alternative's planned retirement of 20,518 and 109,106 acres, respectively, the reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement/fallowing activities would result in an overall air quality benefit and reduction in PM_{10} fugitive dust emissions relative to the existing conditions. Compared to the No Action Alternative, the In-Valley/Groundwater Quality Land Retirement Alternative would result in a slight increase in air quality effects from agricultural production activities. However, it would not be a significant effect.

11.2.5 In-Valley/Water Needs Land Retirement Alternative

11.2.5.1 Construction Emissions

Construction activities for the In-Valley/Water Needs Land Retirement Alternative would occur mostly in central San Joaquin Valley. Emissions associated with the construction of four evaporation basins (totaling approximately 2,150 acres), Se treatment facilities, and RO plant(s), as well as the subsequent land filling requirements of this alternative, would likely outweigh the other action alternatives' emissions associated with the construction of aqueducts, pipeline tunnel portals, pumping plants, treatment facilities, drainwater collection, and regional reuse facilities. The application of the various mitigation recommendations discussed in Section 11.2.11 would reduce significant effects of the In-Valley/Water Needs Land Retirement Alternative to not significant during the construction phase when compared to the No Action Alternative.

11.2.5.2 Operation Emissions

Use of the evaporation basins is not anticipated to cause any microclimate change to the region. The region already has a foggy season, which lasts from November to February. Since vehicular traffic is not expected to increase significantly as a result of general project operations, the only indirect emissions expected would be from employee trips to and from the reuse, Se treatment, RO plant, evaporation basin, and mitigation facilities. The main pollutants of concern from these indirect sources would be carbon monoxide and nitrogen oxide emissions and possibly PM_{10} emissions if the trips require travel over unpaved roads. As a result of the minimal amount travel associated with this alternative, vehicular traffic would not contribute to a significant effect for the In-Valley/Water Needs Land Retirement Alternative.

General lawn and building maintenance at the treatment facilities would make up the area source emission contribution. The products of combustion would be expected from any lawn maintenance, which would be required on the pumping plant sites. Additionally, volatile organic compounds and small quantities of hazardous air pollutants might be expected from solvents and paints used for the building maintenance. Compared to No Action, the effects are not significant.

Finally, energy consumption for the conveyance of the water and the operation of 16 pumping plants and sumps would be point-source contributions. It is assumed that the energy used for this alternative, while coming from an existing electric generating facility, would increase the local baseline demand at an existing facility. The only products of combustion directly associated with the operation of this alternative would be from the use of emergency generators located at pumping stations along the conveyance route. These generators would be used only in the case that power from the existing electrical grid is not present or sufficient to drive the pumps. As emergency generators are already subject to permitting regulations (i.e., already "complying with all applicable regulations"), they would have no significant effect under this alternative compared to No Action.

11.2.5.3 Agricultural Operations

The land retirement component of this alternative would include 193,956 acres. Compared to existing conditions and the No Action Alternative's planned retirement of 20,518 and 109,106 acres, respectively, the reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement/fallowing activities would result in an overall air quality benefit and reduction in PM_{10} fugitive dust emissions relative to both existing conditions and the No Action Alternative.

11.2.6 In-Valley/Drainage-Impaired Area Land Retirement Alternative

11.2.6.1 Construction Emissions

Construction activities for the In-Valley/Drainage-Impaired Area Land Retirement Alternative would occur mostly in the central San Joaquin Valley. Construction associated with one evaporation basin (totaling approximately 1,270 acres), a Se treatment facility, and an RO plant(s) would generate the least amount of air emissions compared to all other in-valley treatment alternatives. The application of the various mitigation recommendations discussed in Section 11.2.11.1 would reduce significant effects of the In-Valley/Drainage-Impaired Area Land Retirement Alternative to not significant during the construction phase when compared to the No Action Alternative.

11.2.6.2 Operation Emissions

One evaporation basin is not anticipated to cause a microclimate change to the region. The region already has a foggy season, which lasts from November to February. Since vehicular traffic is not expected to increase significantly as a result of general project operations, the only indirect emissions expected would be from employee trips to and from the reuse, Se treatment, RO plant(s), evaporation basin, and mitigation facilities. The main pollutants of concern from these indirect sources would be carbon monoxide and nitrogen oxide emissions and possibly PM_{10} emissions if the trips require travel over unpaved roads. As a result of the minimal amount travel associated with this alternative, vehicular traffic would not contribute to a significant effect for the In-Valley/Drainage-Impaired Area Land Retirement Alternative compared to No Action.

General lawn and building maintenance at the treatment facilities would make up the area source emission contribution. The products of combustion would be expected from any lawn maintenance, which would be required on the pumping plant sites. Additionally, volatile organic compounds and small quantities of hazardous air pollutants might be expected from solvents and paints used for the building maintenance. Compared to No Action, the effects are not significant.

Finally, energy consumption for the conveyance of the water and the operation of one pumping plant would be a point-source contribution. It is assumed that the energy used for this alternative, while coming from an existing electric generating facility, would increase the local baseline demand at an existing facility. The only products of combustion directly associated with the operation of this alternative would be from the use of emergency generators located at pumping stations along the conveyance route. These generators would be used only in the case that power from the existing electrical grid is not present or sufficient to drive the pumps. As emergency generators are already subject to permitting regulations (i.e., already "complying with all applicable regulations"), they would have no significant effect under this alternative compared to No Action.

11.2.6.3 Agricultural Operations

The land retirement component of this alternative would include 308,000 acres. Compared to existing conditions and the No Action Alternative's planned retirement of 20,518 and 109,106 acres, respectively, the reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement/fallowing activities would result in an overall air quality benefit and reduction in PM_{10} fugitive dust emissions relative to both existing conditions and the No Action Alternative.

11.2.7 Ocean Disposal Alternative

11.2.7.1 Construction Emissions

The construction emissions of the Ocean Disposal Alternative route would be concentrated in the southern San Joaquin Valley. Construction emissions are likely to be higher in the southern valley area as a result of having to transverse the Coast Ranges. This alternative would result in the installation of the most miles of pipeline and pumping stations of the seven action alternatives. The air quality effects could result from construction of aqueducts, pipeline tunnel portals, and pumping plants, as well as the drainwater collection and regional reuse facilities. Construction activities associated with temporary access/haul roads, staging areas, and disposal of excavated materials from tunnel boring and pipeline installation, as well as the installation of subsurface tile drains to collect the reused drainwater at the regional reuse facilities, would contribute to the air quality effect. The main pollutants of concern would be temporary fugitive dust emissions from land disturbance and exhaust emissions from construction equipment. The application of the various mitigation recommendations discussed in Section 11.2.11.1 would reduce the Ocean Disposal Alternative's significant effects to not significant during the construction phase, compared to No Action.

11.2.7.2 Operational Emissions

Since vehicular traffic is not expected to increase significantly as a result of general project operations, the only indirect emissions expected would be from employee trips to and from the pumping plants. With 23 pumping plants and sumps located throughout the region, emissions would affect the area from Los Banos south through the San Joaquin Valley and west through San Luis Obispo County to the ocean. Because the pumping stations are located throughout the region, it could require long employee trips, increasing emissions. The main pollutants of concern from these indirect sources would be carbon monoxide and nitrogen oxide emissions and possibly PM_{10} emissions if the trips required travel over unpaved roads. As a result of the minimal amount of travel associated with this alternative, vehicular traffic would not contribute to a significant effect for the Ocean Disposal Alternative compared to No Action.

General lawn and building maintenance at the pumping plant sites would make up the area source operational emission contribution. The products of combustion would be expected from any lawn maintenance, which would be required on the pumping plant and power plant sites. Additionally, volatile organic compounds and small quantities of hazardous air pollutants might be expected from solvents and paints used for the building maintenance. Compared to No Action, the effects are not significant.

Energy consumption for the conveyance of the water and the operation of the pumping plants would be point source contributions. It is assumed that the energy used for this alternative, while coming from an existing electric generating facility, would increase the local baseline demand at an existing facility. The only products of combustion directly associated with the operation of this alternative would be from the use of emergency generators located at pumping stations along the conveyance route. These generators would be used only in the case that power from the existing electrical grid is not present or sufficient to drive the pumps. As emergency generators are already subject to SCAQMD regulations (i.e., already “complying with all applicable regulations”), they would have no significant effect under this alternative compared to No Action.

11.2.7.3 Odor Control

Odor control should not be of concern for the Ocean Disposal Alternative because the drainwater contains nitrates, which would prevent the generation of sulfide during conveyance. When present, nitrates are used by microbes as an oxygen source rather than sulfate, so sulfide is not generated. Nitrate addition (bioxide product) is a common and effective method of sulfide control. Compared to No Action, no significant effect would occur.

11.2.7.4 Permit/Regulatory Effects

If the project construction requires any building demolition, compliance with 40 CFR 61 Subpart M (National Emission Standard for Asbestos) may be required if the building has any asbestos-containing materials.

11.2.7.5 Agricultural Operations

The land retirement component of this alternative is the same as described for the In-Valley Disposal Alternative (44,106 acres). The land retirement/land fallowing operations of this alternative would result in an overall quality benefit relative to existing conditions, and would have a significant adverse effect relative to the No Action Alternative. The effects can be mitigated to not significant with the application of SJVAPCD Rule 4550 conservation management practices to lands remaining in agricultural production, in addition to those approved in existing CMP plans.

11.2.8 Delta Disposal Alternatives

11.2.8.1 Construction Emissions

Construction emissions for the Delta Disposal Alternatives would be concentrated in northern San Joaquin Valley, as the route conveys the drainwater north through San Joaquin Valley into Contra Costa County to the Delta. Both Delta Disposal Alternatives would have similar construction emissions with the Carquinez Strait alternative having slightly more because of the additional pipeline needed to reach the strait. The air quality effects could result from construction of aqueducts, pipeline tunnel portals, and pumping plants, as well as the drainwater collection and regional reuse facilities. Construction activities associated with temporary access/haul roads, staging areas, and disposal of excavated materials from tunnel boring and pipeline installation, as well as the installation of subsurface tile drains to collect the reused drainwater at the regional reuse facilities, would contribute to the air quality effect. Both Delta Disposal Alternatives would also include the construction of Se treatment facilities. The air quality effect associated with the construction of the treatment facilities is anticipated to be greater than that associated with construction of the conveyance facilities. The main pollutants of concern would be temporary fugitive dust emissions from land disturbance and exhaust emissions from construction equipment. The emissions from construction of the treatment facilities are anticipated to be higher than those generated from the installation of the pipelines, a significant adverse effect compared to No Action. The application of the various mitigation recommendations discussed in Section 11.2.11.1 would reduce the Delta Disposal Alternatives' effects to not significant during the construction phase.

11.2.8.2 Operational Emissions

Unlike the Ocean Disposal Alternative, only two pumping stations are under consideration for the Delta Disposal Alternatives, requiring fewer employee trips and resulting in lower indirect emissions. The main pollutants of concern from these indirect sources would be carbon monoxide and nitrogen oxide emissions and possibly PM_{10} emissions if the trips required travel over unpaved roads. As a result of the minimal amount travel associated with this alternative, vehicular traffic would not contribute to a significant effect for the Delta Disposal Alternatives compared to No Action.

General lawn and building maintenance area source emission would be considerably lower because only two pumping plant sites would need maintenance. The products of combustion would be expected from any lawn maintenance, which would be required on the pumping plant sites. Additionally, volatile organic compounds and small quantities of hazardous air pollutants might be expected from solvents and paints used for the building maintenance. Compared to No Action, the effects are not significant.

Finally, energy consumption for the conveyance of the water and the operation of 12 pumping plants would be point source contributions. It is assumed that the energy used for this alternative, while coming from an existing electric generating facility, would increase the local baseline demand at an existing facility. The only products of combustion directly associated with the operation of this alternative would be from the use of emergency generators located at pumping stations along the conveyance route. These generators would be used only in the case that power from the existing electrical grid is not present or sufficient to drive the pumps. As emergency generators are already subject to SCAQMD regulations (i.e., already "complying with all applicable regulations"), they would have no significant effect under these alternatives compared to No Action.

11.2.8.3 Odor Control

The bioreactors may generate sulfide during the treatment process. For a detailed description and schematic of the bioreactor process see Section 2.4.1.2. Odor control will be incorporated into the final design. As an example, iron salt chemicals would be added downstream of the bioreactors. The iron reacts with the sulfide in the liquid phase to prevent the escape of odorous hydrogen sulfide. When compared to No Action, the effect is not significant.

11.2.8.4 Permit/Regulatory Effects

Based on current information it does not appear that any alternative would require compliance with any New Source Performance Standards, or Maximum Achievable Control Technology requirements. However, if the project construction requires any building demolition, compliance with 40 CFR 61 Subpart M (National Emission Standard for Asbestos) may be required if the building has any asbestos containing materials.

11.2.8.5 Agricultural Operations

The land retirement component of this alternative is the same as described for the In-Valley Disposal Alternative (44,106 acres). The land retirement/land fallowing operations of this alternative would result in an overall quality benefit relative to existing conditions, and would have a significant adverse effect relative to the No Action Alternative. The effects can be mitigated to not significant with the application of SJVAPCD Rule 4550 conservation management practices to lands remaining in agricultural production, in addition to those approved in existing CMP plans.

11.2.9 Cumulative Effects

Cumulative effects can result from individually minor but collectively significant projects. The determination of significant cumulative effects is based on an evaluation of the consistency of the action alternatives with the overall regional air quality plan. As previously discussed in Section 11.1, the air quality in the San Joaquin Valley is already severely stressed, with ozone and particulate levels exceeding the State and Federal air quality standards. The ozone problem in the valley ranks among the most severe in California. $PM_{2.5}$ emissions are projected to increase through the year 2020, and PM_{10} is not projected to meet the air quality standards for a number of years based on the ambient data.

Some signs of improvement exist, however. Emissions of ozone precursors have shown decreasing trends in recent years and emissions of PM_{10} overall are decreasing in the valley. However, because the air quality in the valley is not dominated by air pollutant emissions from one large urban area like other California air basins, but is instead characterized by a wide distribution of moderately sized urban areas spread along the axis of the valley, the management of air quality in the area is difficult (*California Air Resources Board Almanac 2005, Chapter 4:*

Air Basin Trends and Forecasts – Criteria Pollutants). The wide area distribution of potential air quality impacts from any of the seven action alternatives is indicative of this problem.

While all of the action alternatives would require some type of construction activity resulting in air emissions, the effects of these emissions would be temporary, could be mitigated, and are not expected to contribute to cumulative air quality effects in the project area. The incremental air quality effects associated with the operational and land retirement activities in the project area, on the other hand, would likely have a more sustained, though regulated, impact on the regional air quality. However, the regulatory requirements necessary for the permitting of these incremental emission increases, as well as the best management practices intended for agricultural operations and land retirement/fallowing, would cause the action alternative air quality impacts to be similar to, and in some cases less than, the ongoing impacts of planned urban and agricultural activities in the region, and would not be considered cumulatively significant.

To address comments gathered at one of many public hearings for the SLDFR relating to the project's effect on global warming, the SLDFR refers to the BAAQMD guidelines that state that much of the greenhouse gas production comes from motor vehicles. Since vehicular traffic air emissions are not expected to be significant for any of the alternatives, the SLDFR project would not be expected to significantly contribute to global warming under the BAAQMD guidelines.

11.2.10 Environmental Effects Summary

11.2.10.1 No Action Alternative

- No construction or operation emissions would be generated under the No Action Alternative, and no odors would be generated. Therefore, no effects would occur due to this action compared to existing conditions.
- The reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement activities would result in an overall air quality benefit and reduction in agricultural PM_{10} fugitive dust emissions from the affected lands compared to existing conditions.

11.2.10.2 In-Valley Disposal Alternative

- Emissions associated with the construction of the large evaporation basins for the Se treatment facilities and RO plant(s), as well as the subsequent landfilling requirements of this alternative, would have significant effects on air quality compared to No Action. With mitigation, as described in Section 11.2.11.1, no significant effect would occur.
- A minimum amount of travel and small-scale lawn and building maintenance would be associated with the operation of facilities under the In-Valley Disposal Alternative, and emergency generators would be subject to current regulations. Odor control will be incorporated into the final design of the bioreactors, so that no impact will result. Therefore, no significant effects on air quality would occur during operations under this alternative compared to No Action.

- The reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement/fallowing activities would result in an overall air quality benefit and reduction in agricultural PM_{10} fugitive dust emissions relative to existing conditions. However, compared to the No Action Alternative, the In-Valley Disposal Alternative would result in an overall increase in air quality effects, as nearly 2.5 times less land would be retired/fallowed. This effect could be mitigated by the application of additional conservation management practices on lands remaining in agricultural production.

11.2.10.3 In-Valley/Groundwater Quality Land Retirement Alternative

- Emissions associated with the construction of the large evaporation basins for the Se treatment facilities and RO plant(s), as well as the subsequent landfilling requirements of this alternative, would have significant effects on air quality. With mitigation, as described in Section 11.2.11.1, no significant effect would occur.
- A minimum amount of travel and small-scale lawn and building maintenance would be associated with the operation of facilities under the In-Valley/Groundwater Quality Land Retirement Alternative, and emergency generators would be subject to current regulations. Odor control will be incorporated into the final design of the bioreactors, so that no impact will result. Therefore, no significant effects on air quality would occur during operations under this alternative compared to No Action.
- The reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement activities would result in an overall air quality benefit and reduction in PM_{10} fugitive dust emissions relative to existing conditions. Compared to the No Action Alternative, the In-Valley/Groundwater Quality Land Retirement Alternative would result in a slight increase in fugitive dust air quality effects that are not significant.

11.2.10.4 In-Valley/Water Needs Land Retirement Alternative

- Emissions associated with the construction of the large evaporation basins for the Se treatment facilities and RO plant(s), as well as the subsequent landfilling requirements of this alternative, would have significant effects on air quality. With mitigation, as described in Section 11.2.11.1, no significant effect would occur.
- A minimum amount of travel and small-scale lawn and building maintenance would be associated with the operation of facilities under the In-Valley/Water Needs Land Retirement Alternative, and emergency generators would be subject to current regulations. Odor control will be incorporated into the final design of the bioreactors, so that no impact will result. Therefore, no significant effects on air quality would occur during operations under this alternative compared to No Action.
- The reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement activities would result in an overall air quality benefit and reduction in agricultural PM_{10} fugitive dust emissions relative to both existing conditions and the No Action Alternative.

11.2.10.5 In-Valley/Drainage-Impaired Area Land Retirement Alternative

- Emissions associated with the construction of a single large evaporation basin for the Se treatment facilities and RO plant(s), as well as the subsequent landfilling requirements of this alternative, would have significant effects on air quality. With mitigation, as described in Section 11.2.11.1, no significant effect would occur.
- A minimum amount of travel and small-scale lawn and building maintenance would be associated with the operation of facilities under the In-Valley/Drainage-Impaired Area Land Retirement Alternative, and emergency generators would be subject to current regulations. Odor control will be incorporated into the final design of the bioreactors, so that no impact will result. Therefore, no significant effects on air quality would occur during operations under this alternative compared to No Action.
- The reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement activities would result in an overall air quality benefit and reduction in agricultural PM_{10} fugitive dust emissions relative to both existing conditions and the No Action Alternative.

11.2.10.6 Ocean Disposal Alternative

- Emissions associated with the construction of pipeline and pumping stations of this alternative would have significant effects on air quality. With mitigation, as described in Section 11.2.11.1, no significant effect would occur.
- A minimum amount of travel and small-scale lawn and building maintenance would be associated with the operation of facilities under the Ocean Disposal Alternative, and emergency generators would be subject to current regulations. Odors are not of concern during conveyance. Therefore, no significant effects on air quality would occur during operations under this alternative compared to No Action.
- Odor control should not be of concern for the Ocean Disposal Alternative because the drainwater contains nitrates, which would prevent the generation of sulfide during conveyance. Therefore, no significant effects on air quality would occur due to odorous emissions under this alternative compared to No Action.
- The reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement activities would result in an overall air quality benefit and reduction in agricultural PM_{10} fugitive dust emissions relative to existing conditions. However, compared to the No Action Alternative, the Ocean Disposal Alternative would result in an overall increase in fugitive dust air quality effects, as nearly 2.5 times less land would be retired/fallowed. This effect could be mitigated to not significant by the application of additional conservation management practices on lands in agricultural production.

11.2.10.7 Delta Disposal Alternatives

- Emissions associated with the construction of pipeline and pumping stations of these alternatives would have significant effects on air quality. With mitigation, as described in Section 11.2.11.1, no significant effect would occur.

- A minimum amount of travel and small-scale lawn and building maintenance would be associated with the operation of facilities under the Delta Disposal Alternatives, and emergency generators would be subject to current regulations. Odor control will be incorporated into the final design of the bioreactors, so that no impact will result. Therefore, no significant effects on air quality would occur during operations under these alternatives compared to No Action.
- The reduced land preparation, cultivation, harvest activities, and vehicular travel over unpaved roads associated with this alternative's land retirement activities would result in an overall air quality benefit and reduction in agricultural PM_{10} fugitive dust emissions relative to existing conditions. However, compared to the No Action Alternative, the Delta Disposal Alternatives would result in an overall increase in fugitive dust air quality effects, as nearly 2.5 times less land would be retired/fallowed. This effect could be mitigated to not significant by the application of conservation management practices on lands in agricultural production.

Tables 11-4 through 11-10 summarize the effects that the No Action Alternative and the Action Alternatives have on air resources.

Table 11-4
Summary Comparison of Effects of No Action Alternative

Affected Resource and Area of Potential Effect	No Action Alternative Compared to Existing Condition
Air Quality - Construction Phase	
• Fugitive PM_{10} Emissions	Not applicable
• Equipment Exhaust Emissions	Not applicable
Air Quality – Operations Phase	
• Vehicular Traffic Emissions	No applicable
• Maintenance	Not applicable
• Emergency Generators	Not applicable
• Odorous Emissions	Not applicable
• Agricultural Operations	Approximately 80,000 acres more of land retirement. Beneficial effect.

Table 11-5
Summary Comparison of Effects of In-Valley Disposal Alternative

Affected Resource and Area of Potential Effect	In-Valley Disposal Compared to No Action	In-Valley Disposal Compared to Existing Condition
Air Quality - Construction Phase • Fugitive PM_{10} Emissions • Equipment Exhaust Emissions	Construction of evaporation basins and treatment facilities would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of evaporation basins and treatment facilities would generate emissions. Adverse effect; mitigation feasible.
Air Quality – Operations Phase • Vehicular Traffic Emissions • Maintenance • Emergency Generators • Odorous Emissions • Agricultural Operations	No significant effect. No significant effect. No significant effect. No significant effect. Approximately 65,000 acres less land retirement. Significant effect; with mitigation=no significant effect.	Minimal effect. Minimal effect. Minimal effect. No effect. Approximately 20,000 acres more land retirement. Beneficial effect.

Table 11-6
Summary Comparison of Effects of
In-Valley/Groundwater Quality Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Groundwater Quality Land Retirement Compared to No Action	In-Valley/Groundwater Quality Land Retirement Compared to Existing Condition
Air Quality - Construction Phase • Fugitive PM_{10} Emissions • Equipment Exhaust Emissions	Construction of evaporation basins and treatment facilities would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of evaporation basins and treatment facilities would generate emissions. Adverse effect; with mitigation, no effect.
Air Quality – Operations Phase • Vehicular Traffic Emissions • Maintenance • Emergency Generators • Odorous Emissions • Agricultural Operations	No significant effect. No significant effect. No significant effect. No significant effect. Nearly equivalent (approximately 10,000 acres less) land retirement. No significant effect.	Minimal effect. Minimal effect. Minimal effect. No effect. Approximately 70,000 acres more land retirement. Beneficial effect.

Table 11-7
Summary Comparison of Effects of
In-Valley/Water Needs Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Water Needs Land Retirement Compared to No Action	In-Valley/Water Needs Land Retirement Compared to Existing Condition
Air Quality - Construction Phase • Fugitive PM_{10} Emissions • Equipment Exhaust Emissions	Construction of evaporation basins and treatment facilities would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of evaporation basins and treatment facilities would generate emissions. Adverse effect; mitigation feasible.
Air Quality – Operations Phase • Vehicular Traffic Emissions • Maintenance • Emergency Generators • Odorous Emissions • Agricultural Operations	No significant effect. No significant effect. No significant effect. No significant effect. Approximately 90,000 acres more land retirement. Significant beneficial effect.	Minimal effect. Minimal effect. Minimal effect. No effect. Approximately 170,000 acres more land retirement. Beneficial effect.

Table 11-8
Summary Comparison of Effects of
In-Valley/Drainage-Impaired Area Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Drainage-Impaired Area Land Retirement Compared to No Action	In-Valley/Drainage-Impaired Area Land Retirement Compared to Existing Condition
Air Quality - Construction Phase • Fugitive PM_{10} Emissions • Equipment Exhaust Emissions	Construction of evaporation basins and treatment facilities would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of evaporation basins and treatment facilities would generate emissions. Adverse effect; mitigation feasible.
Air Quality – Operations Phase • Vehicular Traffic Emissions • Maintenance • Emergency Generators • Odorous Emissions • Agricultural Operations	No significant effect. No significant effect. No significant effect. No significant effect. Approximately 200,000 acres more land retirement. Significant beneficial effect.	Minimal effect. Minimal effect. Minimal effect. No effect. Approximately 280,000 acres more land retirement. Beneficial effect.

Table 11-9
Summary Comparison of Effects of Ocean Disposal Alternative

Affected Resource and Area of Potential Effect	Ocean Disposal Compared to No Action	Ocean Disposal Compared to Existing Condition
Air Quality - Construction Phase • Fugitive PM_{10} Emissions • Equipment Exhaust Emissions	Construction of pipeline and pumping stations would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of pipeline and pumping stations would generate emissions. Adverse effect; mitigation feasible.
Air Quality – Operations Phase • Vehicular Traffic Emissions • Maintenance • Emergency Generators • Odorous Emissions • Agricultural Operations	No significant effect. No significant effect. No significant effect. No significant effect. Approximately 60,000 acres less land retirement. Significant effect; with mitigation=no significant effect.	Minimal effect. Minimal effect. Minimal effect. No effect. Approximately 20,000 acres more land retirement. Beneficial effect.

Table 11-10
Summary Comparison of Effects of Delta Disposal Alternatives

Affected Resource and Area of Potential Effect	Delta Disposal Compared to No Action	Delta Disposal Compared to Existing Condition
Air Quality - Construction Phase • Fugitive PM_{10} Emissions • Equipment Exhaust Emissions	Construction of pipeline and pumping stations would generate emissions. Significant effect; with mitigation=no significant effect.	Construction of pipeline and pumping stations would generate emissions. Adverse effect; mitigation feasible.
Air Quality – Operations Phase • Vehicular Traffic Emissions • Maintenance • Emergency Generators • Odorous Emissions • Agricultural Operations	No significant effect. No significant effect. No significant effect. No significant effect. Approximately 60,000 acres less land retirement. Significant effect; with mitigation=no significant effect.	Minimal effect. Minimal effect. Minimal effect. No effect. Approximately 20,000 acres more land retirement. Beneficial effect.

11.2.11 Mitigation Recommendations

Mitigation of effects is needed to achieve Federal and State air quality standards. Air quality mitigation measures should go beyond existing regulations.

11.2.11.1 Construction Emissions

Both the BAAQMD and SJVAPCD guideline documents state that their approach to analyses of PM_{10} construction effects is to require implementation of effective and comprehensive control measures rather than to require detailed quantification of emissions. Table 11-11 contains the SJVAPCD-recommended Regulation VIII Control Measures for Construction Emissions of

PM_{10}. The table also contains enhanced and additional control measures due to the aerial extent of the construction activities. The SLDFR would utilize these control measures as appropriate. The SJVAPCD recognizes that these measures are difficult to implement due to poor availability of alternative fueled equipment and the challenge of monitoring these activities.

Table 11-11
Construction-Related PM_{10} Control Measures

Basic (Regulation VIII) Control Measures for All Construction Sites
• All disturbed areas, including storage piles, which are not being actively utilized for construction purposes, shall be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, covered with a tarp or other suitable cover or vegetative ground cover. • All on-site unpaved roads and off-site unpaved access roads shall be effectively stabilized of dust emissions using water or chemical stabilizer/suppressant. • All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by presoaking. • When materials are transported off site, all material shall be covered, or effectively wetted to limit visible dust emissions, and at least 6 inches of freeboard space from the top of the container shall be maintained. • All operations shall limit or expeditiously remove the accumulation of mud or dirt from adjacent public streets at the end of each workday. (The use of dry rotary brushes is expressly prohibited except where preceded or accompanied by sufficient wetting to limit the visible dust emissions.) (Use of blower devices is expressly forbidden.) • Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions utilizing sufficient water or chemical stabilizer/suppressant. • Within urban areas, trackout shall be immediately removed when it extends 50 or more feet from the site and at the end of each workday. • Any site with 150 or more vehicle trips per day shall prevent carryout and trackout.
Enhanced Control Measures (should they be required)
• Limit traffic speeds on unpaved roads to 15 mph. • Install sandbags or other erosion control measures to prevent silt runoff to public roadways from sites with a slope greater than one percent.
Additional Control Measures (should they be required)
• Install wheel washers for all exiting trucks, or wash off trucks and equipment leaving the site. • Install wind breaks at windward side(s) of construction areas. • Suspend excavation and grading activity when winds exceed 20 mph. • Limit area subject to excavation, grading, and other construction activity at any one time.

Other emissions from construction come from the operation of the construction equipment. While PM_{10} is the pollutant of greatest concern in the area, construction equipment also emits carbon monoxide and ozone precursors. However, according to the BAAQMD guidelines, these emissions are included in the emission inventory that is the basis for regional air quality plans, and are not expected to impede attainment or maintenance of ozone and carbon monoxide standards in the Bay Area. However, a large portion of the SLDFR alternatives would take place in San Joaquin Valley. The SJVAPCD seeks to reduce emissions from construction equipment exhaust. As such, Table 11-12 contains mitigation measures to help reduce the exhaust emissions from construction equipment.

Table 11-12
Construction Equipment Mitigation Measures

- Use of alternative fueled or catalyst equipped diesel construction equipment.
- Minimize idling time (e.g., 10-minute maximum).
- Limit the hours of operation of heavy-duty equipment and/or the amount of equipment in use.
- Replace fossil-fueled equipment with electrically driven equivalents (provided they are not run via a portable generator set).
- Curtail construction during periods of high ambient pollutant concentrations; this may include ceasing of construction activity during the peak-hour of vehicular traffic on adjacent roadways.
- Implement activity management (e.g., rescheduling activities to reduce short-term effects).

11.2.11.2 Operation Emissions

Vehicular traffic air emissions are not expected to be significant for any of the alternatives. As such, no mitigation measure is proposed for vehicular traffic air emissions. However, as previously discussed, emissions of air pollutants are expected, albeit infrequently, from the operation of emergency generators. These emergency engines would not have a significant effect on the existing air quality, and no mitigation measure is proposed.

As for odor, according to the SJVAPCD guidance document, there are no specific requirements to provide for its control. Because offensive odors rarely cause any physical harm, and no requirements for their control are included in State or Federal air quality regulations, the SJVAPCD has no rules or standards related to odor emissions, other than its nuisance rule. Any actions related to odors are based on citizen complaints to local governments and the SJVAPCD. A significant odor problem is defined as more than one confirmed complaint per year averaged over a 3-year period or three unconfirmed complaints per year averaged over a 3-year period. In most cases, the most effective mitigation strategy for odor control is to provide a sufficient distance, or buffer zone, between the source of the odor and the receptor(s). The SLDFR project operations are not expected to cause significant odors, so mitigation beyond the design measures incorporated into the Se treatment process are not required.

11.2.11.3 Agricultural Operations

Current rulemaking in the SJVAPCD requires owners and operators of many agricultural operations in the San Joaquin Valley to develop and implement CMP plans to reduce PM_{10} fugitive dust from on-farm sources such as unpaved roads and equipment yards, land preparation, and harvest activities, as well as other cultural practices. Examples of the CMP plans required under this program include activities that reduce or eliminate the need to move or disturb the soil, protect the soil from wind erosion, equipment modifications, application of dust suppressants, speed reductions on unpaved roads, alternatives to burning brush/prunings, and activities that reduce chemical applications.

Table 11-3 lists the management practices that individual landowners and operators may select from to develop their CMP plans. For those action alternatives with less land retirement than No Action (i.e., less than 109,106 acres), these measures could be employed by all farmers and land owners/managers whose land would remain in agricultural production, including those currently exempt from Rule 4550, or additional measures could be implemented beyond these approved in existing CMP plans.

SECTION TWELVE

AGRICULTURAL PRODUCTION AND ECONOMICS

This section evaluates how drainage service implementation and projected soil and groundwater conditions affect agricultural production over the 50-year planning horizon.

12.1 AFFECTED ENVIRONMENT

The San Luis Unit (the Unit) is predominantly an agricultural region, comprising five water districts that hold contracts for CVP water. Westlands, Broadview, Panoche, and Pacheco water districts, and the southern portion of San Luis Water District, cover about 713,000 acres, though not all of this acreage is irrigated. This area is one of the most productive farming regions in the United States and can continue to be with adequate water supply and drainage.

Recent data compiled from district reports, Reclamation crop reports, and DWR crop surveys indicate that irrigated crop acreage can range up to about 550,000 acres in Westlands, depending on water supply and market conditions. In the four Northerly Area districts (Broadview, Panoche, Pacheco, and the southern portion of San Luis water districts), irrigated acreage has averaged about 80,000 acres in recent years. Not all of this land is in the potentially drainage-impaired area as defined for this EIS.

A wide variety of crops is grown in the Unit. Table 12-1 summarizes the cropping pattern for the two portions of the Unit. The distribution of crops is not uniform within the districts. For example, orchards and vineyards tend to be grown in well-drained and upland areas of both Westlands and the four Northerly Area districts.

Table 12-1
Irrigated Land Use in the San Luis Unit

Major Crop Type	Percent of Irrigated Area, Average from 1995–1999	
	Westlands	Northerly Area Districts
Forage	3	10
Cotton	45	48
Grain	6	3
Sugar Beets	1	1
Other Field	1	2
Tomatoes	17	12
Truck	19	22
Orchard/Vineyard	7	2
Total	100	100

Source: District crop reports, various years.

Over 30,000 acres of land in the Northerly Area districts have subsurface drains installed and operating. These lands discharge drainwater to the Grassland Bypass (which connects to the San Luis Drain). An additional 18,000 acres of drained land outside the Unit also discharge drainwater to the Grassland Bypass. Drains have also been installed on approximately 5,000 acres within the northern portion of Westlands, and these operated up until 1986. Since that time, no drainage service has been provided to the Westlands drainage-impaired area.

12.2 ENVIRONMENTAL CONSEQUENCES

12.2.1 Evaluation Criteria

The objective of drainage service is to provide soil and shallow groundwater conditions that would allow long-term agricultural production. The purpose of this section is to identify criteria to assess and compare how the action alternatives vary from No Action and existing conditions and whether the change is significant in comparison to No Action. The following evaluation criteria are addressed:

- **Agricultural lands in production** are compared to No Action. A change of greater than 5 percent in long-term lands in production is considered a significant effect.
- **Salt balance** and salinity conditions, including trends in soil and shallow groundwater salinity (TDS) and the mass balance of salts added to or removed from the soil and shallow groundwater, are assessed compared to No Action. An objective significance criterion is difficult to establish: the effects of salinity are gradual (though real), and no regulatory standards exist to set an objective criterion. For comparative purposes, a net change in salt balance of 100,000 tons per year is considered significant.
- **Potential crop yields, revenues, and production costs** are affected by or limited by soil salinity. The two previous criteria, lands in production and salt balance condition of those lands, already address the long-term physical productivity of agriculture in the San Luis Unit.

This criterion assesses the gross revenue and net revenue effects of alternatives. It is useful for comparing costs and benefits of alternatives and for providing input to the regional economic and social effects assessments, but is not considered an environmental effect. Therefore, no significance criterion is established.

- **Costs of supplemental water** purchased to meet the San Luis Unit's cropwater use requirements are estimated. This is a cost (or avoided cost) effect, and is shown for purposes of comparing costs and benefits of alternatives. It is not considered an environmental effect, so no significance criterion is established.

12.2.2 Evaluation Approach

A modeling approach developed for this study assesses how drainage conditions under different alternatives affect root zone salinity, crop yields, crop production costs, and drainage quantity and quality.

A spreadsheet-based drainage and salinity model is adapted from the IRDROP (Irrigation and Drainage Operations) Model developed, tested, and used for the 1990 San Luis Unit Drainage Program (Reclamation 1990). The model simulates changes in soil salinity, shallow groundwater volumes (levels) and salinity, and drainage flow and salinity over a user-defined number of years. The model operates on a 1-year time step and is designed to estimate trends in salinity and drainage conditions. Key input data affecting the resultant estimates include cropwater use (based on a single crop or an assumed crop mix), salinity of applied irrigation water, naturally occurring drainage (movement of water out of the shallow water table in the absence of artificial drainage), effective conductance of groundwater into artificial drains, and starting levels of salinity in shallow groundwater.

Importantly, the drainage and salinity model is able to simulate both the upward movement of water and salts from shallow groundwater and the downward movement of water and salts from the percolation of applied irrigation water. Crop evapotranspiration and bare soil evaporation pull water and salts back toward the soil surface, and percolation of irrigation water and rainwater push salts back down. The interaction of these two processes determines the long-term trend in soil salinity and crop productivity. The model also incorporates a set of relationships that account for the precipitation and dissolution of gypsum and similar compounds. A simple approach developed by Aragues et al. (1990) was used that assumes that the saturation solubility of gypsum produces a fairly constant base load of dissolved salts in the soil water and shallow groundwater.

The drainage and salinity model estimates changes in drainage and salinity that result only from conditions and decisions made for the particular site modeled. An existing MODFLOW model developed by the USGS (see Appendix E) is used to estimate regional changes in groundwater conditions, including changes in the depth to shallow groundwater and the rate of net outflow from the shallow groundwater (also referred to above as natural drainage). These results are used as inputs to the drainage and salinity model.

The agricultural economic implications of drainage alternatives were assessed in a separate spreadsheet analysis of crop mix, yields, irrigation and salinity management costs, and net farm revenue. During SLDFR Plan Formulation, different combinations of drainage service, irrigation efficiency, and land retirement were evaluated using MODFLOW, the drainage and salinity model, and economic revenue and cost assessment (see PFR [Reclamation 2002] and PFR Addendum [Reclamation 2004b]). Detailed descriptions of the assumptions, data, and approach are described in those documents.

For each alternative, several combinations of agricultural land use and drainage conditions were assessed: land within the drainage-impaired area with drains installed; lands within the drainage-impaired area without drains installed; lands retired; and upslope lands. For lands in production within the drainage-impaired area, the drainage and salinity model was used to assess long-term soil salinity, feasible crop mix, yields, net revenue, and seasonal average irrigation efficiency (as dictated by the crop mix and available drainage).

12.2.3 No Action Alternative

12.2.3.1 Northerly Area Districts

Key Assumptions

The following assumptions are used to analyze agricultural production and economics under the No Action Alternative in the Northerly Area districts:

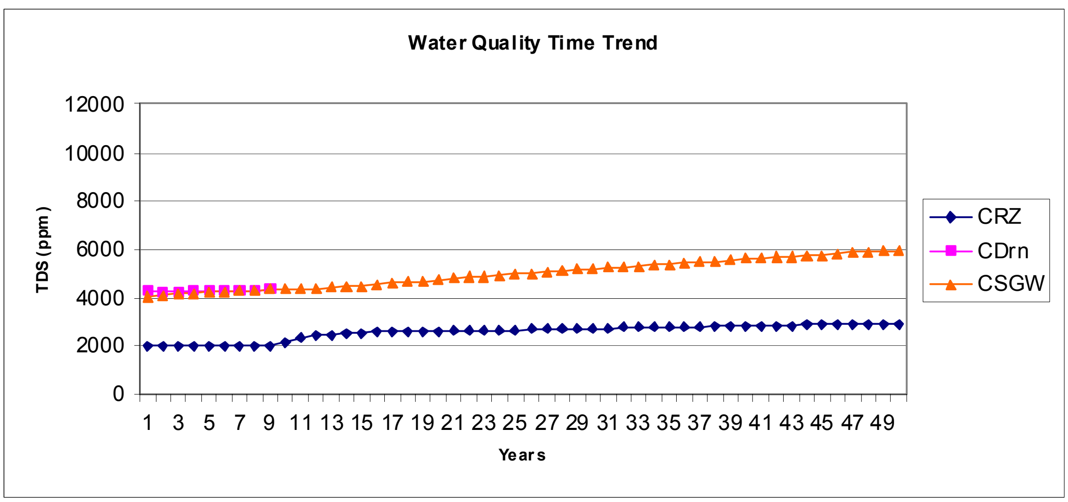
- Drainage collected from each drained acre in the Northerly Area would be about 0.45 AF/acre/year while drains are operating (see Grassland Bypass Project assumption below).
- The current rate of recycling, 0.12 AF/drained acre, would continue in order to meet the load restrictions on discharge. For analysis, the drainwater is assumed to be recycled on all lands within the drainage-impaired area, not just lands with installed drains. This assumption implies that 0.06 AF of drainwater/acre would be applied as irrigation water to each acre within the drainage-impaired area.
- The natural drainage rate was estimated by regional groundwater modeling for the drainage-impaired areas. The rate varies across the region, averaging about 0.2 AF/acre/year by 2030, which is a regional average for the drainage-impaired lands. Mapping of natural drainage rates shows that lands most affected by drainage and salinity have a lower rate. For purposes of analysis, lands with drains installed are assumed to average a natural rate of 0.15 foot/year. The remaining lands are assumed to average 0.30 foot/year, such that the overall, acreage-weighted average is about 0.2 foot/year.
- Drains are designed and operated to maintain a water table depth of between 6 and 6.5 feet.
- The Grassland Bypass Project will continue to operate until the year 2009. After that, no drainage access to the San Joaquin River will be available for this area. Initially, the effects of two assumptions were assessed regarding the response of growers in the drained area:
  - Drains are plugged and no further drainage is collected. The shallow water table continues to build up under the cropped land, increasing the upward movement of salts into the root zone. Levels of irrigation and salinity management must improve substantially to reduce deep percolation yet maintain leaching of salts.
  - Drains continue to operate, but all drain flow must be recycled within the drainage area. The shallow water table is controlled by continued operation of drains, but irrigation

water applied is significantly saltier due to the mixing of recycled drainwater with the normal water supply. The relatively large volume of salt-laden drainwater used for irrigation resulted in steady and rapid rise in soil salinity. Therefore this option was abandoned.

- 30,000 acres of tile drains are currently installed in the San Luis Unit portion of the Grassland Drainage Area, and another 18,000 acres are installed outside the Unit.

Results

Under current conditions, with drainage discharge to the Grassland Bypass, the salt balance and soil conditions are favorable for crop production. Drainage volume collected from field drains is estimated to be approximately 20,200 AF, including drainage from within and outside the Unit. Additional flow into sumps and collectors from shallow groundwater and surface runoff increases total annual drain flow to about 28,000 AF. However, when the Bypass is shut (by assumption), conditions worsen quickly and significantly. Figure 12-1 shows a 50-year trend in the root zone and shallow groundwater salinity for a representative drained area in the Northerly Area districts. The root zone is defined for analytical purposes as the soil from ground surface down to the shallow water table or simply the upper 6 feet of soil, whichever is less. The jump in soil salinity is quite clear in year 9 and later, and results from the loss of drainage and rise in the water table below those lands.



CRZ = Concentration of salts in the root zone (ppm TDS of saturation extract)
CDrn = Concentration of salts in drainwater or potential drainwater (ppm TDS)
CSGW = Concentration of salts in shallow groundwater (ppm TDS)

Figure 12-1 Salinity Trends in the Northerly Area, No Action Alternative

The figure shows the result under the assumption that the drains are plugged. (A side analysis was conducted indicating that the salinity increase is even more pronounced under the assumption that drains continue to operate but that 100 percent of the drainwater has to be recycled.) Soil salinity is typically measured as the electrical conductivity (EC) of a saturation extract in dS/m, and the ultimate root zone salinity shown corresponds to an EC of over 4.1. At this level, the mix of crops that can be grown narrows significantly (see summary Table 12-6).

Because a drainage outlet is no longer provided after year 9, soil salinity would rise and net deep percolation would be limited to the small amount of natural drainage that exists, estimated to be

0.15 foot/year for lands currently having drains installed.[1] A combination of crop mix changes, rotational fallowing, and irrigation management would be needed to maintain land in production.

Crop changes can accomplish two objectives: they can reduce or eliminate crops that are sensitive to saline soil conditions; and they can reduce the overall level of water use and therefore the deep percolation needed for salt leaching. An appropriate mix of salt-tolerant crops can meet these criteria. This analysis has estimated that a mix of 30 percent rotational fallow, 35 percent cotton, and 35 percent grain crops can reduce crop ET to about 1.5 foot/year. At that level of ET, irrigation management equivalent to 85 percent seasonal application efficiency (SAE), measured here as crop ET of applied water divided by total applied water, would hold the net deep percolation equal to the natural drainage of 0.15 foot/year. A further discussion of the implications of crop mix changes and irrigation management in the No Action Alternative is included below in the analysis for the Westlands subareas.

Substantial reductions in net farm revenue would result from the cropping and irrigation changes needed to reduce net deep percolation. Results are summarized at the end of this section, and are presented as benefits (avoided costs) provided by drainage service.

Salt balance in the Northerly Area districts is favorable during the initial years when drainage is discharged through the Grassland Bypass and San Luis Drain to Mud Slough and subsequently to the San Joaquin River. Over 28,000 AF of drainwater at an average salinity of about 4,100 ppm TDS are discharged, removing more than 160,000 tons of salt annually from the area. Additional salts would migrate more slowly from the area through groundwater pathways, but no estimate of this amount has been made. After the closure of the Bypass in 2009, no salts would be removed through artificial drainage.

12.2.3.2 Westlands Water District

The drainage-impaired area within Westlands has been divided into three subareas as shown on Figure 2.1-1. Many of the assumptions described below apply to all three of the subareas. Where differences exist, those are noted.

Key Assumptions

The following assumptions are used to analyze agricultural production and economics in Westlands under the No Action Alternative:

- No drainwater is currently being collected and removed from Westlands. The No Action Alternative assumes that this situation would continue. Irrigation efficiency in Westlands is currently quite high and is expected to remain so over time, consistent with projections made by the DWR (Bulletin 160-93 and unpublished supporting data, 1993). Growers may need to make additional changes in efficiency to manage irrigation in the drainage-impaired area analysis.

[1] Natural drainage is defined as the annual net downward (or lateral) movement of the shallow water table. It varies within the drainage-impaired region. 0.15 feet per year is a representative rate estimated from groundwater modeling.

- Shallow water table depth would continue to be a concern in substantial areas within the district. The changes in depth to water and the acreage affected by shallow groundwater are based on groundwater modeling analysis (see Section 6.2.2).
- The analysis uses the current mix of crops as the starting point for a 50-year simulation of drainage and soil salinity conditions. The analysis will assess how future drainage and salinity conditions in the drainage-impaired area would affect crop selection.
- Irrigation water in the drainage-impaired area is a mix of surface supplies and groundwater. The mix can vary considerably between fields or farms, from year to year, and even within a year. For purposes of analyzing the long-term trends in salinity, irrigation water is estimated to be 88 percent surface water and 12 percent groundwater (based on unpublished estimates of future conditions in Westlands made by Reclamation, 2002). The resulting salinity of applied irrigation water is about 530 ppm TDS.
- Two categories of land retirement are considered in the No Action Alternative (see Section 2.2). The first is land retired under all alternatives, including No Action, as part of existing programs or settlements. This category totals about 44,100 acres. The second category is land assumed to be retired in the No Action Alternative, but that could remain in production under the action alternatives. A total of about 65,000 acres in the drainage-impaired area of Westlands fall in this category. The exact location of these lands is not yet known. For purposes of analysis, they are distributed proportionately among the three subareas. Table 12-2 summarizes the lands retired and those remaining under irrigation.

Table 12-2
Lands Assumed Retired in the No Action Alternative

Westlands Subarea	Total Irrigated (2001 Existing Conditions)	Acres Retired in All Alternatives	Additional Acres Retired Only in No Action Alternatives	Acres Potentially Remaining in Production, No Action Alternatives
North	119,880	38,300	26,800	54,780
Central	127,260	5,800	11,800	109,660
South	129,490	0	26,400	103,090
Total	376,630	44,100	65,000	267,530

Note: Lands outside the drainage-impaired area are not included.

The key issues for the Westlands subareas under No Action are whether lands can stay in production given the small level of natural drainage, and if so, at what cost.[2] The evaluation follows closely what was described above for the Northerly Area districts after closure of drainage to the Grassland Bypass. The natural drainage rate was estimated by regional groundwater modeling for the drainage-impaired areas in Westlands. The rate varies across the region, averaging about 0.25 AF/acre/year by 2030, for all of the drainage-impaired lands. Mapping of natural drainage rates shows that lands most affected by drainage and salinity effects have a lower rate. For purposes of analysis, lands receiving drainage installation in drainage

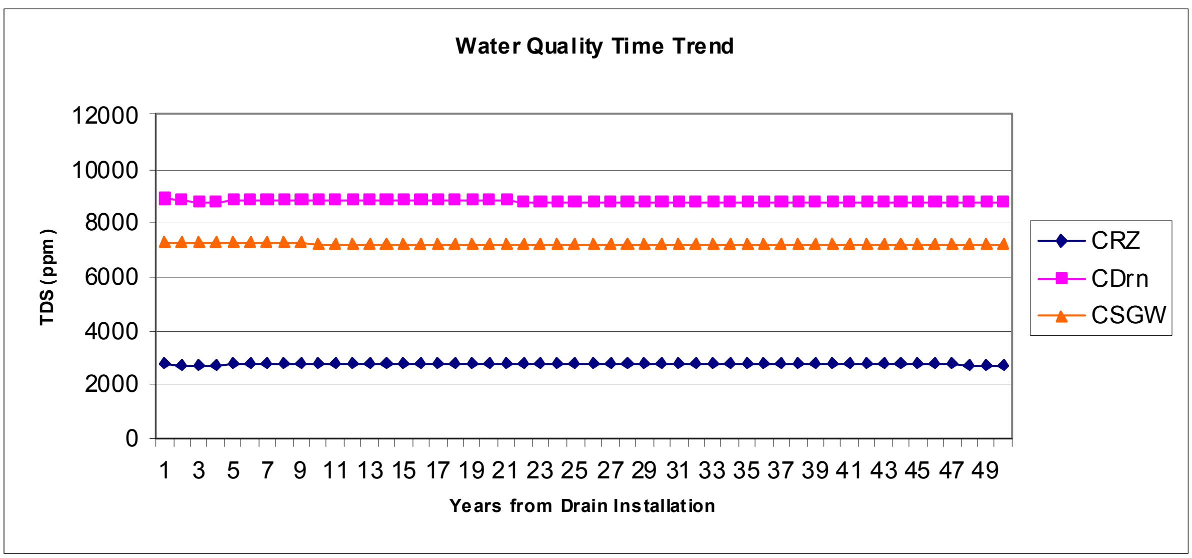
[2] Natural drainage is defined here as the annual net downward (or lateral) movement of the shallow water table.

service alternatives are assumed to average a natural rate of 0.20 foot/year. The remaining lands are assumed to average 0.35 foot/year, such that the overall, acreage-weighted average is about 0.25 foot/year.

As described for the Northerly Area districts, two strategies can be used to reduce deep percolation to a level that does not exceed the natural drainage rate. First, crop mix can be changed to reduce overall water use, including changing the crops grown and increasing the frequency of fallowing. Second, irrigation management and application uniformity can be improved to reduce the deep percolation of applied water. Both strategies must be implemented in a way that can maintain adequate leaching of salts, or that at least provides enough leaching to avoid rapid deterioration of soil conditions. Estimates of current water use in the drainage-impaired area indicate that irrigation efficiencies are already quite high, especially considering the need for leaching water – SAE is estimated to average about 85 percent. Therefore, irrigation efficiencies are assumed to be maintained at this high level under the No Action Alternative. Under the No Action Alternative, no salts are removed from the irrigated area through artificial drainage; consequently, they continue to accumulate in the soil and groundwater.

Results

Results for the three Westlands drainage-impaired subareas (North, Central, South) are similar. The main difference is in the estimated starting salinity in shallow groundwater. Figure 12-2 shows estimated salinity conditions for the Westlands Central drainage-impaired area. Conditions appear to remain relatively stable over the 50-year horizon, but at very restrictive drainage conditions that substantially limit crop mix and profitability.



CRZ = Concentration of salts in the root zone (ppm TDS of saturation extract)
CDRN = Concentration of salts in subsurface drainwater (ppm TDS)
CSGW = Concentration of salts in shallow groundwater (ppm TDS)

Figure 12-2 Salinity Trends in Westlands Central, No Action Alternative

As was described for the Northerly Area districts, salt balance is not achieved in Westlands under the No Action Alternative. Although Figure 12-2 appears to show a balance in salt concentration, in fact a substantial mass of salt continues to percolate below the shallow water table into the deeper groundwater layers. In addition, the No Action Alternative does not provide any outlet for removing the salts that have accumulated in the soil and groundwater from past irrigation. Conditions for Westlands North and South would be similar to Westlands Central.

Discussion of Irrigation Management, Crop Mix, and Natural Drainage

The evaluation of SAE and crop mix changes to maintain land in production without artificial drainage depends critically on the estimated rate of natural drainage. Poorly drained lands have a low rate of natural drainage. If aggregate deep percolation can be kept equal to or less than natural drainage, and the deep percolation provides an acceptable leaching fraction, then long-term root zone equilibrium can be maintained. Several considerations are important for managing irrigated crop production under poor drainage conditions:

- Even if irrigation can be managed to hold deep percolation equal to natural drainage, salts would continue to accumulate in the shallow groundwater. These salts would also continue to migrate into deeper groundwater over time. Only artificial drainage that removes and disposes of salts can improve the long-term salt balance that includes both root zone and groundwater salt loads.
- Very careful irrigation management is required, which means that both SAE and distribution uniformity must be high. The cost of irrigation hardware and management is significantly higher than for irrigation under well-drained conditions.
- Lands for which revenues cannot support the higher irrigation and management costs would go out of production.
- The continued accumulation of salts in the shallow groundwater makes this situation relatively risky. Small changes in the overall water and salt balance (for example, reducing groundwater pumping that provided some portion of the natural drainage, or a change in the salinity of applied water) can result in a fairly rapid deterioration of root zone conditions.
- To keep deep percolation within the limits provided by natural drainage, the cropping pattern generally needs to be restricted to lower-ET crops. Small grains (e.g., wheat and barley) may need to play a larger role in the crop mix. Sugar beets and some forage crops can tolerate the saltier soil conditions, but their relatively high water uses may result in more deep percolation than allowed by drainage conditions.
- The net result of higher soil salinity and restricted deep percolation is a crop mix that excludes both salt-sensitive crops and high water-using crops. Small grains, salt-tolerant row crops, and a mixture of cotton with grains and/or row crops are the most feasible cropping systems. When natural drainage is very restrictive (e.g., less than 0.25 foot/year), rotational fallowing may be required to allow the shallow groundwater to subside. Again, careful irrigation management is needed to avoid excessive salinization of the soil.

The benefits of the action alternatives can be estimated as the costs avoided relative to the No Action Alternative. These avoided costs fall into three categories:

- Irrigation management costs
- Net revenue losses resulting from the restricted crop mix
- Net revenue losses from land retired

Analysis and results for the action alternatives are described later in this section.

Interaction Between Land Retirement and Irrigation Management

In the No Action Alternative, it is estimated that about 109,000 acres of land would be retired within the drainage-impaired area of Westlands. Land retirement has two effects on regional drainage conditions. First, it removes drainage-impaired land from production and, therefore, eliminates the need to provide artificial drainage on those lands. Second, the reduction in irrigation and deep percolation of irrigation water may provide some regional benefit to the shallow groundwater: lands remaining in production may benefit, because the regional water table may be lowered to some degree due to retirement. The magnitude of this second effect has not been quantified, although groundwater analysis performed as part of plan formulation has estimated the effect to be small (see PFR Addendum [Reclamation 2004b]). Several combinations of land retirement and irrigation improvements were evaluated as part of the screening analysis of land retirement scenarios. Results of the screening analysis are described in the PFR Addendum (Reclamation 2004b).

Sensitivity Analysis on Natural Drainage Rate

The natural drainage available to lands in the drainage-impaired area is small but significant. For the Northerly Area drained lands, it is estimated to be about 0.15 foot/year under the No Action Alternative in 2030; the corresponding estimate for most drainage-impaired Westlands' lands is 0.20 foot/year. These are regional averages estimated using a calibrated groundwater model (see Section 6.2.2). Actual conditions are likely to vary around the estimated average, resulting in some lands having more restricted drainage and some lands having less restricted drainage. To illustrate how small changes in the natural drainage rate can affect conditions, the drainage and salinity model was used to estimate the required net deep percolation and the resulting soil and shallow groundwater salinity over time under a range of assumed natural drainage rates. For illustration purposes, conditions in Westlands North are used, but general conclusions apply for the other areas. Also, crop mix is held constant; and regional shallow groundwater trends are assumed to be the same as for the No Action Alternative.

Table 12-3 summarizes the required average irrigation efficiency (defined here as seasonal ET of applied water divided by seasonal applied water) to maintain stable water table conditions. Natural drainage rate was varied between 0.1 and 0.3 foot/year.

Table 12-3
Sensitivity Analysis on Natural Drainage

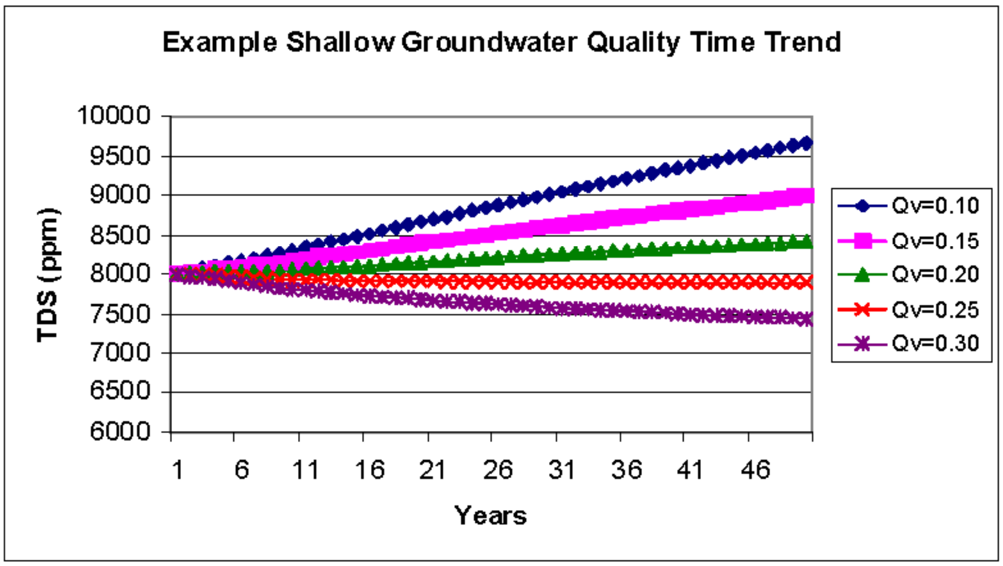
Natural Drainage (feet/year)	Applied Water (feet/year)	Necessary Seasonal Application Efficiency[1]	Estimated Salinity after 50 Years	
			Soil Salinity (EC)	Shallow GW Salinity (EC)
0.10	2.44	92%	4.9[2]	12.5
0.15	2.49	90%	4.6[2]	11.6
0.20	2.54	88%	4.3[2]	10.9
0.25	2.59	86%	4.1[3]	10.3
0.30	2.65	85%	3.9[3]	9.7

Notes:

[1] Defined as the ratio of ETAW to AW required for net deep percolation to equal natural drainage.
[2] Adequate leaching is not achieved. Soil salinity continues to rise over time.
[3] Very high distribution uniformity is required to achieve adequate leaching over entire field.

All of the drainage rates shown in the table require a high level of irrigation management to balance the need for leaching with the small amount of net deep percolation available through natural drainage. In fact, the modeling indicates that for a natural drainage rate of 0.25 foot/year, irrigation management is just able to maintain both leaching and shallow water table management, although the cost is high. At natural drainage rates of 0.20 foot/year or less, adequate leaching is not achieved and soil salinity deteriorates over time. (Note that this conclusion also depends on other assumptions and starting conditions such as TDS of shallow groundwater and applied water.)

Figure 12-3 illustrates the effect on shallow groundwater salinity over time at different rates of natural drainage. Shallow groundwater is defined here as groundwater less than 20 feet below surface. The trend lines all start at 8,000 ppm of TDS and reflect the assumption that land is kept in production. The analysis suggests that shallow groundwater salinity can be held reasonably constant at a natural drainage rate of 0.25 foot/year, assuming irrigation and cropping patterns are managed appropriately. This does not imply, however, that salt balance is achieved: salts continue to move downward and accumulate in the aquifer below 20 feet.



Qv = rate of natural drainage, in feet per year.

Figure 12-3 Sensitivity Analysis on Shallow Groundwater Salinity, Different Conditions of Natural Drainage

This analysis indicates how drainage rates, irrigation water use, and soil salinity interact. Note that achieving the high irrigation efficiencies shown in Table 12-3 would be extremely difficult. A similar analysis could be conducted holding irrigation efficiency constant and estimating the average applied water (as determined by crop mix) that maintains net deep percolation at or below the natural drainage. This approach is described later and is used to estimate the change in crop net revenue from improved drainage conditions.

12.2.4 Action Alternatives

Differences among action alternatives focus on disposal approaches and land retirement. Two major configurations, Out-of-Valley Disposal and In-Valley Disposal, provide essentially the same level of drainage service to the Unit. Their potential effects on agricultural production and economics differ only because of the irrigated land converted for use by the treatment, disposal, and conveyance facilities. Importantly, both configurations incorporate the same assumptions for drainwater reduction/source control. Three other alternatives combine land retirement with components of the In-Valley Disposal Alternative to provide drainage service: In-Valley/Groundwater Quality Land Retirement, In-Valley/Water Needs Land Retirement, and In-Valley/ Drainage-Impaired Area Land Retirement.

12.2.4.1 In-Valley Disposal Alternative

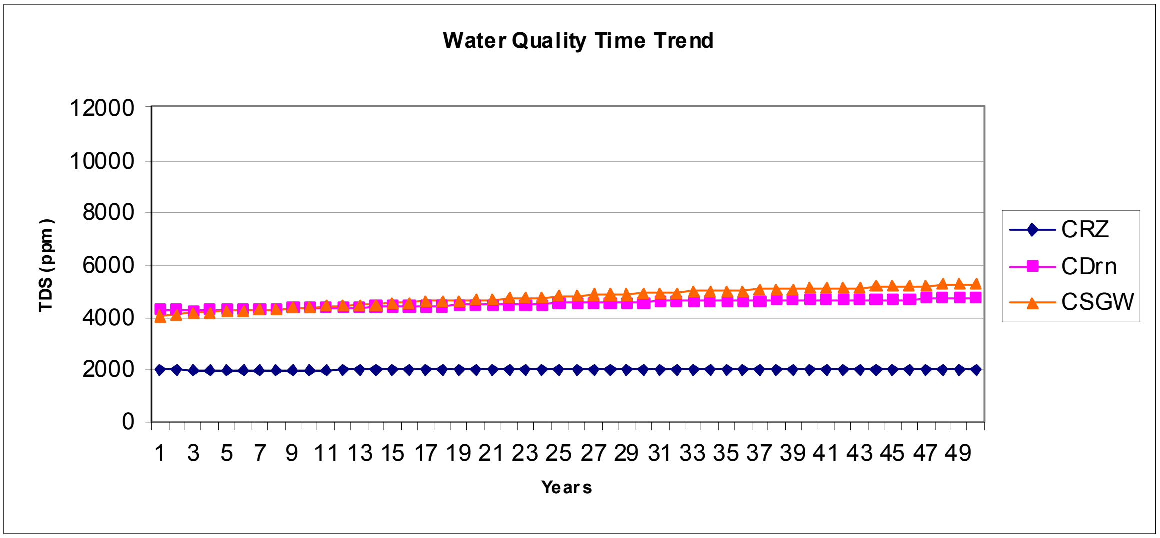
Northerly Area Key Assumptions

The following common assumptions of analysis for the action alternatives are used:

- Drainage service would be provided to the existing drained lands within the Unit districts, and additional drains would be installed as needed over time. Currently, 48,000 acres of lands are drained. By the end of the 50-year planning horizon, a total of about 36,000 acres within the northern San Luis Unit districts would have subsurface drains installed, and 18,000 acres outside of the Unit would have drains, for a total of 54,000 drained acres. New drains are assumed to be installed beginning in 2008.
- Drainage collected from fields would be 0.42 AF/drained acre, with 0.06 AF/drained acre recycled within the drained area. The drainwater is assumed to be recycled on all lands within the drainage-impaired area, not just lands with installed drains.
- All drained lands (including 18,000 acres outside the Unit) would be served by drainage treatment and disposal facilities constructed as part of this plan. All drainage not recycled would be delivered to a drainage reuse facility to provide irrigation for salt-tolerant crops. The reuse facility would reduce the volume of drainage by almost 75 percent: four AF of drainwater would be applied as irrigation on each acre in the reuse facility, with 1.08 AF/acre of drainage collected for further treatment and disposal.
- No groundwater is pumped and used for irrigation within the drainage-impaired lands of the Northern Unit. All irrigation water is provided from surface supplies or from the small amount of drainwater recycled within the drained area.
- Federal costs for drainage treatment and disposal facilities are given in Section 2, but no explicit cost recovery for drainage service is assessed on growers as part of this farm-level effects analysis. An evaluation of cost recovery, payment capacity, and net benefits from drainage service will be completed separately from this EIS.

Northerly Area Results

Drainage service provided to the Northerly Area districts under any of the action alternatives results in relatively stable soil salinity conditions over the 50-year planning horizon. Figure 12-4 displays the estimated average soil, drainage, and shallow groundwater salinity for drained fields in this subarea.



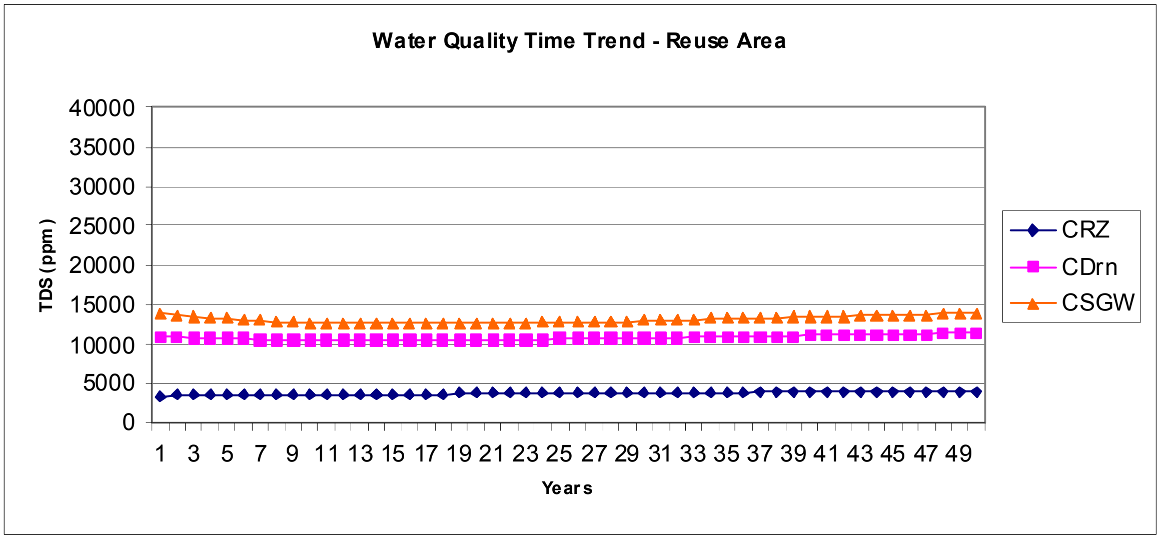
CRZ = Concentration of salts in the root zone (ppm TDS of saturation extract)
CDrn = Concentration of salts in drainwater or potential drainwater (ppm TDS)
CSGW = Concentration of salts in shallow groundwater (ppm TDS)

Figure 12-4 Salinity Trends in the Northerly Area, All Action Alternatives

Soil salinity is estimated to be stable at an average EC of about 2.9 dS/m (EC is the more standard measure for soil salinity. Based on salt constituents and concentration, an EC of 1 dS/m is approximately equal to 700 ppm TDS). Virtually all crops, except the most salt-sensitive trees, vines, and row crops can be grown under these conditions. Because this estimate is of average salinity, some lands can likely be maintained at lower salinity, allowing an even wider range of crops. Other lands may have higher salinity, restricting crop types. Undrained lands within the drainage-impaired area are also estimated to have relatively stable, though somewhat higher, soil salinity. Overall SAE in the Northerly Area is projected to average about 76 percent, although specific estimates can vary significantly across districts, crops, and growing conditions.

Under all of the action alternatives, drainage collected from drained farmlands is conveyed to a regional reuse facility. The primary drainage is used to irrigate a salt-tolerant crop, and the drainage from the reuse facility is collected for further treatment and disposal. The reuse stage reduces the volume of drainage substantially and concentrates it. Figure 12-5 shows the trend in drainage, soil, and shallow groundwater salinity in the Northerly Area reuse facility. By the end of the 50-year planning horizon, the volume of drainwater collected from the reuse facility for further treatment and disposal is estimated to be about 8,900 AF/year.

The soil salinity shown for later years on Figure 12-5 corresponds to an EC of about 10 dS/m. Salt-tolerant crops must be used to provide sufficient water use under such saline conditions.



CRZ = Concentration of salts in the root zone (ppm TDS of saturation extract)
CDrn = Concentration of salts in drainwater or potential drainwater (ppm TDS)
CSGW = Concentration of salts in shallow groundwater (ppm TDS)

Figure 12-5 Salinity Trends in the Northerly Area Reuse Facility, All Action Alternatives

Appendix C presents estimated drained acres, drainage volume, and drainage quality over a 50-year horizon. For each alternative, the amount collected from agricultural fields and that collected from the regional reuse facilities are shown.

Westlands Water District Key Assumptions

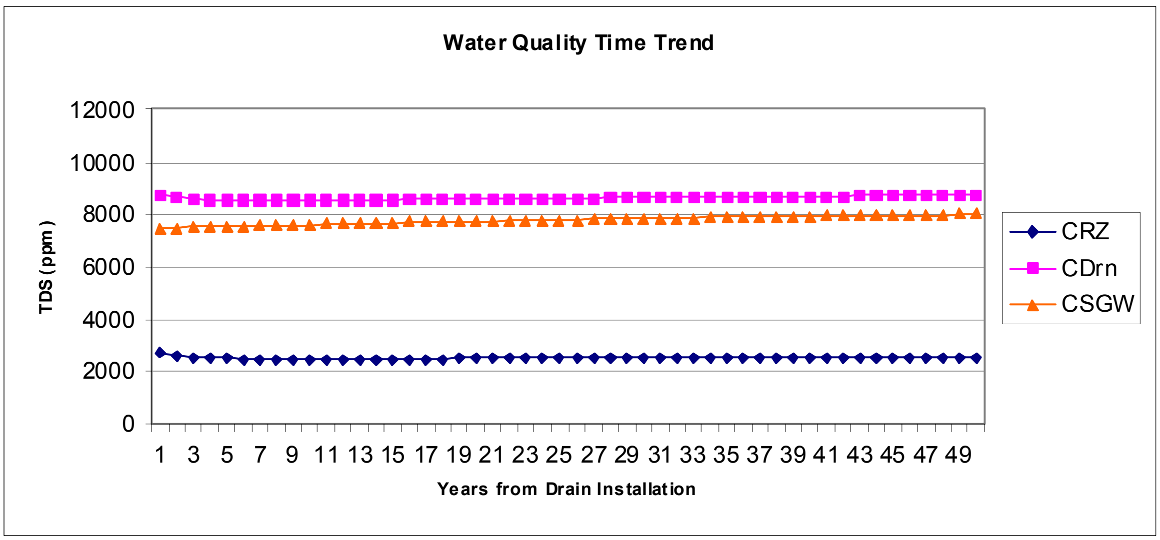
Many of the assumptions described below apply to all three of the Westlands subareas. Where differences exist, those are noted. For all action alternatives, the following assumptions are used:

- New drains would be installed on 159,000 acres within a drainage collector area of 246,000 acres by the end of the 50-year period in the In-Valley Disposal Alternative. New drains are assumed to be installed beginning in year 2008.
- Drainage collected from fields would be 0.35 AF/drained acre/year, with about 0.05 AF/drained acre recycled within the drained area. The drainwater is assumed to be recycled on all lands within the drainage-impaired area, not just lands with installed drains.
- All drained lands would be served by drainage treatment and disposal facilities constructed as part of the alternative. All drainage not recycled would be delivered to drainage reuse facilities to provide irrigation for salt-tolerant crops. The reuse facilities would reduce the volume of drainage by almost 75 percent: 4.2 AF of drainwater would be applied as irrigation on each acre in the reuse facility, with 1.13 AF/acre of drainage collected for further treatment and disposal.
- Irrigation water in the drainage-impaired area is a mix of surface supplies and groundwater. The mix can vary considerably between fields or farms, from year to year, and even within the year. For purposes of analyzing the long-term trends in salinity, irrigation water is assumed to be 88 percent surface water and 12 percent groundwater. The resulting salinity of applied irrigation water is about 530 ppm TDS.

- No explicit costs for drainage service are assessed as part of this EIS analysis. A separate evaluation of costs, payment capacity, and net benefits from drainage service will be completed.

Westlands Water District Results

Drainage service provided to lands in the Westlands subareas under any of the action alternatives allows a more intensive and profitable crop mix to be grown while maintaining soil and shallow groundwater salinity at reasonable levels. Figure 12-6 shows the trend in salinity conditions for a typical field following drain installation. The figure shows estimates for Westlands Central; results are similar for the other two Westlands drainage-impaired subareas. Drainage service provided to the Westlands subareas under any of the action alternatives is scaled in over time. The overall drainage quantity and quality estimates are derived by identifying the acreage of new drain installation each year and then aggregating the overlapping series of quantity and quality estimates over the 50-year planning horizon.



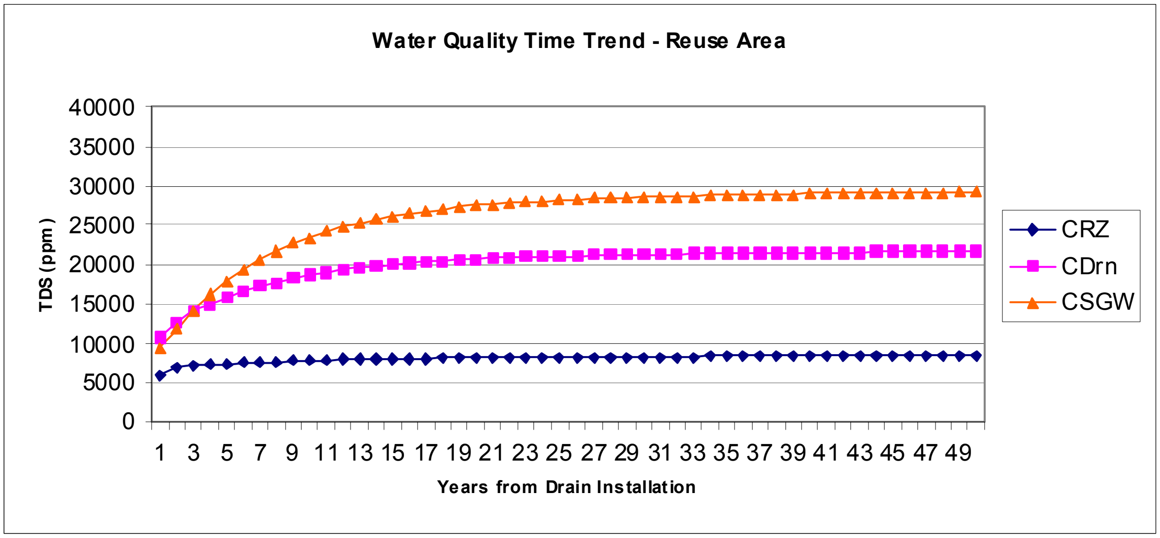
CRZ = Concentration of salts in the root zone (ppm TDS of saturation extract)
CDrn = Concentration of salts in drainwater or potential drainwater (ppm TDS)
CSGW = Concentration of salts in shallow groundwater (ppm TDS)

Figure 12-6 Salinity Trends for a Typical Drained Field in Westlands Central, All Action Alternatives

Soil salinity is estimated to be stable at an average EC of about 2,300 ppm TDS, or 3.3 dS/m. Most crops except salt-sensitive trees, vines, and row crops can be grown under these conditions. Because this estimate is of average salinity, some lands can likely be maintained at lower salinity, allowing an even wider range of crops. Undrained lands within the drainage-impaired area are also estimated to have relatively stable, though somewhat higher, soil salinity. After all planned drainage installation, the overall SAE on drained lands in Westlands North is projected to average about 80 percent, though specific estimates can vary significantly across crops and growing conditions. Note that this SAE includes additional leaching water made possible by drain installation.

Under all of the action alternatives, drainwater collected from drained farmlands is conveyed to a regional Reuse Facility. The primary drainwater is used to irrigate a salt-tolerant crop, and the drainwater from the reuse facility is collected for further treatment and disposal. The reuse stage reduces the volume of drainwater substantially and concentrates it. Figure 12-7 shows the trend in drainage, soil, and shallow groundwater salinity in the reuse facility serving Westlands Central (results for other Westlands reuse facilities would be similar). By the 50th year, the volume of drainwater collected from the Westlands reuse facilities for further treatment and disposal is estimated to be about 12,200 AF/year. The annual trends in the volume and quality of drainwater collected from all of the reuse facilities are shown in Appendix C.

The soil salinity shown for later years on Figure 12-7 corresponds to an EC of about 10.5 dS/m. Very salt-tolerant crops must be used to provide sufficient water use under such saline conditions. Results for reuse facilities in the other Westlands subareas are similar.



CRZ = Concentration of salts in the root zone (ppm TDS of saturation extract)
CDrn = Concentration of salts in drainwater or potential drainwater (ppm TDS)
CSGW = Concentration of salts in shallow groundwater (ppm TDS)

Figure 12-7 Salinity Trends in Westlands Central Reuse Facility, All Action Alternatives

Appendix C describes the estimated drained acres, drainage volume, and drainage quality over a 50-year horizon for all of the subareas. For each alternative, the amount collected from agricultural fields and that collected from the regional reuse facilities are shown.

12.2.4.2 In-Valley/Groundwater Quality Land Retirement Alternative

Key Assumptions

Assumptions and features of this alternative closely follow those described under the In-Valley Disposal Alternative, except that additional lands within Westlands and the Northerly Area are retired. Specific assumptions for this alternative are:

- 10,000 acres of existing irrigated land in Broadview Water District would be purchased and retired. About 6,500 acres of existing tile drain systems within this area would be retired.
- About 38,500 acres of land within Westlands would be retired based on drainwater quality criteria. Lands with Se concentration greater than 50 ppb in the shallow groundwater would

be targeted. An additional 6,000 acres in Westlands would be purchased and used for drainage facilities. These lands are not evenly or proportionately distributed across Westlands subareas, but the per-acre costs and agricultural effects are roughly the same regardless of subarea.

- Drainage service would be provided to remaining lands in the drainage-impaired area. About 135,000 acres by the year 2050 in the In-Valley/Groundwater Quality Land Retirement Alternative would have drains installed. New drains are assumed to be installed beginning in year 2008.
- Other assumptions and estimates of drainage rates, operation of reuse facilities, and irrigation water quality are the same as described for the In-Valley Disposal Alternative.

Results

The land retirement screening analysis (see PFR Addendum [Reclamation 2004b]) concluded that retirement of some land in the drainage-impaired area had little or no effect on drainage conditions for land remaining in production. As a result, this alternative's field-level assessment of salinity and drainage effects is the same as for the In-Valley Disposal Alternative, though the number of acres to which the analysis applies is different.

Important agricultural effects in this alternative are:

- The value of production and the net revenue from agricultural lands are lost when that land is retired. Based on typical crop mix, yields, prices, and production costs, annual losses in net revenue average about $161/acre/year in the Northerly Area and $148/acre/year in Westlands. The data on crop mix, yields, prices, and costs were developed according to Reclamation guidelines for the estimation of project costs and benefits, and are described in the PFR Addendum (Reclamation 2004b). Note that a substantial portion of the net revenue would have been lost under the No Action Alternative because of restrictions in crop mix, increased fallowing, and higher irrigation management costs.
- Some drainage treatment and disposal costs are avoided, compared to the In-Valley and Out-of-Valley Disposal Alternatives. These cost comparisons are summarized in Section 2.13, Table 2.13-3.

12.2.4.3 In-Valley/Water Needs Land Retirement Alternative

Key Assumptions

Assumptions and features of this alternative closely follow those described under the In-Valley Disposal Alternative, except that additional lands within Westlands and the Northerly Area are retired. Specific assumptions for this alternative are:

- 10,000 acres of existing irrigated land in Broadview Water District would be purchased and retired. 6,500 acres of existing tile drain systems within this area would be retired.
- 140,000 acres of land within Westlands would be retired based on drainwater quality criteria. High selenium concentration in the shallow groundwater would be targeted, with the total acreage retired estimated to bring San Luis Unit water supplies and cropwater needs into balance. An additional 6,000 acres in Westlands would be purchased and used for drainage

facilities. These lands are not evenly or proportionately distributed across Westlands subareas, but the per-acre costs and agricultural effects are roughly the same regardless of subarea.

- Drainage service would be provided to remaining lands in the drainage-impaired area. About 70,300 acres by the year 2050 in the In-Valley/Water Needs Land Retirement Alternative would have drains installed. New drains are assumed to be installed beginning in year 2008.
- Other assumptions and estimates of drainage rates, operation of reuse facilities, and irrigation water quality are the same as described for the In-Valley Disposal Alternative.

Results

The land retirement screening analysis (see PFR Addendum [Reclamation 2004b]) concluded that retirement of some land in the drainage-impaired area had little or no effect on drainage conditions for land remaining in production. As a result, this alternative's field-level assessment of salinity and drainage effects is the same as for the In-Valley Disposal Alternative, though the number of acres to which the analysis applies is different.

Important agricultural effects in this alternative are:

- The value of production and the net revenue from agricultural lands would be lost when that land is retired. Based on typical crop mix, yields, prices, and production costs, annual losses in net revenue would average about $161/acre/year in the Northerly Area and $148/acre/year in Westlands. The data on crop mix, yields, prices, and costs were developed according to Reclamation guidelines for the estimation of project costs and benefits, and are described in the PFR Addendum (Reclamation 2004b). Note that a substantial portion of the net revenue would have been lost under the No Action Alternative because of restrictions in crop mix, increased fallowing, and higher irrigation management costs.
- Some drainage treatment and disposal costs would be avoided, compared to the In-Valley and Out-of-Valley Disposal Alternatives. These cost comparisons are summarized in Section 2.13, Table 2.13-3.

12.2.4.4 In-Valley/Drainage-Impaired Area Land Retirement Alternative

Key Assumptions

Assumptions and features of this alternative follow those described under the In-Valley Disposal Alternative, except that all drainage-impaired lands within Westlands would be retired, and some additional land in the Northerly Area would be retired. Specific assumptions for this alternative are:

- 10,000 acres of existing irrigated land in Broadview Water District would be purchased and retired. 6,500 acres of existing tile drain systems within this area would be retired.
- All drainage-impaired land (an additional 254,000 acres plus the 44,000 acres retired in all alternatives) within Westlands would be retired.
- Drainage service would be provided only to remaining lands in the Northerly Area.

Results

Under this alternative, no drainage would be collected, treated, or disposed in Westlands.

Important agricultural effects in this alternative are:

- The value of production and the net revenue from agricultural lands would be lost when that land is retired. Based on typical crop mix, yields, prices, and production costs, annual losses in net revenue would average about $161/acre/year in the Northerly Area and $148/acre/year in Westlands. The data on crop mix, yields, prices, and costs were developed according to Reclamation guidelines for the estimation of project costs and benefits, and are described in the PFR Addendum (Reclamation 2004b). Note that a substantial portion of the net revenue would have been lost under the No Action Alternative because of restrictions in crop mix, increased fallowing, and higher irrigation management costs.
- Much of the drainage treatment and disposal costs would be avoided, compared to the In-Valley and Out-of-Valley Disposal Alternatives. These cost comparisons are summarized in Section 2.13, Table 2.13-3.

12.2.4.5 Out-of-Valley Disposal Alternatives

The analysis of effects is almost identical to that for the In-Valley Disposal Alternative. The important differences are the number of acres over which to aggregate effects and the time pattern of drainage installation. About 160,300 acres of land within Westlands would have new drains installed. Many of the summary tables below reflect those differences.

12.2.4.6 Salinity, Crop Yield, and Cost Effects of All Action Alternatives

The objectives of providing drainage service are to maintain long-term agricultural productivity and to reduce the accumulation of salts in the soil and groundwater. This section provides a summary of how the action alternatives accomplish the objectives in comparison to No Action. Note that under the No Action Alternative, cropping mix changes and rotational fallowing are necessary to maintain land in production with the limited natural drainage. Soil salinities are somewhat higher under this regime of reduced cropwater use, but net revenues are substantially lower.

Soil salinity is measured as the EC of a soil saturation extract. EC provides an estimate of how crop yields may be affected by soil salinity, and therefore can be used to assess the cropping mix and flexibility possible under the action alternatives. Table 12-4 illustrates the differences in soil salinity between alternatives and across regions. All of the changes from No Action to an action alternative are considered significantly beneficial to crop production. The Northerly Area exhibits a greater improvement with drainage service primarily because its lands have somewhat lower natural drainage.

Table 12-4
Average Soil Salinity Estimates for Drained Lands
(EC of saturation extract [dS/m])

Subarea	No Action Alternative	Action Alternatives
Northerly Area districts	4.2	2.9
Westlands North	4.2	3.3
Westlands Central	3.9	3.3
Westlands South	3.9	3.2

Note: Estimates for the No Action Alternative assume substantially restricted cropping pattern and lower water use. All estimates represent average or typical conditions, and assume careful irrigation and salt management (see irrigation cost estimates below). Some lands would have higher EC values, and some lands could be managed to maintain lower EC values.

Long-Term Salt Balance is defined for evaluation purposes as the net change in mass of salts in the root zone and shallow groundwater, relative to the No Action Alternative. Estimation focuses on a comparison of salts added in irrigation water to salts removed from irrigated lands by artificial drainage. Only lands in the drainage-impaired area are included, because no salts are estimated to be accumulating in the root zone in the upslope lands (and by definition, these lands do not have shallow groundwater). The only salt removal occurring in the No Action Alternative is prior to 2009 in the Northerly Area districts. For all alternatives, salt balance is significantly improved in all subareas. In all but one case the salt balance, as estimated here, is positive (net removal) by the year 2050 (Table 12-5). The exception is the In-Valley/Drainage-Impaired Land Retirement Alternative where all impaired land in Westlands is retired so salt is neither applied nor removed. However, a net improvement remains relative to the No Action Alternative.

Table 12-5
Salt Balance Estimates for Drainage Service Alternatives – Net Change Compared to No Action Alternative
(tons of salt per year in 2050)

	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Water Quality Land Retirement	In-Valley/ Water Needs Land Retirement	In-Valley/ Drainage-Impaired Area Land Retirement
Northerly Area	-91,160	-91,160	-90,600	-90,600	-90,600
Westlands	-422,520	-423,600	-401,750	-347,040	-282,920

Notes:
A negative value indicates an improvement in salt balance relative to No Action.
Incoming salt includes all irrigation water salts applied to the root zone, including salts in pumped groundwater; does not include salts from fertilizers and soil amendments. Outgoing salt includes salt leaving the irrigated lands via artificial drainage.
Additional salt migrates slowly out of the area through groundwater; this amount has not been estimated.

Long-Term Yield Effects are based on crop yield relationships formalized by Maas and Hoffman (see, for example, United Nations 1985). They estimated crop yield effects caused by average soil salinity over the growing season. Table 12-6 summarizes the crops that are judged to be agronomically viable to grow under the soil and drainage conditions provided by the action alternatives. A crop is judged agronomically viable if its yield potential is at least 85 percent of what is considered normal for San Joaquin Valley under non-saline conditions. The crop changes suggested in Table 12-6 are based on average conditions in the drainage-impaired area and, thus, should be viewed as illustrative of the direction of effects. Some lands may be able to support moderately sensitive crops under appropriate management and crop rotation. Other lands may ultimately become infeasible to farm.

Table 12-6
Long-Term Yield Effects of Soil Salinity in the Drainage-Impaired Area

Subarea	Viable Crops Under No Action Alternative	Viable Crops Under Action Alternatives
Northerly Area	Cotton, grains, other salt-tolerant field and row crops*	Cotton, grains, sugar beets, alfalfa, tomatoes, most vegetables and field crops
Westlands	Cotton, grains, other salt-tolerant field and row crops*	Cotton, grains, sugar beets, alfalfa, tomatoes, most vegetables and field crops

*Both salt-sensitivity and water use are restricted under No Action. The analysis uses a mixture of cotton, grains, and rotational fallowing.

Based on soil salinity estimates and the limited natural drainage available in the drainage-impaired area, the No Action Alternative reflects the assumption that cropping patterns would shift to a combination of salt-tolerant crops; cotton and grains are assumed for the analysis. In addition, rotational fallowing would be required in conjunction with the restricted crop mix to manage the shallow water table.

Avoided costs are another measure of the benefits of the action alternatives. The benefits of providing drainage service can be estimated as the reduction in production costs and revenue losses that would be incurred under the No Action Alternative. Three categories of avoided costs are considered here:

1. Irrigation and salinity management costs that growers would incur by trying to farm under poorly drained and saline conditions
2. Net revenue losses resulting from growing a salinity-restricted and water-use-restricted crop mix
3. The net revenue losses associated with lands retired under the No Action Alternative

The first two categories, irrigation management and crop selection, are strategies for dealing with the limited natural drainage and high soil salinities that can occur in the drainage-impaired area. Either or both can be used to manage irrigated lands under drainage-impaired conditions. Irrigation management could allow full crop production, but at a significant cost and within limits. Water use estimates for the drainage-impaired area in Westlands indicate that SAE is already well over 80 percent. Increasing efficiency higher than this level is expensive and may be impractical, especially given the imperative to leach salts from the root zone.

Other lands in Westlands upslope areas and in the Northerly Area are not currently at as high a level of irrigation efficiency. For these areas, the costs and benefits of two levels of improvements were assessed as part of SLDFR Plan Formulation (see PFR Addendum [Reclamation 2004b]). Based on that assessment, all of the drainage service alternatives were assumed to implement a moderate reduction in deep percolation on these lands. The costs of the irrigation system improvements were based on estimates in an update to the irrigation cost and performance study prepared for Reclamation under the San Joaquin Valley Drainage Program and the San Luis Unit Drainage Program (CH2M Hill 1994). Irrigation system performance estimates were compiled from studies performed at California State Polytechnic University. The costs were derived by estimating the level of irrigation efficiency and distribution uniformity needed to reduce deep percolation by the target amount of 0.1 foot/acre, on average. Costs associated with higher levels of management are expressed as annual equivalents, including amortized capital costs of irrigation system hardware and O&M costs. Costs are estimated to be $0.9 million/year in the Northerly Area and $1.72 million/year in Westlands.

The second category of avoided costs is net revenue losses associated with changes in cropping patterns, believed to be the more likely outcome in the drainage-impaired area over the long run. Over time, crops would shift toward a more salt-tolerant and lower water-using mix, rotational fallowing would increase, and overall cropwater application would decline. The loss in net revenue would depend on how the mix of crops changes. For this analysis, an estimate is made of the average crop ET and applied water that would allow the drainage-impaired land to remain in production. In Westlands, a mix of 50 percent cotton, 25 percent small grains, and 25 percent rotational fallowing would reduce average deep percolation to a level within the natural drainage on most drainage-impaired lands. For the Northerly Area, with slightly lower estimated natural drainage on its most impaired lands, a crop mix consisting of 35 percent cotton, 35 percent small grains, and 30 percent rotational fallow would be needed. These estimates are used for assessing the potential net revenue losses from poor drainage conditions, by comparing the restricted mix net revenue with the net revenue from crops under good drainage conditions. This analysis only represents a typical or average situation, wherein individual growers would make their decisions based on specific site and market conditions.

Table 12-7 displays estimates of the aggregate loss in net revenue from farming, using the crop shifts described above. Crop mix with drainage service provided is assumed to be similar to overall crop mix in the Unit, with the exception that the most sensitive crops (orchards and vineyards) would not be planted in areas affected by shallow groundwater. The crops for the No Action Alternative are assumed to be a mix of cotton, grains, and rotational fallow.

Prices and yields are based on Fresno County Agricultural Commissioner annual reports. Production costs were derived from the most recent crop budgets prepared by the University of California Cooperative Extension (various years). These assumptions are developed according to Reclamation guidelines for estimating costs and benefits of water projects.

The third category of cost avoided by drainage service alternatives is land retirement. Westlands has implemented a plan to retire 65,000 acres of drainage-impaired land. Under the No Action Alternative, this land is assumed to remain out of production for the 50-year planning horizon. The annual cost per acre is estimated as the loss of net revenue from agricultural production. Based on prices, yields, and production costs developed for the PFR Addendum (Reclamation 2004), the net revenue loss would average $161/acre/year in the Northerly Area and $148/acre/year in Westlands (the difference is due to different crop mixes on the affected lands). Table 12-7 also summarizes the changes in net income resulting from land retirement.

Table 12-7
Benefits (Costs) of Cropping Changes and Irrigation Improvements: Changes Relative to the No Action Alternative (million $/year in 2050)

Subarea	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Water Quality Land Retirement	In-Valley/ Water Supply Land Retirement	In-Valley/ Drainage-Impaired Area Land Retirement
Northerly Area					
Irrigation Improvements	-$0.90	-$0.90	-$0.90	-$0.90	-$0.90
Cropping Changes	$8.85	$8.85	$8.85	$8.85	$8.85
Land Retirement	-$0.85	-$0.63	-$2.33	-$2.33	-$2.33
Total	$7.09	$7.32	$5.61	$5.61	$5.61
Westlands					
Irrigation Improvements	-$1.72	-$1.72	-$1.72	-$1.72	-$1.72
Cropping Changes	$16.27	$16.27	$16.27	$16.27	$16.27
Land Retirement	$8.44	$8.72	$3.03	-$11.21	-$27.91
Total	$22.99	$23.27	$17.58	$3.34	-$13.35

Notes:

Irrigation improvements on all Northerly Area lands and on Westlands lands outside the drainage-impaired area are assumed in all action alternatives to reduce percolation to the regional aquifer. The costs of the improvements are shown in this table.

Avoided losses increase over time as drainage is installed. The estimates shown are annual figures as of the end of the planning horizon.

Negative values represent costs relative to No Action.

Water purchase costs would be incurred in several of the alternatives, to provide full water supply for the San Luis Unit. An assumption is maintained in all alternatives that groundwater pumping would average the long-term safe yield in Westlands. CVP water supply is subject to significant shortages in most years. One of the effects of land retirement for drainage control would be to reduce the overall cropwater use in the San Luis Unit. Water allocated to lands being retired would become available for other lands within the Unit. An approach was developed in the PFR Addendum (Reclamation 2004b) to estimate the amount made available for other uses by land retirement. The value of water was estimated to be the avoided cost to Westlands (or growers) of having to purchase and transfer water from other users in the Central Valley. This value was estimated to be $100/AF under average year conditions (not including district charges), based on estimates made for other planning efforts in the region (see, for example, California Bay-Delta Authority 2004).[3]

[3] More detailed analysis of the economic implications of water transfers and their cost is provided in the National Economic Development (NED) Analysis of the San Luis Unit Drainage Feasibility Re-evaluation (Appendix M). Specifically, that document evaluates the potential price effects of various amounts of water either purchased or sold, and the effect of limiting water transfer quantities to amounts observed in recent years. Those assumptions change the absolute costs of alternatives that include water transfers, but they do not change the relative ranking of alternatives,

Using this estimate of unit value, the drainage service alternatives can be compared based on the cost that would be needed to provide full water supply to the San Luis Unit. As greater amounts of land are retired, the cost would decline (more water would be available for reallocation from retired lands). The In-Valley/Water Needs Land Retirement Alternative was designed to provide an approximate "break-even" water supply condition – it would reduce total irrigation demands in the Unit to meet available expected supplies. Note that this break-even amount is an estimate based on several important assumptions: future CVP deliveries, groundwater pumping amounts, and total and per-acre cropwater demands.

Table 12-8 presents the estimated cost of water purchases avoided, under the assumption that the In-Valley/Water Needs Land Retirement Alternative would require no additional water purchases by the Unit. The estimates in this table assume that Westlands or its growers would acquire or develop other water supplies to meet the cropwater demand of lands remaining in production under each alternative.

Table 12-8
Estimates of Water Purchase Costs – Net Change Compared to No Action Alternative*
(million $ per year in 2050)

	In-Valley Disposal	Out-of-Valley Disposal	In-Valley/ Water Quality Land Retirement	In-Valley. Water Supply Land Retirement	In-Valley/ Drainage-Impaired Area Land Retirement
Northerly Area	$0.00	$0.00	$3.02	$4.80	$4.80
Westlands	-$13.45	-$13.72	-$5.63	$20.82	$51.82

* A negative value is a net cost, and a positive value is a net benefit to the San Luis Unit. The In-Valley/Drainage-Impaired Area Land Retirement Alternative results in water that can be available for uses beyond the Unit's irrigation needs.

12.2.5 Cumulative Effects

The analysis of effects in this section has not considered how the recovery of drainage service costs (incremental effects in the drainage service area) might affect agricultural production and economics in the Central Valley or State. Preliminary estimates of drainage service costs appear to be quite substantial. If recovered solely through water, land, or drainage assessments on growers using the drainage facilities, the costs would likely affect their ability to operate profitably over the long term. Under the worst circumstances, costs of project repayment could be so burdensome that growers would simply not participate in the drainage service provided. Some lands could be taken out of production to avoid the need to drain them.

Water transfers and future land retirements could influence the need for drainage and the potential effects of drainage service. A proposed (though not finalized) sale of Broadview Water District's entire CVP water allocation to a San Felipe Unit contractor (or alternatively to another CVP contractor) would remove from irrigation about 6,500 acres of drained lands in the Northerly Area. This retirement was assumed to be part of the three land retirement alternatives, but it could occur regardless of the drainage service alternative. Such reductions in irrigated land would reduce the need for drainage service and, therefore, would reduce the benefits to drainage service estimated above.

The interaction between San Luis Unit water supply and drainage conditions has been addressed to some extent by assessing the cost of water purchases (or the value of water sales) under different alternatives. This assessment is based in part on assumptions regarding future CVP deliveries to agricultural service contractors. A number of planning studies are now underway to evaluate conveyance, storage, and operation options (projects) that could change CVP deliveries. If some of these potential projects were to proceed, the demand for supplemental water purchases would decline, lowering the avoided costs shown for alternatives with land retirement. Similarly, the value of water is substantially influenced by purchases for environmental water supplies and related programs, such as the Environmental Water Account and other environmental water purchases made under the CALFED Program, and purchases for Level 4 refuge supply.

The cumulative effect of these other activities and potential projects on agricultural production is uncertain or speculative and, therefore, not possible to quantify. Water purchase programs and transfers could reduce agricultural production to some unknown extent in the San Joaquin Valley. Various water supply and management projects, including surface storage projects, groundwater storage, and improved water use efficiency, could help maintain or increase production.

12.2.6 Environmental Effects Summary

Each alternative is summarized below. The No Action Alternative is compared to existing conditions as described in Section 12.1. The following categories of effects and significance thresholds are included:

- Agricultural lands in production. A significant effect of an action alternative exists if lands in production change by more than 5 percent for either Westlands or the Northerly Area, as compared to the No Action Alternative (for No Action, the comparison is to the existing conditions).
- Crop yields, revenues, production costs.

12.2.6.1 No Action Alternative

Table 12-9 summarizes the effect of the No Action Alternative relative to existing conditions as described in Section 12.1. An additional 65,000 acres of land would be taken out of production in the Westlands subareas. Continued deterioration in soil and shallow groundwater conditions in Westlands would result in restricted crop production and resultant loss of net revenue to farmers. The loss of access to the Grassland Bypass for drainage discharge would result in significant crop revenue losses in the Northerly Area.

Table 12-9
Summary Comparison of Effects of No Action Alternative

Affected Resource and Area of Potential Effect	No Action Alternative Compared to Existing Conditions
Agricultural Lands in Production	65,000 acres out of production. Negative effect.
Crop Yields and Revenues	Continued decline in gross and net crop revenue due to restricted crop mix. Important financial and economic effect, but not an important environmental effect.
Salt Balance	Continued net addition of over 300,000 tons/year of salts to root zone and shallow groundwater. Negative effect.
Cost of Supplemental Water	Reduced need to purchase supplemental water as lands are retired. Not an important environmental effect.

12.2.6.2 Action Alternatives

Compared to the No Action Alternative, the In-Valley and Out-of-Valley Disposal Alternatives allow over 50,000 acres of agricultural land to remain in production. In addition, substantial losses in net revenue from crop production are avoided. The increased land remaining in production is judged to be a significant beneficial impact. Tables 12-10 and 12-11 summarize effects for the disposal alternatives (the three Out-of-Valley Alternatives are similar in their effects on agricultural production).

Table 12-10
Summary Comparison of Effects of In-Valley Disposal Alternative

Affected Resource and Area of Potential Effect	In-Valley Disposal Compared to No Action	In-Valley Disposal Compared to Existing Condition
Agricultural Lands in Production	52,000 acres back in production (65,000 acres avoided land retirement minus lands used for drainage facilities). Significant beneficial effect.	27,000 acres of existing retired land back in production. 13,000 acres used for drainage facilities. Net change is small.
Crop Yields, Revenues, Production Costs	Annual avoided losses of $30.1 million. Improved flexibility of crop selection. Important beneficial financial and economic effect, but not a significant environmental effect.	Avoided losses in gross and net crop revenues due to improved flexibility of crop selection. Beneficial effect.
Salt Balance	Net reduction of over 500,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction in salt accumulation. Beneficial effect.
Cost of Supplemental Water	Over $13 million/year of additional water purchases required to provide for greater leaching and higher water use in drained areas. Not a significant environmental effect.	Additional water purchases have negative financial effect on region.

Table 12-11
Summary Comparison of Effects of Out-of-Valley Disposal Alternatives

Affected Resource and Area of Potential Effect	Out-of-Valley Disposal Compared to No Action	Out-of-Valley Disposal Compared to Existing Condition
Agricultural Lands in Production	55,000 acres back in production (65,000 acres avoided land retirement minus lands used for drainage facilities). Significant beneficial effect.	27,000 acres of existing retired land back in production. 10,000 acres used for drainage facilities. Net change is small.
Crop Yields, Revenues, Production Costs	Annual avoided losses of $30.6 million. Improved flexibility of crop selection. Important beneficial financial and economic effect, but not a significant environmental effect.	Avoided losses in gross and net crop revenues due to improved flexibility of crop selection. Beneficial effect.
Salt Balance	Net reduction of over 500,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction in salt accumulation. Beneficial effect.
Cost of Supplemental Water	Over $13 million/year of additional water purchases required to provide for greater leaching and higher water use in drained areas. Not a significant environmental effect.	Additional water purchases have negative financial effect on region.

Effects of the three land retirement alternatives are summarized in Tables 12-12 through 12-14.

Table 12-12
Summary Comparison of Effects of In-Valley/Groundwater Quality Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Groundwater Quality Land Retirement Compared to No Action	In-Valley/Groundwater Quality Land Retirement Compared to Existing Condition
Agricultural Lands in Production	6,000 acres back in production (65,000 acres avoided land retirement minus lands retired for drainage control and lands used for drainage facilities). Not a significant effect.	Net change of 21,000 acres of existing land out of production. 10,400 acres used for drainage facilities. Net change is small.
Crop Yields, Revenues, Production Costs	Annual avoided losses of $23.2 million. Improved flexibility of crop selection. Important beneficial financial and economic effect, but not a significant environmental effect.	Avoided losses in gross and net crop revenues due to improved flexibility of crop selection. Beneficial effect.
Salt Balance	Net reduction of almost 500,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction in salt accumulation. Beneficial effect.
Cost of Supplemental Water	Almost $3 million/year of additional water purchases required to provide for greater leaching and higher water use in drained areas. Not a significant environmental effect.	Additional water purchases have negative financial effect on region.

Table 12-13
Summary Comparison of Effects of In-Valley/Water Needs Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Water Needs Land Retirement Compared to No Action	In-Valley/Water Needs Land Retirement Compared to Existing Condition
Agricultural Lands in Production	90,000 acres out of production (net change in lands retired for drainage control and lands used for drainage facilities). Significant effect, but not irreversible.	Net change of 117,000 acres of existing land out of production. 5,500 acres used for drainage facilities. Net reduction in land in production, but not irreversible.
Crop Yields, Revenues, Production Costs	Annual avoided losses of $9.0 million. Improved flexibility of crop selection. Moderately beneficial financial and economic effect, but not a significant environmental effect.	Avoided losses in gross and net crop revenues due to improved flexibility of crop selection. Beneficial effect.
Salt Balance	Net reduction of about 440,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction in salt accumulation. Beneficial effect.
Cost of Supplemental Water	$25 million/year reduction in cost of additional water purchases as a result of land retirement. Not a significant environmental effect.	Beneficial financial effect.

Table 12-14
Summary Comparison of Effects of
In-Valley/Drainage-Impaired Area Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Drainage-Impaired Area Land Retirement Compared to No Action	In-Valley/Drainage-Impaired Area Land Retirement Compared to Existing Condition
Agricultural Lands in Production	203,000 acres out of production (net change in lands retired for drainage control and lands used for drainage facilities). Significant effect, but not irreversible.	Net change of 230,000 acres of existing land out of production. 4,400 acres used for drainage facilities. Net reduction in land in production, but not irreversible.
Crop Yields, Revenues, Production Costs	Annual losses of $7.7 million. Not a significant environmental effect.	Avoided losses in gross and net crop revenues due to improved flexibility of crop selection. Beneficial effect.
Salt Balance	Net removal of about 370,000 tons/year from root zone and shallow groundwater. Significant beneficial effect.	Net reduction in salt accumulation. Beneficial effect.
Cost of Supplemental Water	$56 million/year reduction in cost of additional water purchases (includes value of excess water for other uses) as a result of land retirement. Not a significant environmental effect.	Beneficial financial effect. Use of available water for other needs could be a beneficial environmental effect.

12.2.7 Mitigation Recommendations

The In-Valley Disposal, Out-of-Valley Disposal, and In-Valley/Groundwater Quality Land Retirement Alternatives provide improved growing conditions for crop production. Adverse effects on agricultural production resulting from use of lands for drainage facilities are more than offset by avoided land retirement.

No mitigations are identified for significant adverse effects to agricultural lands in production and economics associated with In-Valley/Water Needs and Drainage-Impaired Area Land Retirement Alternatives. The In-Valley/Water Needs and In-Valley/Drainage-Impaired Area Land Retirement Alternatives would result in relatively large amounts of land retirement as compared to No Action. The management of these retired lands (excluding lands for drainage facilities) would maintain the lands for future agricultural use, to the extent that becomes feasible and appropriate. Therefore, no irreversible and significant loss of agricultural lands would occur.

Growers on lands to be retired would be fully compensated for the productive value of their land, so no significant economic adverse effect would fall on them. Effects on farm workers and others potentially affected by land retirement are described in other sections of this EIS (notably, Regional Economics and Social Issues and Environmental Justice).

SECTION THIRTEEN
LAND AND SOIL RESOURCES

According to the American Farmland Trust, California's Great Central Valley is the most threatened major land resource area in the United States. This is based on the market value of agricultural production, development pressure, and land quality issues (AFT 1995). The San Luis Unit contains some of the most productive lands in California. However, increasingly severe soil drainage problems and associated soil salinity and sodicity problems are putting this valuable natural resource at risk. This EIS evaluates seven action alternatives to improve existing conditions and reverse the trend toward further damage to land and soil resources in the drainage study area.

The San Luis Drainage Feature Re-evaluation lands consist of various landforms from west to east: hills (residual soils from sedimentary rocks), fan remnants (alluvium), alluvial fans (upper and mid), lower alluvial fans or fan skirts, and basin floors. Three interfan areas are also present in the study area. These areas are particularly vulnerable to drainage problems because they receive subsurface inflows from both of the two adjoining fans as well as converging canal seepage from two directions. The high groundwater recharge potential in interfan areas is often complicated by fine textured soils that restrict lateral flow and cause the water tables to rise in these areas. These interfan areas are susceptible to salt sink development. The Red Rock Ranch reuse area is a good example of an interfan land type. The interfan areas generally are the highest-elevation lands affected by shallow groundwater. Because the drainage problem involves the shallow-water table and its detrimental effects on soil salinity and land productivity, the focus of this effects analysis will be the uppermost 5 feet of the soil column. The fan skirts, interfan areas, and basin floor lands (46 percent of the Unit) are generally affected by shallow groundwater tables, while the middle and upper alluvial fans and the fan terrace lands (54 percent of the Unit) are generally not affected by shallow groundwater (Reclamation 1991a). The area affected by shallow groundwater is expected to increase to about 52 percent of the Unit over the 50-year planning period for the Re-evaluation.

Supporting material for this section is provided in Appendix I.

13.1 AFFECTED ENVIRONMENT

Westlands currently contains more than 350,000 acres suitable for growing any crop and about 250,000 acres suitable for only salt-tolerant crops. Based on the Westlands 2002 crop report (www.westlandswater.org), it appears that about 100,000 acres of land are now idle or fallowed. Many of these lands appear to be idle because of salinity and drainage problems. However, water supply limitations also limit the number of irrigated acres. Some of these lands were classified as nonarable by Reclamation and have never been irrigated with CVP water. A large number of arable acres in Westlands are idle in dry years because of inadequate water supply. About 1,000 acres of basin floor and fan skirt lands are not suited to grow any crop and were never completely reclaimed from native conditions. The Northerly Area also has lands suitable for growing all crops and some lands suitable for only salt-tolerant crops.

During the past 80 years, irrigation has changed some characteristics of the drainage study area's soils. Cultivation has generally decreased and redistributed soil organic matter in the top few inches of soil. Land subsidence and water erosion have changed the character of some slopes from simple to complex, and accelerated wind erosion has occurred on some of the sandier soils (Arroues 1998). The primary effect of irrigation on soils has been that deep percolation incidental to irrigation has caused the water table to rise into the root zone of many crops. Capillary rise of water and associated excess salts has salinized many formerly nonsaline soils. Increased soil salinity is nearly always accompanied by an increase in soil sodicity due to the greater solubility of sodium salts compared to calcium salts in the increasingly concentrated soil solution.

Over the years, some lands have been retired from agriculture because the groundwater drainage problem was too severe. Reclamation has purchased some of those lands, and Westlands has purchased others. As of 2001, a total of 2,091 acres have been retired from commercial irrigation. Westlands has retained the water supply that was formerly associated with all retired lands. Reclamation used its land classification system to rate Westlands lands for irrigation suitability. A summary of SLU lands irrigation suitability as of 2001 is presented in Table 13-1. Reclamation's land classification system reflects land development costs such as drains and assumes a drainage outlet would be provided. The land classes are based on the productive potential of the land following all needed land development operations. The annualized costs of needed land development operations are factored into the lands net return and profit potential (repayment capacity).

Table 13-1
San Luis Unit Land Classification Data

Class	Irrigation Suitability Rating	Westlands acres	San Luis acres*	Panoche acres	Broadview acres	Pacheco acres	Total San Luis Unit acres*
1	Excellent	196,519	6,005	10,129	267	558	213,478
2	Good	238,278	26,885	22,752	3,815	3,787	295,517
3	Fair	82,154	16,752	6,362	5,586	48	110,902
4	Marginal	73,298	6,339	409	6	0	80,052
Total arable		590,249	55,981	39,652	9,674	4,393	699,949
6	Unsuitable	15,225	8,097	276	31	138	23,767

* Includes some acres outside of the Unit.

13.1.1 Prime and Unique Farmlands

The NRCS has provided a list of Prime Farmlands in the drainage study area. Unique farmlands are not present in the study area.

As defined by the U.S. Department of Agriculture, Prime Farmlands consist of soils that are best suited to producing food, seed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. Adequate moisture and a sufficiently long growing season are required. Prime Farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Due to increasing drainage and salinity problems, the SLU has lost about 121,000 acres of lands qualifying as Prime Farmland since 1985. However, these lands are still considered to be Farmlands of Statewide Importance (FSI). Some of the fan remnant lands along the western boundary of the Westlands are considered to be too steep for Prime Farmland (over 5 percent slope), but local landowners and growers have demonstrated that these lands can be developed for orchard crops. Land development involves large cuts and fills, drainageways to handle infrequent runoff from upslope lands, and installation of drip or microjet irrigation systems. Once these lands are developed, they often qualify for Prime Farmland and are generally rated as Class 1 or 2 sprinkler lands by Reclamation's land classification system.

About 5,000 acres of Prime Farmland have been lost due to excessive sediment deposition in the Huron area. Arroyo Pasajero floodwaters back up on the San Luis Canal and deposit large quantities of sediment. These sediment deposits have resulted in Prime Farmlands being retired from agriculture. Westlands conceptual land use plans call for a flood channel and detention basin on downslope poorly drained retired lands. Creating a flood channel and detention basin would greatly improve this situation and minimize the further degradation of Prime Farmlands in the well-drained Huron area. Minor urbanization, feedlot development, and commercial development near major Interstate 5 interchanges have also removed Prime Farmlands from agricultural production in the Unit.

The remaining Prime Farmlands are listed in Appendix I, Attachment I-1. These lands are generally present on the well-drained middle and upper alluvial fans and on some of the more topographically favorable fan remnants near the western edge of the drainage study area. Nearly all of these lands are considered Prime Farmland. These lands can be used for any climatically adapted crops including valuable vegetable and orchard crops. Recent changes in Westlands water priority area water distribution policies and the availability of water supplies from downslope retired, idle, and fallowed lands have given these well-drained lands an increased and more reliable water supply. Land fallowing has decreased on these lands, and the acreage of orchards, vineyards, and salt-sensitive vegetable crops has increased. Irrigation suitability factors such as soil salinity and soil quality remain favorable on these lands. Some of these lands are among the most productive irrigated lands in the world. Steady-state modeling indicates that soil salinity of the active root zone on these well-drained lands based on a freely drained condition and a regular soil salinity profile predicts an average active root zone (0 to 36 inches) salinity of less than 2 dS/m. Plow layer and seedbed salinity would be less than 1.5 dS/m. This analysis assumes a mix of 90 percent San Luis Canal water and 10 percent groundwater. Soil quality factors such as aggregate stability, organic matter content, soil structure, and plow layer tilth are all at favorable levels. Irrigation suitability of these lands is currently rated as excellent based on Reclamation's most current land classification specifications for the area.

13.1.2 Farmlands of Statewide Importance

Many lands in the study area are no longer considered Prime Farmlands due to rising water tables and associated soil salinity problems. However, these lands are still considered to be FSI. The State of California standard environmental reference definition of FSI is "land other than Prime Farmland which has a good combination of physical and chemical characteristics for the production of crops, and has been used for the production of crops within the last 3 years." About 300,000 acres of basin floor, fan skirt, and interfan areas have been designated as FSI. Although this FSI in its present state lacks the productive capacity associated with Prime Farmlands, it is still suited for some crops and is considered a valuable natural resource worthy of analysis for environmental effects. Appendix I, Attachment I-2 contains FSI by county for the study area.

No drainage outlet currently exists for most of these lands, and soil salinity is generally increasing to the point that crop production is limited. While salt-tolerant crops such as cotton can be produced at near-maximum yields, other climatically adapted crops, such as many vegetables, are not produced due to reduced yields associated with excess salts. The presence of better lands upslope and the uncertainty about future drainage solutions also tend to discourage the use of FSI for orchard crops. Large areas currently appear idle both in and out of land retirement areas.

Soil salinity values (expressed in terms of electrical conductivity of the soil saturation extract [ECe]) are currently in the 3 to 10 dS/m range on these lands. The average soil salinity predicted by the APSIDE (agricultural production/ salinity/ irrigation drainage/ economics model) is about 5 dS/m in the top 5 feet of soil. Due to the presence of residual gypsum in soils of the drainage-impaired areas, the actual measured ECe values would be from 1 to 3 dS/m higher than the model predictions. Drained areas would have a residual gypsum addition of about 1 dS/m in the active root zone, and undrained areas would have a residual gypsum addition of about 3 dS/m. Due to the continuous upflux of water and salt, an inverted soil salinity profile has formed in some undrained areas where the ECe in the top foot of soil is higher than the average ECe of the soil profile. This analysis suggests that undrained lands and drained lands without an adequate drainage outlet would be too saline for Prime Farmland criteria. Drained lands with an adequate drainage outlet would meet criteria for Prime Farmland.

The occurrence of high salinity in surface soils complicates crop emergence and crop stand establishment, especially on vegetable crops. Soil quality is generally decreasing as sodium salts tend to concentrate in surface soils. Excess sodium tends to reduce soil friability, aggregate stability, and tilth. Alternative features such as evaporation basins, wetland mitigation areas, and drainwater reuse areas are expected to be sited almost entirely on FSI. Most of the retired lands would also be located on FSI.[1]

---

[1] Features in the Westlands conceptual land use plan for retired lands including commercial corridors, flood detention basins, and surface-water storage facilities would also be sited on FSI. The Westlands conceptual land use plan is preliminary and not evaluated in this EIS. Assumptions for management of retired lands are discussed in Section 2.3.4.

Two areas comprising about 4,000 acres currently serve as drainwater reuse facilities in the Northerly Area. At least five district or privately owned drainwater reuse areas were observed in Westlands. Soil salinity conditions on these lands are in the 5 to 20 dS/m range, and nearly of all these lands are growing salt-tolerant grasses that are used as forage. Some aspects of soil quality on these lands are slightly better than on similar cropped lands, since the perennial grasses tend to encourage a favorable soil structure and organic matter content in surface soils.

About 2,000 acres of FSI are currently managed for wildlife habitat, and many more acres are idle, dry farmed, or grazed. Preliminary data for some of these lands indicate that shallow groundwater levels are steadily receding and surface soil salinities are decreasing somewhat on these retired lands (Lee, pers. comm., 2003). Three years after land retirement, ECe values range from 1 to 9 dS/m with an average of 4 to 5 dS/m. Soil quality trends are difficult to evaluate; some of the soils tend to form a dry bog-type crumb structure as they dry. Deep, wide cracks are also present in wildlife habitat areas during dry periods. Surface soil organic matter levels are currently about 3 to 4 percent and are expected to decline somewhat over time as less crop residue is returned to the soils.

Minor acreages of private evaporation basins and highly saline salt management and drainwater disposal areas are also present in the study area's FSI. These areas are typically highly saline lands that have been rendered useless for future agricultural activities.

There are currently about 700 acres of salt sinks in 18 widely scattered areas in the area of potential effect (APE) (refer to Appendix I, Figure I-8). These lands are highly saline and have been rendered useless for agriculture. These lands are the most adversely impaired lands in the area, since the salts are not controlled or confined to a particular area.

13.1.3 Land Use

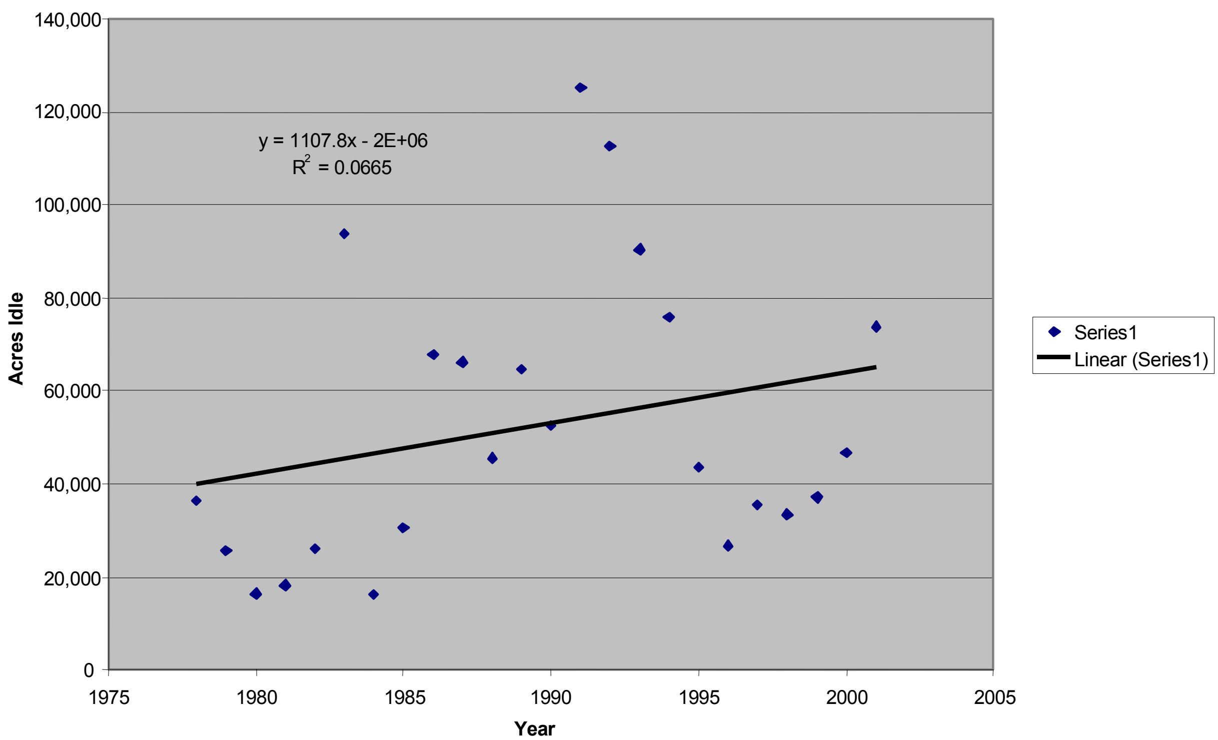
The county general plans indicate that the great majority of the drainage study area is zoned for agricultural lands. Agricultural zoning has permitted some agricultural-related commercial and residential activities such as cotton gins, feedlots, food processing, and farm labor housing. Other activities such as the interchange commercial complexes along Interstate 5 require approval from county planning departments.

Nearly all of the landowners in the study area are participating in the Williamson Act agricultural land protection program. This act gives landowners a property tax break for promising to keep their lands in agricultural production. Lands are valued for agriculture, not for urban uses or other development with higher property values than agriculture. Three small urban areas located in the study area are Mendota, Huron, and Kettleman City. Minor additions are planned for these communities.

Cropping patterns and land use have changed in the drainage study area over the years. While the study area is dominated by irrigated agriculture, minor urban areas (Huron, Mendota), and commercial uses (Harris Ranch complex, food processors) are also present and increasing. Some formerly irrigated lands are now used for dryland pasture, wildlife habitat, dryland grain, drainwater reuse areas, and sediment settling basins. Westland's crop report indicates that idle and fallow lands have been increasing over the years (Figure 13-1).

Much of the random variation shown on Figure 13-1 is due to annual water supply variability, and the systematic variation associated with the slight upward trend over time is associated with declining land productivity in drainage-impaired areas and long-term water availability restrictions. Other factors, such as increased on-farm irrigation efficiencies and reduced acreage in some high-water-use crops such as alfalfa may have also affected the magnitude of the trend. The trendline and equation are not statistically significant but are included to give the reader a general picture of historic land fallowing conditions.

Figure 13-1. Westlands Fallow and Idle Acreage Trends



A summary of cropping pattern changes in Westlands between 1978, 1990, and 2001 are listed in Table 13-2. The year 1978 coincides with the first water deliveries to the SLU's distribution system, and 1990 roughly corresponds to the peak of irrigated acres prior to acreage reductions forced by increased drainage-related salinity problems and decreased water supplies. The 2001 acreages reflect the existing conditions evaluated in this report. It should be noted that new information on the Westlands internet site indicates about 100,000 acres are now idle in the district (Westlands 2002). Retired lands increased from 2,091 acres in 2001 (existing condition year) to 20,518 acres in 2002. There are also some indications of an increasing amount of idle land in parts of the Northerly Area (Broadview District).

Table 13-2
Crop Summary Data, Westlands Water District

Crop	1978 acres	1990 acres	2001 acres	General trend
Alfalfa hay	13,771	10,716	9,701	Decrease
Cotton	272,061	235,290	188,569	Decrease
Orchards, vineyards	13,012	25,139	59,495	Increase
Small grain	129,130	34,994	50,631	Decrease-stable
Tomatoes	30,224	95,159	85,122	Increase- stable
Other vegetables	37,839	73,706	88,088	Increase
Sugar beets	6,746	7,393	5,007	Variable-stable
Other Field crops	16,584	14,206	7,484	Decrease
Alfalfa seed	17,337	10,716	2,214	Decrease
Fallow, idle	36,335	52,544	73,802	Increase
Double crop	9,021	7,069	12,873	Variable

Authorizing legislation for the SLU restricted the production of surplus crops on newly irrigated lands. The idea behind the legislation was to discourage crop surpluses that would generally drive crop prices down for existing dryland producers in more humid areas. The surplus crop list varied from year to year, but the list often included crops such as cotton, small grains, and other field crops. The cropping patterns shown in Table 13-2 indicate that a large decrease in surplus crops grown in Westlands has occurred.

The SLU is also subject to Reclamation law concerning acreage limitation. Fresno office personnel report that in the mid to late 1970s, about 250,000 acres were considered excess lands and were ineligible to receive CVP water (Phillips, pers. comm., 2003). The problem has been greatly reduced over the years, but about 5,000 acres are still considered excess lands that are ineligible for CVP water.

Reclamation law also prohibits delivery of water to lands that Reclamation considers unsuitable for sustained irrigation pursuant to Reclamation's Irrigation Suitability Land Classification System. Some of this land has been irrigated over the years, but none is irrigated today (Phillips, pers. comm., 2003). Development of new irrigation technology and expensive landowner land development and improvement operations have reduced the Class 6 acreage in the SLU to about 24,000 acres.

The approximate percentages of land use categories along the Out-of-Valley Disposal Alternatives conveyance routes are listed in Table 13-3. These percentages include drainage features in the Unit. The percentages reflect general land use types along the conveyance facilities rather than land use in the proposed routes. For example, a majority of the canal alignments follow existing ROW, and the ROW itself is in the general land types.

Table 13-3
Percentage of General Land Use Types for Out-of-Valley Disposal Alternatives

	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
Grazing Land	20	10	10
Crop Land	76	74	67
Urban Lands	1	6	8
Wetland, Riparian, and Sensitive Coastal	2	10	15

13.2 ENVIRONMENTAL CONSEQUENCES

This section focuses on physical effects of the alternatives on agricultural lands and soils. The agricultural production and economics section (Section 12) of this EIS contains a more detailed analysis of effects on agricultural productivity in terms of economic effects from anticipated crop production trends.

13.2.1 Evaluation Criteria for Land and Soil Resources

Nearly all of the well-drained areas of the SLU are considered Prime Farmland except for some of the steeper fan remnant lands and some large settling basins on Arroyo Pasajero (NRCS 1990, 1996, 2003). Nearly all of the drainage-impaired lands are considered FSI because soil salinity is too elevated and depth to water table is too shallow for maximum crop production and classification as Prime Farmland. The NRCS criteria for Prime Farmland and FSI are discussed in Sections 13.2.1.1 and 13.2.1.2.

The acreage of evaporation basins and on-farm salt management facilities is taken directly from the alternative descriptions and on-site surveys of existing reuse facilities.

The acreage of potential and existing salt sinks is based on field observations, data collected in Reclamation feasibility studies, NRCS soil salinity maps, groundwater data supplied by Westlands, and HydroFocus model output. For a more detailed description of the data and criteria used in the salt sink acreage predictions, refer to Appendix I)

The four primary evaluation criteria for land and soil resources and the relative weights applied to each are listed below:

Criteria	Units	Weighting Factor
Lands qualifying for Prime Farmland	(change in acres)	2
Lands qualifying for FSI	(change in acres)	1
Acreages of evaporation basins and salt storage facilities	(acres)	10
Acreages of salt sinks	(change in acres)	20

13.2.1.1 Prime Farmland

The NRCS criteria for Prime Farmland are as follows:

- Lands must be irrigated in San Joaquin Valley.
- Soil salinity of the active root zone (1 meter) must be lower than ECe 4 dS/m.
- Lands must not be affected by shallow groundwater.
- The exchangeable sodium percentage of the active root zone (1 meter) should be less than 15.

- The soil reaction of the saturated soil paste should be pHp 4.5 to 8.4 (pHp is the soil reaction Ph of the saturated soil paste).
- Slopes should generally be 6 percent or less.
- Soils are not subject to frequent flooding.

Soils affected by flooding, shallow groundwater, or other changeable factors can be considered Prime Farmlands if remedial measures, such as subsurface drains, are effective. An on-site inspection by an NRCS soil scientist is generally needed to evaluate the effectiveness of the remedial measures. For this analysis Prime Farmland must not be affected by shallow groundwater at depths less than 5 feet.

Changes in land qualifying for Prime Farmland over 5,000 acres are considered to be significant in the impact evaluation area.

13.2.1.2 Farmland of Statewide Importance

No specific statewide criteria for FSI are available other than the lands must have been irrigated within the past 3 years. In some states any irrigated lands that are classed by NRCS as irrigated capability Class IV or higher are classed as FSI. The party leader for the NRCS soil surveys in Kings and Western Fresno counties indicated that the following criteria were used in those counties (Arroues, pers. comm., 2003).

- ECe = 16.0 dS/m or less in the top meter
- Sodium adsorption ratio = less than 23 in the top meter
- Exchangeable sodium percentage = less than 25 in the top meter
- pHp = 4.5 to 9.0 in the top meter
- Water table depth permits growth of crops commonly grown on the soils. For this analysis depth to groundwater on FSI should not be less than 3 feet.
- Land must have been irrigated in past 3 years
- The product of the soil erodibility factor (k) and the percent slope <3.0 (roughly 8 to 10 percent slope)

A change of 10,000 acres of lands qualifying for FSI is considered a significant effect.

13.2.1.3 Evaporation Basins and Salt Management Facilities

These facilities are used to store large volumes of salts and would render the land unsuitable for future irrigation. The salts are under control and confined to discreet areas. Management and confinement operations must prevent off-site salt deposition resulting from wind and water erosion and lateral seepage. Once these facilities reach salt storage capacity, they must be isolated and capped with good soil. Dryland grasses could be grown on the reclaimed sites. Since these basins would irreversibly damage the land’s agricultural productivity, any increase in the acreage of evaporation basins is considered a significant adverse effect.

13.2.1.4 Salt Sink Areas

Salt sink areas are typically very high in surface soil salts. These salts are subject to wind erosion and often contain high levels of trace elements. These areas are typically irregularly shaped and can isolate other nearby tracts of higher quality land. Salt sinks are much more adverse to the environment than are evaporation basins, since the salt sink areas are unmanaged / uncontrollable and may contain elevated surface accumulations of Se and other trace elements. Refer to Appendix I for further information on salt sinks.

The following criteria were used to identify existing salt sink areas; salt sink areas must meet one or more of these criteria:

- Salts visible on the soil surface
- Little or no vegetation
- Temperature adjusted (25°C) EM38 horizontal readings over 500 mS/m
- Surface soil ECe over 30 dS/m
- Recent aerial photography indicates high salts on soil surface

Potential salt sink areas were identified using the following indicators:

- Steep groundwater gradients that suddenly flatten.
- Steep topographic gradients that suddenly flatten.
- Aerial photo or on-site observations indicate some soil surface salt accumulation but measured soil salinity values are not available or are not elevated enough to meet the criteria for existing salt sinks.
- April observation well groundwater readings shallower than 4 feet and do not subside below 6 feet in October.
- October groundwater levels shallower than 5 feet.
- HydroFocus model indicates a water table 7 feet or less in the general area following land retirement or shallow groundwater at depths shallower than 4 feet in irrigated undrained areas.
- Growers report equipment bogs down in the general area in springtime.
- Existing drainage system sumps handle unusually large volumes of water for the area drained, and tend to keep running even when the drained field is fallowed.
- Cone penetrometer testing and drill logs indicate water tables shallower than 4 feet, and/or artesian pressures in coarse-textured substrata layers.
- NRCS soil survey indicates highly saline soil conditions too elevated for FSI designation. (ECe over 16 ds/m in the upper meter of soil).

In uncontrolled salt sink areas, the salts may accumulate in irregular polygons; an 80-acre salt sink could render a much larger area unproductive due to isolation of better lands and field size issues. Prevailing winds can blow the salts to other nearby areas and cause severe damage to crops. Bare soil evaporation and associated soil surface salt deposition processes can also lead to accumulation of harmful toxic elements on the soil surface. Since the acreage of salt sinks is difficult to predict, often no remediation or mitigation measures are undertaken. The landowner has probably retired the land and would have no income from farming to finance remediation or mitigation measures. The grower or landowner is generally not responsible for the increase in salts, since flows from upslope lands are often the source of the excess recharge. Due to the uncontrolled and unpredictable nature of salt sink development, the estimated salt sink acreage is rated two times more adverse than a like acreage of evaporation basins.

Since salt sink areas would remove land from agricultural production and have the potential to damage nearby lands, any increase in the acreage of salt sinks is considered a significant adverse effect.

13.2.1.5 Other Evaluation Criteria

The soil classification systems described below were used to estimate the acreages of Prime Farmland and FSI that currently, potentially, and historically have existed in the San Luis Unit.

The lands were also evaluated using Reclamation's irrigation suitability land classification criteria. This evaluation was only presented in the affected environment sections of the analysis and is intended to represent anticipated land productivity under the action alternatives. A copy of the land classification standards primarily affected by the action alternatives evaluated in this EIS for the drainage study area is presented in Appendix I, Table I-3. These standards were used in the April 1991 Westlands land reclassification survey. Reclamation's land classification system is based on the productive potential of the lands following the completion of all land development operations rather than on existing conditions. The cost of the land development operations is also factored into Reclamation's land classification system. All Reclamation land classification surveys assume that all lands would be provided drainage service if and when needed. Only the estimated on-farm costs of the drainage service were factored into the land classification. Based on the 1991 Reclass survey, it appears that all lands with the exception of about 23,700 acres would qualify as FSI, if adequate drainage service is provided, and over 500,000 acres would qualify as Prime Farmland (Reclamation 1991b).

Other land evaluation criteria considered in some of the alternatives were the NRCS land capability class evaluation. This system rates the productivity of the lands based on the existing situation, the lands' limitations for field crops, and the risk of damage if the lands are used for crops. A summary of the system is listed below:

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants or that require very careful management or both.
- Class IV lands have very severe limitations that reduce the choice of plants or that require very careful management or both.
- Class V–VIII lands are increasingly unsuitable for cultivation.

Generally irrigated capability Classes III and IV would qualify for FSI, while Classes I and II would qualify as Prime Farmlands.

13.2.1.6 Land Use

Local land use general plan information, including zoning laws and ordinances, was obtained from each county in the drainage study area. Broad land use categories such as urban, municipal, irrigated agricultural, dryland agriculture, and wildlife habitat areas were selected based on easily identifiable uses that could be determined from recent aerial photos. These categories are also consistent with the Westlands conceptual plan for land use on retired lands.

Cropping patterns were evaluated based on Westlands records and data provided in the agricultural production and economics analysis (Section 12).

Construction effects to land and soils were evaluated based on the number of ROW acres required for action alternatives conveyance features, treatment plants, pumping stations, and ocean outfall facilities. Since construction-related effects and mitigation measures would be similar for all alternatives and specific sites for many features have not yet been determined, the number of acres needed for pipelines, canals, and other features was considered the primary effect analysis indicator for all alternatives. On-farm features such as canals, ditches, open drains, and field access roads would be needed to farm the reuse area. A representative layout for the reuse areas was used to estimate acres of action alternatives features. A field irrigation run length of 630 feet was used to estimate on-farm road, ditch, and drain requirements. Features for the reuse areas were estimated at 7 percent of the gross reuse area acreage. Historically the percentage of unproductive land needed by commercial farms in Westlands was 5 percent, but this increase in unproductive acreage is mostly due to shorter irrigation runs anticipated for the reuse areas. The effects of construction activities on the reuse areas would be considered less than those of construction activities along major off-farm conveyance features.

Effects from canals would include temporary construction effects as well as permanent severance of agricultural operations. The permanent severance issues associated with open canals would make them less compatible than pipelines with existing land uses. Pipeline effects would include the potential for backfilling with less productive subsoil materials; however, no permanent severance problems are anticipated. General construction effects common to all construction activities would include potential wind erosion and release of dust during construction activities and temporary suspension of normal agricultural activities in construction areas. Since these effects would be similar for all construction alternatives, the relative land-related effects would be determined based on the total acreages needed for action alternatives features and facilities.

Table 13-4 shows the weighting factors that were used to assess environmental effects on action alternatives features. The higher the weighting number value, the greater the potential damages or land use disruption. A negative rating number indicates adverse effects. The construction ratings are roughly equivalent to the rating values for the Important Farmland evaluations. Since canals and permanent aboveground action alternatives features would cause long-lasting effects and land use changes, they are weighted higher than pipelines in the damage assessment procedure. Since the features anticipated for the reuse areas are common to all existing agricultural uses in the drainage study area, they are rated the least damaging of the construction-related effects. The approximate miles of pipeline ROW in sensitive land areas such as wetlands, urban areas, riparian areas, and lands within 0.25 mile of the coast were also considered relatively major land effects and assigned a rating value of 10 due to the high level of temporary construction effects in these areas. None of the alternatives would have new canals in sensitive land areas.

Table 13-4
Action Alternatives Features and Associated Weighting Values Used in Land Use Effects Analysis

Feature	Weighting Value
Miles of pipelines in sensitive areas	10
Miles of canals	6
Pipelines (miles)	2
On-farm roads and ditches in reuse areas (acres)	1
Total permanent right-of-way acres needed	1

13.2.2 Evaluation Approach

All alternatives, including the No Action Alternative, would affect land and soil resources. The following features are evaluated for one or all of the alternatives.

- Drained lands affected by shallow groundwater
- Undrained lands affected by shallow groundwater
- Wildlife habitat in retired lands
- Dry farming retired lands
- Groundwater irrigation of Westlands-acquired lands (No Action)
- Reuse areas
- Well-drained alluvial fans and fan remnants with more reliable water supplies
- Evaporation basins
- Potential salt sink development
- Construction effects to lands and soils along conveyance features and at facility sites

The primary land and soil resource effects would be quantified in terms of the approximate acreage change of lands that qualify for Prime Farmlands and FSI. The acreages required for evaporation basins are also considered a major effects indicator because these basins would severely damage the lands. Soil quality factors are also used to qualitatively assess effects to lands. The primary soil quality factors evaluated for trends in the drainage study area are soil salinity, soil sodicity, and depth to shallow groundwater.

Prime Farmlands were evaluated based on NRCS criteria. Soil salinity estimates for upland areas were developed based on a steady-state equation that evaluated root zone salinity by quarters of the root zone. The Agricultural Research Service Watsuit model was also used as a check on salinity estimates on well-drained upland areas. The two models both indicated nearly the same soil salinity results for the active root zone. Refer to Appendix I, Section I4 for more information on these models.

Soil salinity estimates for the FSI drainage-impaired area were taken from the APSIDE model described in Section 12. The inputs for this model were evaluated for accuracy by a Reclamation soil scientist and determined to be reasonably comparable to actual field-measured values. In a few cases, APSIDE model inputs were modified based on this review. (see Appendix I, Attachment I-4). APSIDE then compared soil salinity values to crop salt-tolerance data based on research done mostly at The Riverside Salinity Laboratory to predict crop adaptability and yields, which in turn were factored into the cropping pattern analysis.

Soil salinity values for the reuse sites were taken from preliminary feasibility study soil salinity models (Minteq) and actual field soil salinity data collected at two existing reuse sites. Depth to groundwater and the extent of drainage-impaired areas for each alternative were provided by the groundwater models developed for this EIS and are referenced in Section 6. Natural drainage estimates for most areas were also based on data provided by HydroFocus. Natural drainage rate estimates for the reuse areas were based on intensive groundwater monitoring studies conducted on retired lands located on the basin floor and fan skirts about 5 miles southwest of the town of Tranquility. This site is in a similar topographic position as the proposed reuse areas.

Land use changes for retired lands were based on the land retirement estimates presented for each alternative. Retired lands not required for project facilities are assumed to be evenly distributed among fallowing, dryland farming, and dryland pasture. A land use summary table is presented in Appendix I, Table I-5.

Cropping pattern changes for the drainage-impaired areas were based on the APSIDE model. Cropping patterns on the higher fans not affected by shallow groundwater were based on a logical extension of existing cropping pattern trends provided by Westlands.

Land use estimates for the in-valley and out-of-valley conveyance routes were estimated from USGS topographic maps and soil survey information. On-site spot checks of some of the routes were also conducted. Spot checks focused on sensitive areas such as coastal areas, riparian areas, wetlands, and urban areas.

13.2.3 No Action Alternative

The No Action Alternative assumes that the proposed Federal action would not be implemented to improve the drainage and salt outlet problem. Each district and the growers would continue to attempt to solve the drainage problem on their lands but no major improvements would take place. A total of 379,000 acres would be affected by shallow groundwater by the year 2050. Presumably, no new private drain systems would be installed due to the expense of on-farm reuse and salt disposal installations. The Northerly Area districts and Panoche Drainage District, in particular, would be severely impacted by the loss of their drainage outlet in 2009. Water tables in much of Panoche Drainage District are expected to rise to within 2 feet of the ground surface, making irrigated farming nearly impossible and creating several salt sink areas. Nearly the entire Panoche Irrigation District and many adjoining areas would no longer qualify as Prime Farmland due to the shallow groundwater conditions and associated soil salinity problems. Conditions would continue to deteriorate after 2050. Salt management and disposal facilities would be installed in some current reuse areas that serve privately drained areas.

Under this alternative, agricultural productivity in the area would continue to decline. A total of 109,100 acres of lands would be retired from irrigation, and soil salinity would continue to rise on drainage-impaired lands, decreasing the overall land productivity in the area.

The retired lands would be used for wildlife habitat, dry pasture, and dryland summer fallow grain operations. These lands would no longer qualify for FSI since they would not be irrigated.

Portions of the additional 65,000 acres of land acquired by Westlands (Sagouspe settlement) and retired from CVP irrigation water deliveries could be irrigated with groundwater or other non-CVP water sources. Salt-tolerant crops such as cotton, grains, and sugar beets would be grown on these lands. Irrigation of these lands with groundwater would provide some drainage relief for the entire drainage-impaired area and reduce the potential for salt sink development. These lands would still meet the criteria for FSI, but soil salinity would be too elevated for some crops. It is anticipated that between 0 and 17,000 acres of these lands would be irrigated in any given year. The average acreage irrigated is assumed to be 6,500 acres (10 percent). It is further assumed that these acres would be rotated so that about 15,000 acres of lands would be irrigated in any consecutive 3-year period. Based on this assumption, the 15,000 acres would still qualify as FSI.

Lands remaining in production in drainage-impaired areas would continue to experience soil salinity increases. Soil salinity on these lands would exceed criteria for Prime Farmland. Growers would produce mostly salt-tolerant, low-water-use crops such as cotton, barley, safflower, and winter annual dairy support crops such as triticale. The amount of fallowed lands would increase, especially in low water supply years, which would cause the water table to slowly recede in response to the slow natural drainage (<0.1–0.3 foot per year) and to use the water supplies on permanent crops and more valuable vegetable crops grown on the higher lands that are not affected by shallow groundwater. Many of these lands have been removed from consideration as Prime Farmland since 1985, and about 76,000 acres that now are considered Prime Farmland would no longer qualify based on current soil salinity and water-table trends and projections made by the APSIDE and Hydrofocus models.

The middle and upper alluvial fans would remain productive Prime Farmland under the No Action Alternative. Production on these lands may actually increase due to additional water supplies becoming available upon retirement and increased fallowing of downslope lands.

When compared to the existing environment, this alternative would result in a net loss of about 76,000 acres of Prime Farmland and a loss of about 87,000 acres of FSI.

The size of existing district and private salt management facilities and terminal reuse areas is expected to increase by about 160 acres during the impact analysis period.

Salt sink areas are expected to increase in the No Action Alternative relative to the existing situation, since the effects of recent groundwater transfers to upslope lands have not yet fully impacted downslope areas. Groundwater-pumping-induced drainage would also be reduced somewhat under the No Action Alternative on APE lands due to land retirement.

Land use would not change due to management of retired lands for related purposes: dryland farming, grazing, or fallowing. Nearly all of the retired lands are committed to preservation as agricultural lands under the Williamson Act. These lands would not be completely changed from agriculture.

Effect Summary	Weighting Factor
Loss of Prime Farmland	76,000 acres (-152,000)
Loss of FSI	87,000 acres (-87,000)
Acreage of evaporation basins and salt storage areas	160 (-1,600)
Salt sink acreage increase	5,300 acres (-106,000)
Net effect index for land and soil resources	-346,600

13.2.4 In-Valley Disposal Alternative

Under this alternative, drainage conditions would improve, but some lands would be taken out of production for use as evaporation basins and associated mitigation facilities. Agricultural productivity would improve but not as significantly as with the three Out-of-Valley Disposal Alternatives. The lands that are artificially drained would be suited for all field crops and most vegetable crops. Soil salinity could be maintained at levels consistent with Prime Farmland soils and would result in a potential increase of about 218,000 acres of Prime Farmland. This would be a significant beneficial effect compared to No Action.

Some portions of the drainage-impaired areas that are not artificially drained would be intermittently farmed with salt-tolerant crops such as cotton, sugar beets, barley, wheat, and salt-tolerant winter forage mixes. Maintaining soil salinity at levels consistent with most field crops would be a constant battle on these lands, and soil ECe values would typically exceed criteria for Prime Farmlands. Many of these lands would probably be fallowed in poor water supply years and during periods of low crop prices. In these periods, water would be moved to more productive upslope lands. Some lands would also be idled due to marginal irrigation suitability associated with soil salinity and waterlogged conditions. Although these lands would be affected by excess salts and shallow groundwater, they would still meet the general criteria for FSI.

The alluvial fan areas would continue to be productive as water supplies previously committed to the drainage-impaired areas would be gradually shifted to the more productive upslope lands.

A total of 44,106 acres of land would be retired under this alternative. Data from the Reclamation land retirement demonstration area indicate that the water table would slowly recede following land retirement and surface soil salinity would gradually decrease. This was true for both wildlife habitat areas and areas surrounding the wildlife habitat that are used for occasionally irrigated grain. Leaching incidental to natural rainfall and the lowering of the capillary fringe zone away from the root zone has apparently facilitated the decrease in soil salinity following land retirement. These lands would no longer qualify as FSI because they would no longer be regularly irrigated. Some of the retired lands would also serve as reuse areas. The anticipated active root zone soil salinity of these areas would be about ECe 8 dS/m on the northern reuse area and about ECe 12 dS/m on the three Westlands reuse areas. These salinity values are too high for Prime Farmland but are consistent with FSI. Under this alternative, approximately 33,000 acres would be removed from FSI. This is an unavoidable adverse effect when compared to existing conditions, but there is a significant beneficial effect from the No Action Alternative (with a loss of 87,000 acres of FSI).

Lands used for evaporation basins were generally considered marginal for irrigation use even with artificial drains due to substrata with very low permeability. These lands would become highly saline after a period of years and would generally be unsuitable for irrigated or dryland farming.

A few salt sink areas would be reclaimed under this alternative using on-farm and project drainage facilities. This reduction in salt sinks is a significant beneficial effect.

Lands used for mitigation areas would be maintained at soil salinity levels consistent with Prime Farmlands. However, they would not be considered Prime Farmland unless they were irrigated for wildlife food crops, since land irrigation is one requirement for classification as Prime Farmland in the San Joaquin Valley.

The net acreage changes relative to the existing environment and No Action are as follows. This alternative is rated over 719,000 rating points better than the No Action Alternative.

Effect Summary Relative to Existing Conditions	Weighting Factor
Increase in lands qualifying as Prime Farmland	218,000 acres (+436,000)
Decrease in lands qualifying as FSI	33,000 acres (-33,000)
Evaporation basin acreage	3,290 acres (-32,900)
Decrease in salt sink acreage	200 acres (+4,000)
Net effect index on land and soil resources	+374,100

Effect Summary Relative to No Action	Weighting Factor
Increase in lands qualifying as Prime Farmland	294,000 acres
Increase in lands qualifying as FSI	54,000 acres
Evaporation basin acreage	3,290 acres
Decrease in salt sink acreage	5,500 acres
Net effect index on land and soil resources	+719,100

About 65 miles of pipeline would be constructed as part of the In-Valley Disposal Alternative along with four pumping plants and associated ROW. A total of 240 acres of permanent ROW would be needed. About 3,290 acres of evaporation basins plus any additional required mitigation (alternative habitat) areas would be needed. About 19,000 acres would be required for reuse areas. Construction activities would involve drain and pipeline installation and reconfiguration of some fields in the reuse area. Construction of pumping plants and water treatment facilities would require about 166 acres. It is assumed that retired lands would be used to site in-valley features when possible; however, other types of construction-related land and soil effects would occur. The construction effect index number is calculated below.

- Miles of canals: 0
- Miles of pipelines: 65
- Acres of reuse area roads, ditches: 534
- Acres of permanent ROW: 240
- Construction effect index rating: -904

Construction-related effects to land and soil resources would be mostly mitigatable and by themselves would not be considered a significant effect. Relative effect levels were evaluated and are displayed as a way to rank the alternatives.

The In-Valley Disposal Alternative would have the fewest construction-related effects on land and soil resources. However, the large evaporation basins needed for this alternative would remove about 3,290 acres of FSI from agricultural uses. Conversion of FSI to evaporation basins is considered a significant adverse effect, but the restoration of at least 218,000 acres to Prime Farmland status is judged to outweigh the adverse effects of the ponds. The In-Valley Disposal Alternative is judged to have a significant beneficial overall effect compared to the No Action Alternative.

Land retirement assumptions for the In-Valley Disposal Alternative indicate that Westlands would purchase and retire about 37,000 acres of land, and Reclamation would purchase and retire about 7,000 acres of land under the CVPIA program. Westlands retirement lands would probably be used for sheep pasture or dryland grain (summer fallowed). Other projected uses for retired lands would be project facilities such as reuse and evaporation basin sites. Although land use changes would reduce the amount of FSI by about 33,000 acres, this would not be considered a significant adverse effect when compared to the No Action Alternative and may be mitigatable (see Section 13.2.11).

13.2.5 In-Valley/Groundwater Quality Land Retirement Alternative

This alternative would be similar to the In-Valley Disposal Alternative but would retire all the lands in Westlands with Se concentrations over 50 ppb in shallow groundwater. About 83,000 acres would be retired in Westlands, and 10,000 acres in Broadview Water District would also be retired. The total retired acreage would be 92,592 acres. Drains would be installed on a total of 187,116 acres. The drainage systems would improve soil salinity conditions in many areas and would increase the Prime Farmland acreage by about 187,000 acres relative to existing conditions and about 263,000 acres compared to the No Action Alternative. Due to increased land retirement the acreage land qualifying for FSI relative to existing conditions would decrease by about 76,000 acres, and relative to the No Action Alternative the FSI acreage would increase by about 11,000 acres.

Plans call for 2,890 acres of evaporation basins in this alternative. The salt sink analysis predicts that about 23 salt sinks totaling about 900 acres would be present in retired areas, which is an increase of 200 acres over existing conditions and about 5,100 acres less than No Action. The overall effects rating compared to the No Action Alternative is plus 613,000 rating points.

Effects Summary Relative to Existing Conditions	Weighting Factor
Increase in lands qualifying as Prime Farmland	187,000 acres (+374,000)
Decrease in lands qualifying as FSI	73,000 acres (-73,000)
Evaporation basin acreage	2,890 (-28,900))
Increase in salt sink acreage	200 acres (-4,000)
Net effect index on land and soil resources	+268,100

Effects Summary Relative to No Action	Weighting Factor
Increase in lands qualifying as Prime Farmland	263,000 acres
Increase in lands qualifying as FSI	14,000 acres
Evaporation basin acreage	2,890 acres
Decrease in salt sink acreage	5,100
Net effect index on land and soil resources	+613,100

Effects for this alternative were scaled from the In-Valley Disposal Alternative based on the number of acres of evaporation basins needed. The effects index value for this alternative is 2,890/3,290 (-904) = -794.

13.2.6 In-Valley/Water Needs Land Retirement Alternative

This alternative is similar to the In-Valley Disposal Alternative except that all lands with Se concentrations in shallow groundwater over 20 ppb would be retired. A total of 193,956 acres of irrigated lands would be retired including about 10,000 acres in Broadview Water District. A total acreage of 122,833 acres would have tile drains installed. These drains combined with improved outlet conditions on the Northerly Area districts would permit a salinity reduction on many lands and would result in an increase of about 123,000 acres of land qualifying for Prime Farmland relative to existing conditions. Retirement of lands that presently qualify for FSI would reduce FSI acreages by about 181,000 acres.

Plans call for 2,150 acres of evaporation basins under this alternative. The salt sink analysis predicts that retired lands contain 38 potential salt sink sites. A reduction in groundwater pumping in the APE would also tend to increase the acreage of salt sinks. A total salt sink acreage of 2,300 is predicted under this alternative. This alternative is about 352,000 rating points better than the No Action Alternative.

Effect Summary Relative to Existing Conditions	Weighting Factor
Increase in lands qualifying as Prime Farmland	123,000 acres (+246,000)
Decrease in lands qualifying FSI	178,000 acres (-178,000)
Evaporation basin acreage	2,150 (-21,500)
Increase in salt sink acreage	1,600 (-32,000)
Net effect index for land and soil resources	+ 14,500

Effect Summary Relative to No Action	Weighting Factor
Increase in lands qualifying as Prime Farmland	198,000
Decrease in lands qualifying as FSI	91,000
Evaporation basin acreage	2,150
Decrease in salt sink acreage	3,700
Net effect index for land and soil resources	+351,500

Construction-related effects of this alternative were scaled from the -In-Valley Disposal Alternative based on the acreages of evaporation basins planned for each alternative. The index value is 2,150/3,290 (904) = 591.

13.2.7 In-Valley/Drainage-Impaired Area Land Retirement Alternative

This alternative would retire the entire drainage-impaired area in Westlands and 10,000 acres in Broadview Water District. No project drainage service would be provided in Westlands and all on-farm drainage and salt management would cease in retired areas. Groundwater pumping would also cease in the retired drainage-impaired areas. A total of 308,000 acres would be retired. Drainage, collection, reuse, and treatment would continue in the Northerly Area on about 47,500 acres of lands, thus facilitating favorable soil salinity conditions and Prime Farmland status of these lands. About 53,000 acres of Prime Farmland in Westlands would become too saline for Prime Farmland and/or would be retired. About 301,000 acres would be retired from irrigated agriculture and would no longer qualify as FSI.

Plans call for 1,270 acres of evaporation basins in the Northerly Area. The salt sink analysis predicts that at least 68 potential salt sinks would form comprising about 5,500 acres. Since no groundwater pumping for drainage relief is anticipated in the APE, these salt sinks would be larger under this alternative in comparison to alternatives that allow some irrigation and associated groundwater pumping in the APE. A total of about 5,500 acres of salt sinks, or about 1.5 percent of the drainage-impaired area, are predicted. Due mainly to the retirement of large acreages of land in Westlands that would no longer qualify as Prime Farmland or FSI, this alternative is rated lower than the No Action Alternative for land and soil resources by about 260,000 rating points. It should be noted that this alternative is much better for the Northerly Area than the No Action Alternative.

Effect Summary Relative to Existing Conditions	Weighting Factor
Decrease in lands qualifying as Prime Farmland	53,000 acres (-106,000)
Decrease in lands qualifying as FSI	298,000 acres (-298,000)
Evaporation basin acreage	1,270 (-12,700)
Increase in salt sink acreage	4,800 (-96,000)
Net effect index for land and soil resources	-512,480

Effect Summary Relative to No Action	Weighting Factor
Increase in lands qualifying as Prime Farmland	23,000
Decrease in lands qualifying as FSI	211,000
Evaporation basin acreage	1,270
Decrease in salt sink acreage	500
Net effect index for land and soil resources	-259,700

Construction-related effects for this alternative were scaled from the In-Valley Disposal Alternative based on the evaporation basin acreages. The index value is 1,270/3,290 (904) = 349.

13.2.8 Out-of-Valley Disposal Alternatives

Under any of the Out-of-Valley Disposal Alternatives, drainage conditions would improve significantly and agricultural production would gradually increase. These alternatives would allow the drainage study area lands, except for lands required for reuse areas, to reach their productive potential. These alternatives would drain about 1,200 more acres than the In-Valley Disposal Alternative, which would facilitate a corresponding increase in Prime Farmland acreage. The Out-of-Valley Disposal Alternatives would be the best for land and soil resources in the, drainage study area. No evaporation basins would be needed for these alternatives, which is considered a benefit for land and soil resources. Many of the lands on the lower alluvial fans and interfan areas would gradually improve and meet the criteria for Prime Farmland. The reuse areas would remain in the category of FSI.

The Out-of-Valley Disposal Alternatives would create a net increase in Prime Farmland in the Unit of about 295,000 acres relative to the No Action Alternative and about 219,000 acres relative to existing conditions. The increase in lands meeting the criteria for Prime Farmland would be considered a beneficial effect. The reuse areas would be too saline for Prime Farmland, but would still qualify for FSI. These lands could be quickly reclaimed if reuse areas were no longer needed, since the excellent deep drainage system that would be installed under these lands would facilitate salt leaching. About 31,000 acres would no longer qualify as FSI due to suspension of irrigation.

On-farm and project drainage facilities would be used to facilitate reclamation of about 200 acres of salt sink areas.

A total of 44,106 acres would be retired for these alternatives. At least 50 percent of the retired lands would be used for drainwater reuse areas. The remaining retired lands would presumably be used for dryland pasture or dry-farmed grain, and/or be fallowed or idled.

The acreage changes in important farmland categories for these alternatives relative to the existing environment are listed below. These alternatives would be about 759,000 rating points better than the No Action Alternative.

Effect Summary Relative to Existing Conditions	Weighting Factor
Increase in lands qualifying as Prime Farmland	219,000 acres (+ 438,000)
Decrease in lands qualifying as FSI	28,000 acres (-28,000)
Evaporation basin acreage	0 acre (0)
Decrease of salt sink acreage	200 acres (+4,000)
Net effect index for land and soil resources	414,000

Effect Summary Relative to No Action	Weighting Factor
Increase in lands qualifying as Prime Farmland	295,000 acres
Increase in lands qualifying as FSI	59,000 acres
Evaporation basin acreage	0 acre
Decrease of salt sink acreage	5,500 acres
Net effect index for land and soil resources	+759,000

Proposed features associated with the Out-of-Valley Disposal Alternatives are presented in Table 13-5.

Table 13-5
Comparison of Proposed Features of Out-of-Valley Disposal Alternatives

Feature	Ocean Disposal	Delta-Chipps Island Disposal	Delta-Carquinez Strait Disposal
Miles of pipeline	174.8	46.5	63.9
Miles of new canal	0	60.1	60.1
Acres of reuse area roads and ditches	544	544	544
Acres of permanent ROW	670	740	810
Miles of pipeline in sensitive areas	4	20	32
Construction effect index rating	-1,604	-1,938	-2,163

Lands along the canal and pipeline routes to the ocean would be temporarily disturbed during construction activities for the Out-of-Valley Disposal Alternatives, and normal uses of the lands could be suspended during construction. These construction activities could cause major disruptions in urban areas or sensitive land areas such as wetlands, riparian areas, or coastal habitats. Although temporary, these disruptions would be significant adverse effects. All pipelines would be backfilled in a manner to retain land productivity. In some cases on NRCS capability Class I to IV lands, valuable topsoil would be stockpiled and placed on top of other backfill materials. With these construction measures to minimize temporary disturbances, effects on soil and land resources can be mitigated to not significant.

Open canals could sever some land ownerships and make farm or ranch units more expensive to operate. Bridges and siphons would be provided at regular intervals to reduce these effects.

Since effects from portions of the Out-of-Valley Disposal Alternatives that are similar to the In-Valley Disposal Alternative are equivalent, only minor differences in construction-related effects can be used to rank these alternatives. The land and soil resources rankings for the Out-of-Valley Disposal Alternatives are listed below:

- Ocean Disposal Alternative (best)
- Delta-Chipps Island Disposal Alternative
- Delta-Carquinez Straight Disposal Alternative

Land use effects would be minimal in the drainage study area; however, about 8,000 acres of the retired lands would be used for action alternatives features such as reuse areas, water treatment, and conveyance facilities. The remaining 36,000 acres of retired lands could be used for wildlife habitat, dryland sheep pasture, and dryland grain production (summer fallow or annual).

Land uses would likely change in small-acreage areas along the conveyance route outside of the study area. Open canals would probably require conversion of some farmland and rangeland to ROW for municipal uses. This would not be considered a significant effect when compared to the No Action Alternative.

13.2.9 Cumulative Effects

Cumulative effects of the major resource indicators evaluated are presented below. All of the alternatives including the No Action Alternative would contribute to significant adverse cumulative effects for at least some indicators for the land and soil resources of California. Some alternatives would result in a net positive cumulative effect for land and soil resources.

Prime Farmland acreage is decreasing throughout the San Luis Unit, California, and the nation. Urbanization and sediment deposition issues unrelated to SLDFR alternatives have removed about 6,000 acres of Prime Farmland from agricultural production during the past 30 years in the San Luis Unit. Urbanization and retirement of irrigated lands due to lack of water supplies are the primary causes of Prime Farmland losses in California. Recent reports from the California Department of Conservation (CDC 2001) indicate that 44,000 acres of Prime Farmland were lost between 1998 and 2000, and a total of 91,000 acres of land was urbanized. The loss of Prime Farmlands and FSI as a result of some action alternatives and the No Action Alternative would reduce the long-term food security of the nation. Land and water lost to agriculture would also tend to make future food supplies more expensive. Prime Farmland losses of 14,000 acres or more are considered a significant adverse cumulative effect, since this level approximates the Prime Farmland acreages converted annually during the past 3 years in the entire state of California. The No Action Alternative and In-Valley/Drainage-Impaired Area Land Retirement Alternative both exceed the threshold level for cumulative significant adverse impacts. Loss of Prime Farmland due to land retirement in irrigated areas such as California is somewhat less detrimental to the nation’s food security than irreversible losses in more humid regions of the country. Many western states currently have more good lands than water; therefore, lack of irrigation water is the most limiting factor on food production. It should be noted that some of the alternatives considered would restore up to nearly 300,000 acres of land to Prime Farmland status. This would be a very significant beneficial effect for the farmland resources of California and the nation.

Loss of lands qualifying for FSI is also a major concern in California. These lands are less productive than Prime Farmland but are currently used to grow salt-tolerant crops. Losses of FSI over 28,000 acres would be considered a significant threshold for cumulative impacts to the State of California. Urbanization and reduction of agricultural water supplies is currently causing major reductions in the FSI acreage in California. All of the alternatives evaluated would result in significant FSI losses on both a local and regional basis.

Evaporation basins are used to isolate and store salts leached from irrigated lands. These basins facilitate maintenance of high productivity of vast acreages of farmland. Lands used for evaporation basins are salinized to the point of being useless for any type of agricultural uses. There are currently about 4,000 acres of active and abandoned evaporation basins in the San Joaquin Valley. The In-Valley Alternatives would significantly increase the acreage of evaporation basins.

Salt sinks are currently present in some irrigated areas of the San Joaquin Valley. Some of these salt sinks are remnants of natural conditions and some are the result of canal seepage, irrigation of lands unsuited for sustained irrigation, and localized canal seepage and/or drainage problems. From a land and soil productivity perspective most salt sink areas have been irreversibly damaged and could not be economically reclaimed for agricultural production. These areas can also reduce the agricultural productivity of surrounding lands. Any increase in salt sink acreages is considered an adverse cumulative effect. Salt sink acreages predicted for the No Action Alternative are considered to be a significant adverse cumulative effect on the productivity of land and soil resources of California. All of the action alternatives reduce the predicted salt acreage compared to No Action.

13.2.10 Environmental Effects Summary

13.2.10.1 No Action Alternative

When compared to the existing environment, this alternative would result in a net loss of about 76,000 acres of Prime Farmland and a loss of about 87,000 acres of FSI. An increase of 5,300 acres of salt sink area is predicted compared to existing conditions.

Loss of productive farmland is inconsistent with local zoning policies and general plans. The land and soil index rating for this alternative is -346,600.

13.2.10.2 In-Valley Disposal Alternative

This alternative would increase the productivity of SLU lands, increasing the acreage of land meeting the criteria for Prime Farmland. The evaporation basins required for this alternative would be an unavoidable adverse effect, but would be more than offset by the beneficial effects of increases in land productivity. The land and soil index rating for this alternative is + 374,100.

13.2.10.3 In-Valley/Groundwater Quality Land Retirement Alternative

This alternative would increase the productivity of SLU lands and increase the acreage of lands meeting the criteria for Prime Farmland. Unavoidable adverse effects of evaporation basins and salt sinks would be more than offset by the beneficial effects in land productivity. The index rating for this alternative is +268,100.

13.2.10.4 In-Valley/Water Needs Land Retirement Alternative

This alternative would remove large acreages from irrigated production. Salt sinks would develop in some of these areas, but salt sink acreage would be less than predicted under No Action. Loss of productive farmland is inconsistent with local zoning policies and general plans. As far as land and soil resources are concerned this alternative is somewhat superior to the No Action Alternative, but represents a degraded condition from existing conditions. The index rating for this alternative is +14,500.

13.2.10.5 In-Valley/Drainage-Impaired Area Land Retirement Alternative

This alternative would remove large acreages from irrigated production. Salt sinks would develop in some areas, but salt sink acreage would be less than predicted under No Action. Loss of productive farmland is inconsistent with local zoning policies and general plans. This alternative is rated the worst for land and soil resources. The index rating for this alternative is -512,480.

13.2.10.6 Out-of-Valley Disposal Alternatives

These alternatives all provide significant beneficial effects to San Joaquin Valley's land and soil resources. All of the Out-of-Valley Alternatives are superior to the In-Valley Disposal Alternatives because they would not require evaporation basins. These alternatives also provide a longer-term solution to the drainage problem since they tend to export salts rather than store salts in project soils and aquifer systems. Index ratings for these alternatives are presented below:

Alternative	In-Valley	Construction
Ocean Disposal	+414,000	-1,604 (best)
Delta-Chipps Island Disposal	+414,000	-1,938
Delta-Carquinez Straits Disposal	+414,000	-2,163

Tables 13-6 through 13-13 summarize the effects that the No Action Alternative and the action alternatives have on land use and soil resources.

Table 13-6
Summary Comparison of Effects of No Action Alternative

Affected Resource and Area of Potential Effect	No Action Alternative Compared to Existing Conditions
Prime Farmland	Decrease of 76,000 acres. Negative effect.
FSI	Decrease of 87,000 acres. Negative effect.
Evaporation basins, salt management areas	About 160-acre increase. Negative effect.
Salt sinks	Increase of 5,300 acres. Negative effect.
Construction-related	None. No effect.
Land use	Inconsistent with local policies. Negative effect.

Table 13-7
Summary Comparison of Effects of In-Valley Disposal Alternative

Affected Resource and Area of Potential Effect	In-Valley Disposal Compared to No Action	In-Valley Disposal Compared to Existing Conditions
Prime Farmland	Increase of 294,000 acres. Significant beneficial effect.	Increase of 218,000 acres. Major positive effect.
FSI	Increase of 54,000 acres. Significant beneficial effect.	Decrease of 33,000 acres. Negative effect.
Evaporation basins	Increase of 3,290 acres. Significant adverse effect; unavoidable.	Increase of 3,290 acres. Negative effect.
Salt sink	Decrease of 5,500 acres. Significant beneficial effect.	Decrease of 200 acres. Positive effect.
Construction-related	Significant adverse effects. Mitigatable to not significant.	Adverse effects, mitigatable.
Land use	50,000 acres of land stays in production, cropping patterns improve. Significant beneficial effect.	Minor changes. Minimal effect.

Table 13-8
Summary Comparison of Effects of
In-Valley/Groundwater Quality Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Groundwater Quality Land Retirement Compared to No Action	In-Valley/Groundwater Quality Land Retirement Compared to Existing Conditions
Prime Farmland	Increase of 263,000 acres. Significant beneficial effect.	Increase of 187,000 acres. Major positive effect.
FSI	Increase of 14,000 acres. No significant effect.	Decrease of 73,000 acres. Negative effect.
Evaporation basins	Increase of 2,890 acres. Significant adverse effect; unavoidable.	2,890 acres. Negative effect.
Salt sinks	Decrease of 5,100 acres. Significant beneficial effect.	Increase of 200 acres. Negative effect.
Construction-related	Significant adverse effects. Mitigatable to not significant.	Negative effects, mitigatable to minor effect.
Land use	Minor changes. No significant effects.	Minor changes. Minimal effects.

Table 13-9
Summary Comparison of Effects of
In-Valley/Water Needs Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Water Needs Land Retirement Compared to No Action	In-Valley/Water Needs Land Retirement Compared to Existing Conditions
Prime Farmland	Increase of 198,000 acres. Significant beneficial effect.	Increase of 123,000 acres. Positive effect.
FSI	Decrease of 91,000 acres. Significant adverse effect; mostly unavoidable.	Decrease of 178,000 acres. Negative effect.
Evaporation basins	Increase of 2,150 acres. Significant adverse effect; unavoidable.	2,150 acres. Negative effect.
Salt sinks	Decrease of 3,700 acres. Significant beneficial effect.	Increase of 1,600 acres. Negative effect.
Construction-related	Significant adverse effects. Mitigatable to not significant.	Negative effects. Mitigatable to minor effects.
Land use	Major changes inconsistent with local and State plans and laws. Significant adverse effect; unavoidable.	Major land use changes. Negative effect.

Table 13-10
Summary Comparison of Effects of
In-Valley/Drainage-Impaired Area Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Drainage-Impaired Area Land Retirement Compared to No Action	In-Valley/Drainage-Impaired Area Land Retirement Compared to Existing Conditions
Prime Farmland	Increase of 23,000 acres. Significant beneficial effect.	Decrease of 53,000 acres. Negative effect
FSI	Decrease of 211,000 acres. Significant adverse effect; mostly unavoidable.	Decrease of 298,000 acres. Major negative effect.
Evaporation basins	Increase of 1,270 acres. Significant adverse effect.	1,270 acres. Negative effect.
Salt sinks	Decrease of 500 acres. Significant beneficial effect.	Increase of 4,800 acres. Major negative effect.
Construction-related	Not significant.	Minor effects.
Land use	Major changes inconsistent with local and state plans and laws. Significant adverse effect; unavoidable.	Major negative effect.

Table 13-11
Summary Comparison of Effects of Ocean Disposal Alternative

Affected Resource and Area of Potential Effect	Ocean Disposal Compared to No Action	Ocean Disposal Compared to Existing Conditions
Prime Farmland	Increase of 295,000 acres. Significant beneficial effect.	Increase of 219,000 acres. Major positive effect.
FSI	Increase of 59,000 acres. Significant beneficial effect.	Decrease of 28,000 acres. Negative effect.
Evaporation basins	None. No effect.	None. No effect.
Salt sinks	Decrease of 5,500 acres. Significant beneficial effect.	Decrease of 200 acres. Minimal effect.
Construction-related	Significant adverse effect. Mitigatable to not significant.	Significant negative effect. Mostly mitigatable to no effect.
Land use	50,000 acres of land stays in agricultural production. Cropping patterns improve. Significant beneficial effect.	Minor changes. Minimal effect.

Table 13-12
Summary Comparison of Effects of Delta-Chipps Island Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Chipps Island Disposal Compared to No Action	Delta-Chipps Island Disposal Compared to Existing Conditions
Prime Farmland	Increase of 295,000 acres. Significant beneficial effect.	Increase of 219,000 acres. Major positive effect.
FSI	Increase of 59,000 acres. Significant beneficial effect.	Decrease of 28,000 acres. Negative effect.
Evaporation basins	None. No effect.	None. No effect.
Salt sinks	Decrease of 5,500 acres. Significant beneficial effect.	Decrease of 200 acres. Minor positive effect.
Construction-related	Significant adverse effect. Mitigatable to not significant.	Significant negative. Mostly mitigatable to no effect.
Land use	50,000 acres stays in agricultural production. Cropping patterns improve. Significant beneficial effect.	Minor changes. Minimal effect.

Table 13-13
Summary Comparison of Effects of Delta-Carquinez Strait Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Carquinez Strait Disposal Compared to No Action	Delta-Carquinez Strait Disposal Compared to Existing Conditions
Prime Farmland	Increase of 295,000 acres. Significant beneficial effect.	Increase of 219,000 acres. Major positive effect.
FSI	Increase of 59,000 acres. Significant beneficial effect.	Decrease of 28,000 acres. Negative effect.
Evaporation basins	None. No effect.	None. No effect.
Salt sinks	Decrease of 5,500 acres. Significant beneficial effect.	Decrease of 200 acres. Minor positive effect.
Construction-related	Significant adverse effect. Mitigatable to not significant.	Significant negative effect. Mostly mitigatable to no effect.
Land use	Productivity of land increases. 50,000 acres stay in agricultural production. Cropping patterns improve. Significant beneficial effect.	Minor changes. Minimal effect.

13.2.11 Mitigation Recommendations

Providing bridges and canal siphons at regular intervals across canals to reduce **severance effects** on local land users can mitigate permanent land use effects. Pipelines in areas of cropland and high-quality rangelands should be backfilled in a manner that places the existing topsoil back on the surface of the backfill. Pipeline areas would be reseeded with rangeland grasses and forbs common in the adjacent areas. Stockpiles, new canal banks, and temporary construction zones should be periodically sprayed with water to prevent wind erosion and abate dust. Water erosion control measures would be needed along some pipeline alignments and canals. These mitigation measures are judged to reduce construction effects to the no-significant-effect level or in some alternatives the minor adverse effect level.

SECTIONFOURTEEN
RECREATION RESOURCES

This section briefly describes the recreation resource setting for the San Luis Drainage Feature Re-evaluation and identifies environmental effects of the alternatives.

14.1 AFFECTED ENVIRONMENT

14.1.1 Physical Environment

Recreation in the Central Valley portion of the project area that could be affected by the action alternatives consists mainly of wildlife viewing and hunting in wildlife refuges or wildlife management areas. Most recreation activities associated with these areas are associated with the presence of waterfowl and upland game. Some wildlife areas are open to the public with hiking trails, viewing areas, camping, hunting, self-guided tours, and limited fishing in some of the wildlife areas. Also numerous private hunting clubs provide opportunities for members to hunt ducks, geese, and pheasants.

Most visitation to the wildlife refuges and management areas occurs during winter when the waterfowl are present. Approximately 45 percent of the total use occurs between October and January, with June through August use at approximately 20 percent of total use. All hunting occurs between October and January, and fishing occurs year-round (Reclamation 1997).

The existing condition of the project area consists of the San Luis Drain that passes through several wildlife areas, including numerous duck ponds, the Los Banos Wildlife Management Area (WMA), the San Luis National Wildlife Refuge (NWR), the Grasslands WMA, and the North Grasslands WMA. Hunting in the 2004-2005 season for ducks, geese, and pheasants is permitted between the last Saturday in October through January 2005, in the San Luis NWR and in Los Banos WMA. Most species of ducks (except pintails and canvasbacks) and geese can be hunted during the entire season, while pintails and canvasbacks have a split season during that period (CWA 2004). Fishing is also permitted in these areas. San Luis NWR provides self-guided tours, and camping is permitted at the staging areas during hunting season. Camping is also permitted at Los Banos WMA in the parking lots, and the management area is open to hiking and bike riding all year.

Recently, the California Environmental Protection Agency's Office of Environmental Health Hazard Assessment issued the following advisories for waterfowl consumption. The office determined whether a public health hazard may exist from consumption of waterfowl taken from certain locations based on laboratory testing data. The guidelines are based on risk estimates that assume long-term consumption; therefore, the occasional intake of duck meat above the recommended amounts is not expected to produce a health hazard. All of the following warnings are due to elevated Se levels (CDFG 2004):

- Grasslands area (western Merced County) – no one should eat more than 4 ounces of duck meat in any 2-week period. No one should eat livers of duck from the area.
- Suisun Bay (Contra Costa and Solano counties) – no one should eat more than 4 ounces per week of (greater or lesser) scaup meat or more than 4 ounces of scoter meat in any 2-week period. No one should eat livers of duck from the area.
- San Pablo Bay (Contra Costa, Marin, Solano and Sonoma counties) – no one should eat more than 4 ounces per week of greater scaup meat or more than 4 ounces of scoter meat in any 2-week period from the Bay. No one should eat livers of duck from the area.
- San Francisco Bay (Alameda, Contra Costa, Marin, San Francisco, San Mateo, and Santa Clara counties) – no one should eat more than 4 ounces per week of greater scaup meat from the Central Bay or more than 4 ounces of greater scaup meat from the South Bay in any 2-week period. No one should eat livers of duck from the area.

Fishing is allowed in several of the refuges. Although not officially allowed, fishing is also popular along many of the irrigation canals and sloughs. For example, fishing is not officially permitted at Mud Slough, and biological toxicity monitoring was implemented in Mud Slough to assess the effects of the Grassland Bypass Project's drainwater on the aquatic community. Tissue sampling of the biological specimens allows analysis of the potential risk to fish and wildlife resources as well as the public health risks (Reclamation 1996). "No Fishing" signs have been posted at Mud Slough to protect people from ingesting high Se levels.

Fishing discussed herein is considered recreational, but fishing may also be considered to occur on a subsistence level. A discussion of subsistence-level fishing is contained in Section 18.

The In-Valley Disposal Alternative would include a drainwater collection system within each subarea, regional reuse facilities within each subarea (up to 16), four evaporation basins (one in each subarea), an RO treatment facility and Se biotreatment plant adjacent to each of the four evaporation basins, and a conveyance system for collecting reused drainwater from each subarea and delivering it to the RO and Se treatment facilities. The approximate location of the Northerly Area evaporation basin would be adjacent to and south of the Grasslands WMA, one of the largest blocks of wetlands in the Central Valley. This WMA is comprised of 70,000 acres of privately owned lands with perpetual conservation easements by the U.S. Fish and Wildlife Service (Grasslands WMA 2003). The Westlands North evaporation basin would be located approximately 3 miles south of the town of Mendota and within 10 miles of the Mendota Wildlife Area, which consists of 11,800 acres of flatlands and floodplains (Mendota Wildlife

Area 2003). The Westlands Central evaporation basin would be located northwest of the community of Five Points, and the Westlands South evaporation basin would be located south of Lemoore Naval Air Station. No wildlife areas are located near either of these communities.

For both Delta Disposal Alternatives, the potential alignment would begin in the northwestern portion of the San Luis NWR and would pass through the China Island area of the North Grasslands WMA. The alignment would then be located near several small, regional parks, but would not actually pass through any. Included are Laird Park (near Grayson), South County Regional Park and San Durham Ferry State Recreation Area (near San Joaquin), Clifton Court Forebay (south of Discovery Bay), and Contra Loma Regional Park and Antioch Municipal Reservoir (near Antioch).

For the Delta-Chipps Island Disposal Alternative, the potential alignment would pass by an existing powerplant in Pittsburg and would not cross any recreation lands. For the Delta-Carquinez Strait Disposal Alternative, the alignment would continue west to Crockett. From Pittsburg, the route would first follow the Southern Pacific and AT&SF rail lines to the Concord Naval Weapons Station. There the route would follow the Southern Pacific rail line to Martinez, along Martinez Waterfront Regional Shoreline, past Port Costa, to Crockett. Both alignments would be closed pipe from an area just north of Brentwood.

Recreation activities in the Sacramento-San Joaquin River Delta (Delta) include motor boating, fishing, swimming, waterskiing, and sailing with motor boating and fishing leading in popularity. Approximately 20 public and more than 100 commercial recreational facilities that provide rentals, services, camping guest docks, fuel, supplies, and food are located in the Delta. Sport fishing in the Delta occurs year-round and may take place on private vessels or from shore. Other recreation activities in the Delta include overnight camping, picnicking, photography, bicycling, hunting, and wildlife observation. Numerous private waterfowl and pheasant hunting clubs exist in the Delta region as well (State Board 1997).

The Ocean Disposal Alternative’s conveyance system would not cross through any recreation areas. In one area, the alignment of this alternative would pass just to the north of Camatti Park along the headwaters of the Estrella River, northeast of Paso Robles.

The Point Estero outfall would consist of approximately 1.5 miles of pipeline off the coast and a diffuser at the end of the pipeline 200 feet below sea level. South of Point Estero in nearby Cayucos, sea kayaking, skin diving, surfing, and swimming are all popular water activities. In addition, deep sea fishing tours can be booked from the south out of Morro Bay or the north at San Simeon.

Cayucos Land Conservancy, formed in March, 1999, was recently granted a perpetual conservation easement (issued March 3, 2000) over the coastal terrace that stretches from Cayucos to Villa Creek. California Department of Parks and Recreation received fee ownership. As a result of the easement, Cayucos Land Conservancy plans to keep the land “as is” and plans to actively participate in the development of a long-term management plan (www.cayucos.org/clc/index.html).

14.1.2 Regulatory Environment

Several Federal and State regulations could be applicable for recreation resources and are described in Appendix L, Section L6. Included are the Wild and Scenic Rivers Act of 1968, California Wild and Scenic Rivers Act, Wilderness Act of 1964, as amended, and Federal Water Project Recreation Act. No wild and scenic rivers are located within the project area so neither the Federal nor State regulations would apply. In addition, no wilderness areas are in the project area so the Wilderness Act would not be applicable.

The Federal Water Project Recreation Act requires that recreation and fish and wildlife enhancement be given full consideration in Federal water development projects; however, these alternatives are drainage options, and as such, would not have any water development components. The evaporation basins would be located and designed to discourage wildlife use. The mitigation areas, while they would encourage wildlife use and could provide recreational value, are also not part of a water development project. Thus, the Federal Water Project Recreation Act would not be applicable to this alternative.

14.2 ENVIRONMENTAL CONSEQUENCES

14.2.1 Evaluation Criteria

The recreation activities in the drainage study area primarily consist of wildlife viewing, hunting, and fishing in the wildlife refuges. There are three significance criteria for recreation resources:

- Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facilities would occur or be accelerated?
- Does the project include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?
- Do any of the project facilities interfere with the use of existing recreation?

The potential pipelines, canals, reuse facilities, treatment plants, and evaporation basins are to be located in areas that currently are agricultural and are outside cities or densely populated areas. The primary issue that could affect recreation would be the location and design of the reuse facilities and evaporation basins. Wildlife currently frequent numerous duck ponds and wetland areas in the project area and could be attracted to both the reuse areas and evaporation basins. These basins in particular would have elevated salt and Se levels that would pose potential biological hazards for wildlife (Section 8.2.4).

14.2.2 Evaluation Approach

To assess the environmental consequences of the alternatives on recreation resources, the potential routes and alternative features developed during the San Luis Drainage Feature Re-evaluation effort were evaluated. The miles of tunnel and pipe, acres of reuse and Se treatment facilities, and acres of evaporation basins and mitigation facilities are shown in Tables 2.5-1, 2.6-1, 2.7-1, and 2.8-1 contained in the alternative descriptions.

The pipeline and tunnel routes as well as the estimated location of treatment facilities, evaporation basins, and mitigation areas were checked to the TOPO! feature maps and DeLorme gazetteer maps for identification of recreation areas (TOPO! 2001; DeLorme 1998). In addition, two GIS layers – Public Lands and Parks – were checked against the possible alignments for recreation uses (ESRI, undated).

14.2.3 No Action Alternative

The No Action Alternative would consist of reasonably foreseeable future conditions without drainage service alternatives. Under the No Action Alternative approximately 109,100 acres of land would be retired from irrigation. Some reuse due to the existing Grassland Bypass Project would occur, and existing pilot projects that could utilize reuse and treatment systems would continue in the area.

With no drainage service to the drainage study area, it is probable that salts and Se could accumulate in some areas and reduce the viability of the affected lands for wildlife habitat. Recreation use could be reduced if some areas with hunting or wildlife viewing potential were put out of operation. In addition, fishing in the nearby wildlife refuges could be affected if the salts or Se levels became elevated due to uncontrolled discharges within the watershed from seepage, unplanned discharges, and/or storm events.

14.2.4 In-Valley Disposal Alternative

The In-Valley Disposal Alternative would include a drainwater collection system within each subarea, regional reuse facilities within each subarea (up to 16), four evaporation basins (one in each subarea), an RO treatment facility and Se biotreatment plant adjacent to each of the four evaporation basins, and a conveyance system for collecting reused drainwater from each subarea and delivering it to the RO and Se treatment facilities.

The evaporation basins have the potential to attract wildlife (Figure 14-1). As explained in Section 8.2.4, salts and Se can accumulate in the evaporation basins and reuse areas and could pose a biological risk to wildlife. Indirectly, this may have a significant adverse effect on wildlife viewing/hunting if wildlife numbers are reduced at adjoining private duck clubs or wildlife management areas. To protect wildlife from accumulations of salts and Se, the basins would be designed and operated to be as unattractive to birds and other wildlife as possible. Also, the development of additional wetlands and other related habitat enhancements would mitigate significant effects to waterbirds and, therefore, mitigate indirect effects on recreation. Thus, with mitigation the effect on recreation is reduced to not significant.

With the creation of the evaporation basins, substantial acres of alternative and/or compensation habitat for mitigation would be constructed and/or enhanced managed wetland habitats (Section 20.2.2). It is possible that some of the waterfowl currently using known wildlife refuges or duck clubs could use these newly created wetlands, and they could be located near existing refuges or wildlife management areas. However, the future management of these mitigation lands is uncertain, and it may be that they could be managed for recreation, such as hunting or wildlife viewing, as are current refuges if this would not encourage the waterfowl to visit the evaporation basins. Thus, it is anticipated that recreation would not increase with this alternative. Although the location of recreation use might shift, overall recreation in the area would be unaffected.

Any retired agricultural lands converted to nonirrigated crops would continue to periodically be disturbed for soil management activities, and, therefore, would not typically develop significant wildlife value (Section 7.2.4.1). In retirement, these lands would be managed for grazing and/or dryland farming, or would remain fallow. Because the nearby habitat does not change significantly due to land retirement, the wildlife viewing/hunting would be unaffected. Therefore, land retirement would not affect recreation under this alternative.

14.2.5 In-Valley/Groundwater Quality Land Retirement Alternative

Under the In-Valley/Groundwater Quality Land Retirement Alternative, lands within Westlands having a Se concentration greater than 50 ppb in the shallow groundwater, as well as lands acquired by Westlands, would be retired. Some land in the Northerly Area (Broadview Water District) would also be retired, for a total of 92,592 acres of land retirement (including the 44,106 acres to be retired under the In-Valley Disposal Alternative). All of the facilities under the In-Valley/Groundwater Quality Land Retirement Alternative would be similar to the In-Valley Disposal Alternative but would be scaled down due to the reduction in lands requiring drainage service.

The environmental consequences of this alternative are expected to be comparable to those discussed in Section 14.2.4, but would be of a lesser magnitude because the evaporation basins are not as large.

14.2.6 In-Valley/Water Needs Land Retirement Alternative

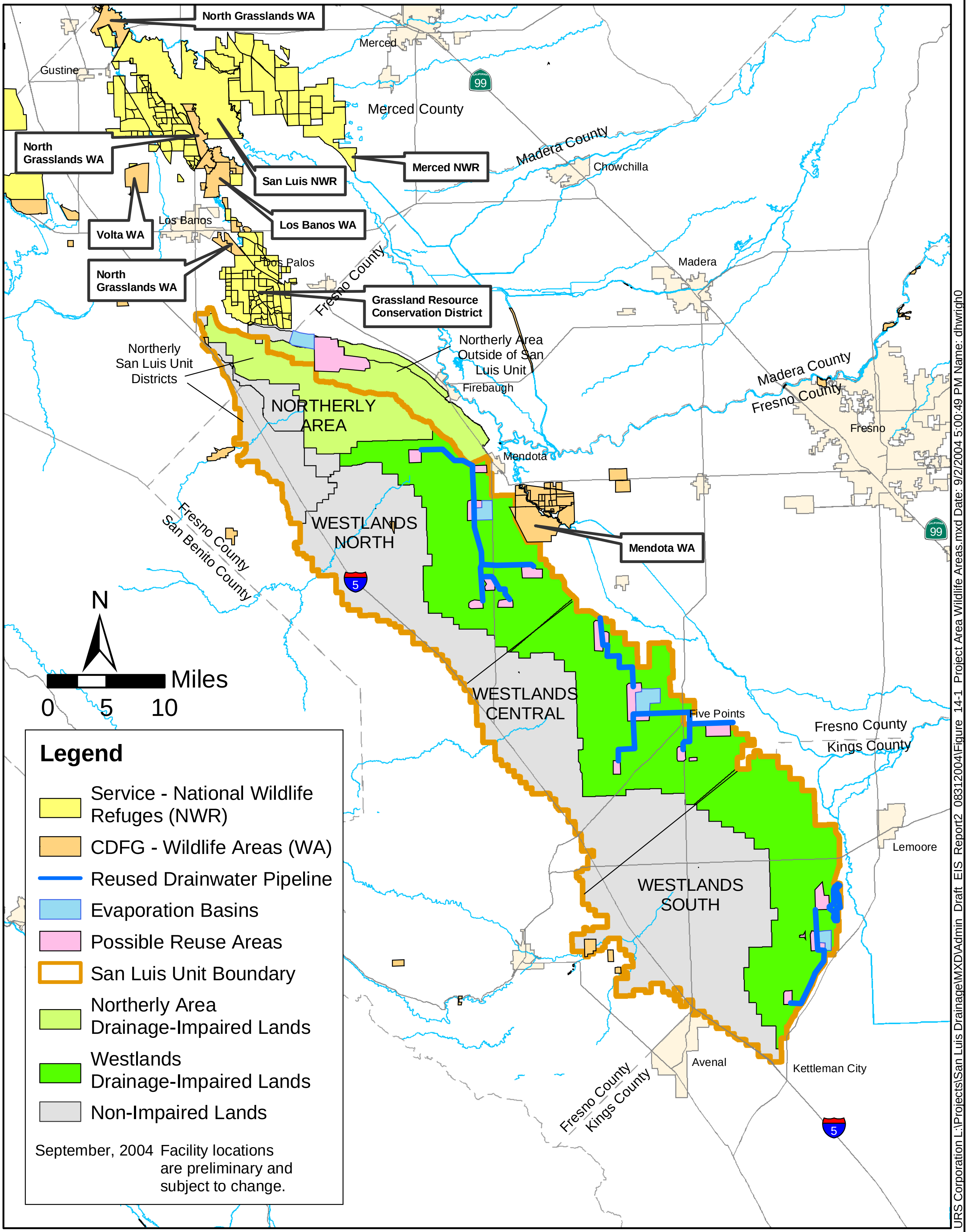
Under the In-Valley/Water Needs Land Retirement Alternative, lands within Westlands having an Se concentration greater than 20 ppb in the shallow groundwater, as well as lands acquired by Westlands, would be retired. Some land in the Northerly Area (Broadview Water District) would also be retired, for a total of 193,956 acres of land retirement (including the 44,106 acres to be retired under the In-Valley Disposal Alternative). All of the facilities under the In-Valley/Water Needs Land Retirement Alternative would be similar to the In-Valley Disposal Alternative but would be scaled down due to the reduction in lands requiring drainage service.

The environmental consequences of this alternative are expected to be comparable to those discussed in Section 14.2.4, but would be of a lesser magnitude because the evaporation basins are not as large.

14.2.7 In-Valley/Drainage-Impaired Area Land Retirement Alternative

Under the In-Valley/Drainage-Impaired Area Land Retirement Alternative, all drainage-impaired lands within Westlands would be retired. Some land in the Northerly Area (Broadview Water District) would also be retired, for a total of 308,000 acres of land retirement (including the 44,106 acres to be retired under the In-Valley Disposal Alternative). Drainage service would be provided to lands remaining in production within the Northerly Area. Facilities installed under this alternative would include a drainwater collection system within the Northerly Area, regional reuse facilities within the Northerly Area, one evaporation basin, an RO treatment facility and Se biotreatment plant adjacent to the evaporation basin, and a conveyance system for collecting reused drainwater from each reuse area and delivering it to the RO and Se treatment facility.

The environmental consequences of this alternative are expected to be comparable to those discussed in Section 14.2.4, but would be substantially less because there is only one evaporation basin.



San Luis Drainage Feature Re-evaluation	Project Area Wildlife Areas	Figure 14-1
17324004		

14.2.8 Ocean Disposal Alternative

This alternative would consist of a system of tunnels, pipelines, and pumps to direct the drainage from the Northern Area south and west to Point Estero on the northern edge of Estero Bay. This alternative includes up to 16 drainage reuse areas but does not include any treatment systems. The drainage reuse areas could have some ponded areas where salts and Se could accumulate, but these areas would be minor in comparison to the evaporation basins. Because this alternative does not include any treatment systems, there would not be any indirect effect on recreation due to the addition of evaporation basins with their accumulation of salts and Se.

Features of this alternative do not cross through any recreation areas. The alignment of this alternative would pass just to the north of Camatti Park along the headwaters of the Estrella River, northeast of Paso Robles. The potential pipeline alignment would follow existing roads as much as possible and avoid existing recreation areas, so there is not a significant effect on recreation when compared to the No Action Alternative.

At Point Estero, the pipeline is either buried in or suspended from the seabed approximately 1.4 miles out into the Pacific Ocean. Then, the drainage is released through the diffuser into the water 200 feet below sea level. Although ocean-based recreation occurs in the area, including sea kayaking, surfing, and deep sea fishing, it is very unlikely that diffusing of the drainwater would be noticed because of the distance from land and depth of the diffuser. Because of the location of the end of the pipeline and the depth of the diffuser, there would be no significant effect on ocean-based recreation when compared to the No Action Alternative.

14.2.9 Delta-Chipps Island Disposal Alternative

This alternative would include a drainage collection system within each subarea, drainage reuse facilities within each subarea, a conveyance system for collecting reused drainwater from each subarea and delivering it to the Delta conveyance system, a Se biotreatment facility, and the Delta conveyance system consisting of a network of open canals, pumping plants, and buried pipelines and incorporating the existing San Luis Drain, culminating at a disposal area in the Delta near Chipps Island. The indirect effects on wildlife viewing and hunting due to the accumulation of salts and Se in the reuse facilities would be minor.

Conveyance of the drainwater would be by open canal and closed pipeline. The potential route for both Delta Disposal Alternatives follows the same alignment from the continuation of the existing San Luis Drain to the Pittsburg area. The route would begin in the northwestern portion of the San Luis NWR and would pass through the China Island area of the North Grasslands WMA. The first section of the new alignment would consist of closed pipeline; thus, no further attraction for wildlife and no increase in recreation would occur. The addition of open canals could attract more fishing, but fishing in these areas is marginal. It would be expected that fishing would shift from another area to these canals rather that increase or decrease overall. Several recreation areas are located in the vicinity of the rest of the route (up to Pittsburg), but this alternative does not cross through any of these recreation areas. Therefore, because of the location and type of conveyance facilities proposed for this alternative, there would not be a significant effect on wildlife viewing or hunting or to established recreation areas when compared to the No Action Alternative.

At Pittsburg, this alternative continues as closed pipeline along the edge of a powerplant to the Delta. There, the buried pipeline extends approximately 1 mile into the Delta from the shoreline at Mallard Slough where the treated drainwater would be released at a depth of 18 feet. Although water-based recreation, such as fishing and waterskiing, is very popular in the Delta, the buried pipeline would not affect these uses beyond the construction period. The discharged drainwater could pose a biological risk to fish in the Delta, and these effects are discussed in Section 8.2.9 for the Delta-Chipps Island Disposal Alternative. However, current levels of mercury and other toxins in the Delta are at levels that already are elevated, and people are currently advised to limit their intake of fish from the Delta. The additional treated drainwater from this alternative would have a minor effect on recreation in the Delta.

14.2.10 Delta-Carquinez Strait Disposal Alternative

This alternative follows exactly the same route and has the same reuse and treatment facilities as the Delta-Chipps Island Disposal Alternative to the Pittsburg area. There, the Delta-Carquinez Strait Disposal Alternative continues as closed pipeline for another 18.9 miles to Crockett. The route first follows the Southern Pacific and AT&SF rail lines to Concord Naval Weapons Station. Then, the route follows the Southern Pacific rail line to Martinez, along Martinez Waterfront Regional Shoreline, past Port Costa, to Crockett. Although this conveyance is right along the shoreline and passes through Martinez Waterfront Regional Shoreline, the route follows the existing rail line the entire way. The diffuser would be approximately 16 miles downstream of the western end of the Delta and 1 mile from the shoreline at Crockett at a depth of 18 feet. The discharged drainwater could pose a biological risk to fish in the Delta, and these effects are discussed in Section 8.2.10 for this alternative. However, current levels of mercury and other toxins in the Delta are at levels that already are elevated, and people are currently advised to limit their intake of fish from the Delta. The additional treated drainwater from this alternative would have a minor effect on recreation in the Delta.

14.2.11 Cumulative Effects

The action alternatives would not increase overall recreation use in the project area. Some recreation uses could shift areas, as with the addition of open canals or mitigation lands. However, the types of recreation uses that could be affected (wildlife viewing, hunting, and fishing) typically require extensive open space and, thus, the small incremental effects of any of the action alternatives on recreation opportunities in the project area would be negligible. Recreation opportunities are expected to increase as communities grow and as wildlife habitat areas are improved under provisions of CVPIA Section 3406 (d)(2).

14.2.12 Environmental Effects Summary

14.2.12.1 No Action Alternative

- The No Action Alternative with possible unplanned discharges or seepage of stormwater runoff into the existing San Luis Drain, in comparison to the existing environment, may have an effect on wildlife viewing/hunting opportunities in refuges connected to the San Joaquin River.

14.2.12.2 In-Valley Disposal Alternative

- Compared to the No Action Alternative, the In-Valley Disposal Alternative with its evaporation basins and reuse facilities would accumulate salts and Se that could pose a biological risk to wildlife. Indirectly, this may have a significant adverse effect on wildlife viewing/hunting if wildlife numbers are reduced, but mitigation could be incorporated into the design and operation of the basins as well as including construction of alternative habitat that could maintain wildlife viewing and hunting opportunities. With sufficient mitigation, there would be no significant effect on recreation opportunities.

14.2.12.3 In-Valley/Groundwater Quality Land Retirement Alternative

- Compared to the No Action Alternative, the In-Valley/Groundwater Quality Land Retirement Alternative with its evaporation basins and reuse facilities would accumulate salts and Se that could pose a biological risk to wildlife. Indirectly, this may have a significant adverse effect on wildlife viewing/hunting if wildlife numbers are reduced, but mitigation could be incorporated into the design and operation of the basins as well as including construction of alternative habitat that could maintain wildlife viewing and hunting opportunities. With sufficient mitigation, no significant effect would occur to recreation opportunities.

14.2.12.4 In-Valley/Water Needs Land Retirement Alternative

- Compared to the No Action Alternative, the In-Valley/Water Needs Land Retirement Alternative with its evaporation basins and reuse facilities would accumulate salts and Se that could pose a biological risk to wildlife. Indirectly, this may have a significant adverse effect on wildlife viewing/hunting if wildlife numbers are reduced, but mitigation could be incorporated into the design and operation of the basins as well as including construction of alternative habitat that could maintain wildlife viewing and hunting opportunities. With sufficient mitigation, no significant effect would occur to recreation opportunities.

14.2.12.5 In-Valley/Drainage-Impaired Area Land Retirement Alternative

- Compared to the No Action Alternative, the In-Valley/Drainage-Impaired Area Land Retirement Alternative with its one evaporation basin and reuse facilities would accumulate salts and Se that could pose a biological risk to wildlife. Indirectly, this may have a significant adverse effect on wildlife viewing/hunting if wildlife numbers are reduced, but mitigation could be incorporated into the design and operation of the basin as well as including construction of alternative habitat that could maintain wildlife viewing and hunting opportunities. With sufficient mitigation, no significant effect would occur to recreation opportunities.

14.2.12.6 Ocean Disposal Alternative

- Compared to the No Action Alternative, the Ocean Disposal Alternative with its reuse facilities could accumulate some salts and Se that could pose a biological risk to wildlife. However, the amount of salts and Se would be minor, and the indirect effects on wildlife viewing and hunting due to this accumulation would not be considered a significant effect.

- Compared to the No Action Alternative, this alternative proposes construction of a pipeline from the Northern Area south and west to Point Estero on the northern edge of Estero Bay. The potential pipeline alignment would follow existing roads as much as possible and avoid existing recreation areas, so there would not be a significant effect on recreation.
- Although ocean-based recreation occurs in the vicinity of the end of this alternative, because of the location of the end of the pipeline and the depth of the diffuser, there would be no significant effect on ocean-based recreation.

14.2.12.7 Delta-Chipps Island Disposal Alternative

- Compared to the No Action Alternative, this alternative with its reuse facilities could accumulate some salts and Se that could pose a biological risk to wildlife. However, the amount of salts and Se would be minor, and the indirect effects on wildlife viewing and hunting due to this accumulation would not be considered a significant effect.
- This alternative proposes new construction of pipeline and open canal from the continuation of the San Luis Drain to the Pittsburg area in comparison to the No Action Alternative. Because the location and type of conveyance facilities proposed for this alternative would be primarily underground, there would not be a significant effect on wildlife viewing or hunting.
- Although water-based recreation is very popular in the Delta, the buried pipeline would not affect these uses beyond the construction period. The buried pipeline extends approximately 1 mile into the Delta from the shoreline at Mallard Slough where the treated drainwater would be released at a depth of 18 feet. The discharged drainwater could pose a biological risk to fish in the Delta, but current levels of mercury and other toxins in the Delta are at levels that already are elevated. People are currently advised to limit their intake of fish from the Delta. The additional drainwater from this alternative would have a minor but not significant effect on recreation in the Delta.

14.2.12.8 Delta-Carquinez Strait Disposal Alternative

- Compared to the No Action Alternative, this alternative with its reuse facilities could accumulate some salts and Se that could pose a biological risk to wildlife. However, the amount of salts and Se would be minor, and the indirect effects on wildlife viewing and hunting due to this accumulation would not be considered a significant effect.
- This alternative proposes new construction of pipeline and open canal from the continuation of the San Luis Drain to the Crockett area in comparison to the No Action Alternative. Because the location and type of conveyance facilities proposed for this alternative would be primarily underground, there would not be a significant effect on wildlife viewing or hunting.
- Although water-based recreation is very popular in the Delta, the buried pipeline would not affect these uses beyond the construction period. The conveyance route follows the existing rail line the entire way. The diffuser would be approximately 16 miles downstream of the western end of the Delta and 1 mile from the shoreline at Crockett at a depth of 18 feet. The discharged drainwater could pose a biological risk to fish in the Delta, but current levels of mercury and other toxins in the Delta are at levels that already are elevated. People are

currently advised to limit their intake of fish from the Delta. The additional drainwater from this alternative would have a minor but not significant effect on recreation in the Delta.

Tables 14-1 through 14-8 summarize the effects that the No Action Alternative and the action alternatives have on recreation resources.

Table 14-1
Summary Comparison of Effects of No Action

Affected Resource and Area of Potential Effect	No Action Alternative Compared to Existing Condition
Wildlife Viewing/Hunting	Unplanned discharges or seepage of stormwater runoff into the San Luis Drain could elevate Se levels. Negative effect.
Ocean-Based Recreation	Not applicable.
Delta Recreation	Not applicable.

Table 14-2
Summary Comparison of Effects of In-Valley Disposal Alternative

Affected Resource and Area of Potential Effect	In-Valley Disposal Compared to No Action	In-Valley Disposal Compared to Existing Condition
Wildlife Viewing/Hunting	Accumulated salts and Se in evaporation basins could pose biological risk to waterfowl that might be hunted. Significant effect; with mitigation = no significant effect	Possible effect.
Ocean-Based Recreation	Not applicable.	Not applicable.
Delta Recreation	Not applicable.	Not applicable.

Table 14-3
Summary Comparison of Effects of
In-Valley/Groundwater Quality Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Groundwater Quality Land Retirement Compared to No Action	In-Valley/Groundwater Quality Land Retirement Compared to Existing Condition
Wildlife Viewing/Hunting	Accumulated salts and Se in evaporation basins could pose biological risk to waterfowl that might be hunted. Significant effect; with mitigation = no significant effect	Possible effect.
Ocean-Based Recreation	Not applicable.	Not applicable.
Delta Recreation	Not applicable.	Not applicable.

Table 14-4
Summary Comparison of Effects of
In-Valley/Water Needs Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Water Needs Land Retirement Compared to No Action	In-Valley/Water Needs Land Retirement Compared to Existing Condition
Wildlife Viewing/Hunting	Accumulated salts and Se in evaporation basins could pose biological risk to waterfowl that might be hunted. Significant effect; with mitigation = no significant effect	Possible effect.
Ocean-Based Recreation	Not applicable.	Not applicable.
Delta Recreation	Not applicable.	Not applicable.

Table 14-5
Summary Comparison of Effects of
In-Valley/Drainage-Impaired Area Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Drainage-Impaired Area Land Retirement Compared to No Action	In-Valley/Drainage-Impaired Area Land Retirement Compared to Existing Condition
Wildlife Viewing/Hunting	Accumulated salts and Se in the evaporation basin could pose biological risk to waterfowl that might be hunted. Significant effect; with mitigation = no significant effect	Possible effect.
Ocean-Based Recreation	Not applicable.	Not applicable.
Delta Recreation	Not applicable.	Not applicable.

Table 14-6
Summary Comparison of Effects of Ocean Disposal Alternative

Affected Resource and Area of Potential Effect	Ocean Disposal Compared to No Action	Ocean Disposal Compared to Existing Condition
Wildlife Viewing/Hunting	Salts and Se could accumulate in reuse facilities. No significant effect.	Salts and Se could accumulate in reuse facilities. Minimal effect.
Ocean-Based Recreation	Pipeline diffuser would be 1.4 miles out to sea and 200 feet deep. No significant effect.	Pipeline diffuser would be 1.5 miles out to sea and 200 feet deep. Minimal effect.
Delta Recreation	Not applicable.	Not applicable.

Table 14-7
Summary Comparison of Effects of Delta-Chipps Island Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Chipps Island Disposal Compared to No Action	Delta-Chipps Island Disposal Compared to Existing Condition
Wildlife Viewing/Hunting	Salts and Se could accumulate in reuse facilities. No significant effect.	Salts and Se could accumulate in reuse facilities. Minimal effect.
Ocean-Based Recreation	Not applicable.	Not applicable.
Delta Recreation	Pipeline diffuser would be 1 mile offshore and 18 feet deep. No significant effect.	Pipeline diffuser would be 1 mile offshore and 18 feet deep. Minimal effect.

Table 14-8
Summary Comparison of Effects of Delta-Carquinez Strait Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Carquinez Strait Disposal Compared to No Action	Delta-Carquinez Strait Disposal Compared to Existing Condition
Wildlife Viewing/Hunting	Salts and Se could accumulate in reuse facilities. No significant effect.	Salts and Se could accumulate in reuse facilities. Minimal effect.
Ocean-Based Recreation	Not applicable.	Not applicable.
Delta Recreation	Pipeline diffuser would be 1 mile offshore and 18 feet deep. No significant effect.	Pipeline diffuser would be 1 mile offshore and 18 feet deep. Minimal effect.

14.2.13 Mitigation Recommendations

The primary need for mitigation would be the indirect effect on recreation that the accumulation of salts and Se in the evaporation basins and reuse facilities could have on wildlife populations. Mitigation could include constructing and operating the reuse and evaporation facilities in such a way that they would be unattractive to wildlife. See Section 20.2.2 for a discussion of mitigation options.

In addition, substantial acres of wildlife habitat for evaporation basin mitigation could be constructed or enhanced, which could include managed wetland habitats. It is possible that some of the waterfowl currently using existing wildlife refuges or duck clubs could use these constructed or enhanced wetlands, and they could be located near existing refuges or wildlife management areas. However, the future design and management of these potential mitigation lands is uncertain, and it may be that they could be managed for recreation, such as hunting or wildlife viewing, as are current refuges in the San Joaquin Valley.

SECTION FIFTEEN
CULTURAL RESOURCES

This section describes the regulatory context, the major cultural areas that could be affected by project construction and operation, and the potential environmental consequences of the alternatives.

15.1 AFFECTED ENVIRONMENT

The following paragraphs describe the major cultural areas that are likely to be affected by project construction and operation. Except where noted, the cultural areas follow those described by Baumhoff (1978). These cultural areas are San Joaquin Valley, Sacramento-San Joaquin River Delta, the South Coast Ranges, and the northern part of the Southern Coast. For the prehistoric period each area shares some characteristics but was occupied by distinct populations.

15.1.1 Regulatory Environment

A number of State and Federal laws and regulations pertain to cultural resources. The National Historic Preservation Act (NHPA) and CEQA are the primary laws applicable to the project. It should be noted that compliance with the NHPA is generally comprehensive enough to satisfy CEQA requirements.

Federal cultural resources regulations for the implementation of Section 106 of the NHPA (36 CFR 800) requires Federal agencies to take into account the effects of their undertakings on historic properties and allow the Advisory Council on Historic Preservation a reasonable opportunity to comment on such undertakings. The goal of the Section 106 process is to offer a measure of protection to sites that have been determined eligible for listing on the National Register of Historic Places. The criteria for determining National Register eligibility are found in 36 CFR Part 60. These criteria state that eligible resources (historic properties) consist of:

> . . . [D]istricts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that (a) are associated with events that have made a significant contribution to the broad patterns of our history; or (b) that are associated with the lives of persons significant in our past; or (c) that embody the distinctive characteristics of a type, period, or method of construction, or that possess high artistic values, or that represent a significant distinguishable entity whose components may lack individual distinction; or (d) that have yielded or may be likely to yield information important to history or prehistory.

Amendments to the NHPA (1986 and 1992) and subsequent revisions to the implementing regulations (1999, 2000) have expanded the provisions for public participation and, in particular, Native American involvement and consultation throughout the Section 106 process.

State historic preservation regulations affecting this project include statutes and guidelines contained in CEQA (Public Resources Code Sections 21083.2 and 21084.1 and Section 15064.5 of the CEQA Guidelines). The CEQA guidelines define historical resources as those determined eligible for listing on the California Register of Historical Resources, those included in a local register as defined in Section 5020.1(k) of the Public Resources Code, or those identified as significant in a historical resources survey meeting the requirements of Section 5024.1(g) of the Public Resources Code. Under CEQA, a project may have a significant effect on the environment if it may cause a substantial adverse change in the significance of a historical resource (CEQA Guidelines Section 15064.5).

In addition, California law, like Federal law, protects Native American burials, skeletal remains, and associated grave goods and provides for the sensitive treatment and disposition of those remains. Section 7070.5(b) of the California Health and Safety Code specifies the protocol that must be followed in the event that human remains are discovered either by archeological investigation or by project activities on State and private lands.

Further cultural resource guidance is provided in the Reclamation Manual (Policy LND P01, Cultural Resource Management policy; Directives and Standards LND 02-01, Cultural Resources Management directions; Directives and Standards LND 07-01, Inadvertent Discovery of Human Remains of Reclamation Lands).

Pursuant to 36 CFR 800 efforts must be made to solicit input from both interested members of the public and local Native American tribes regarding potential effects to cultural resources within the APE. Federal agencies are required to contact tribes to determine if any sites of religious or cultural significance that may be eligible for the National Register of Historic Places are within the APE. At least five different tribes and Native American groups are present within the greater study area. Potential interested members of the public include historic preservation interest groups, historical societies, and museums that are local to the project vicinity.

15.1.2 San Joaquin Valley

15.1.2.1 Prehistory

San Joaquin Valley has a long and complex cultural history with distinct regional patterns that extend back more than 11,000 years. The first generally agreed-upon evidence for the presence of prehistoric peoples in San Joaquin Valley is represented by the distinctive fluted spear points termed Clovis points found on the margins of extinct lakes. The Clovis points are found on the same surface with the bones of extinct animals such as mammoths, sloths, and camels. Based on evidence from elsewhere, the ancient hunters who used these spear points existed during a narrow time range of 10,900 to 11,200 before present (BP).

The next cultural period represented, the Western Pluvial Lakes Tradition, thought by most to be subsequent to the Clovis period, is another widespread complex that is characterized by stemmed spear points. This poorly defined early cultural tradition is regionally known from a small number of sites in the Central Coast Range, San Joaquin Valley lake margins, and Sierra Nevada foothills. The cultural tradition is dated to between 8,000 and 10,000 years ago, and its practitioners may be the precursors to the subsequent cultural pattern.

About 8,000 years ago many California cultures shifted the main focus of their subsistence strategies from hunting to seed gathering as evidenced by the increase in food-grinding implements found in archeological sites dating to this period. This cultural pattern is best known for southern coastal California, where it has been termed the Milling Stone Horizon (Wallace 1954, 1978), but recent studies suggest that the horizon may be more widespread than originally described and is found throughout much of cismontane California. Radiocarbon dates associated with this period vary between 8,000 and 2,000 BP, although most dates cluster in the 6,000 to 4,000 BP range (Basgall and True 1985).

Cultural patterns as reflected in the archeological record, particularly specialized subsistence practices, became codified within the last 3,000 years. The archeological record becomes more complex, as specialized adaptations to locally available resources were developed and populations expanded. Many sites dated to this time period contain mortars and pestles and/or are associated with bedrock mortars implying the intense exploitation of the acorn. The range of subsistence resources utilized and exchange systems expanded significantly from the previous period. Along the coast and in the Central Valley archeological evidence of social stratification and craft specialization is indicated by well-made artifacts such as charmstones and beads, often found as mortuary items. Ethnographic lifeways serve as good analogs for this period.

15.1.2.2 History

Long-term Euro-American incursions began with the Spanish missionaries and soldiers who entered California from the south in 1769. This period is characterized by the establishment of coastal missions and military presidios, the development of large tracts of land owned by the missions, and subjugation of the local native population for labor. With Mexico’s independence from Spain in 1822, the mission period in California began to end. After 1836, large tracts of land were divided by government grants into large ranchos, often tens of thousands of acres or more. These large tracts often maintained large herds of cattle and horses, with agricultural development limited to small garden plots and vegetable-growing operations. In addition to the Spanish explorers and settlers, American explorers made forays into the region.

San Joaquin Valley was sparsely populated by Euro-Americans during the Mexican Period, but large herds of semiwild horses and cattle were common. Mexican expeditions were mostly military ones sent to control Native Americans and get revenge for their raids on Mexican resources.

The Gold Rush changed the region significantly. The need for meat led to the establishment of cattle ranches and market hunting of tule elk and waterfowl. The region became a major stock raising area serving the mining towns of the Sierras and cities of Stockton, Sacramento, and San Francisco. Hogs were taken to the tulares to root in the summertime and driven into the foothills in the fall to fatten up on oak acorns. The latter had a direct negative impact on one of the Yokuts main food resources. As the Gold Rush faded, the miners shifted to new pursuits and agriculture expanded significantly. Miller and Lux consolidated their holdings in the region and owned a major portion of bottom lands along the San Joaquin River.

Modern patterns of land use for the region were established between 1857 and 1871 (Preston 1981). During this time emphasis shifted from livestock to growing crops facilitated by drainage and irrigation. However, dry farming of grain was the major crop on the alluvial lands. Droughts and floods during the period hastened this change. Thousands of cattle either starved or were drowned by floodwaters. Some of the first efforts at major crops of cotton took place in the 1870s but it did not become important until the 1920s (Turner 1981). Also, the rise of agribusiness began about this time, with small farms declining and corporate farms increasing. The Great Depression of the 1930s also brought in waves of Dust Bowl migrants and many of the present residents can trace their ancestry to these people.

Dry-farming practices predominated during the early years until the 1880s when large-scale diversions of water from the San Joaquin River and its tributaries began. By the turn of the century, more than 350,000 acres were being irrigated across San Joaquin Valley. New pump technology in the 1920s allowed more groundwater to be used. Valuable crops, such as vegetables, fruits, and nuts, were grown. New farming techniques allowed for leveling for irrigation on a scale never before possible. These practices had devastating results to the region’s prehistoric sites and very few remain undisturbed. It is these conditions that characterize portions of the study area today.

The construction of the Central Valley Project in the mid-1900s drastically changed the hydrology of the San Joaquin River by diverting most of the river’s flows at Friant Dam. The construction of the west-side canals to offset the Friant diversions led to the further development of irrigated agriculture and subsequent drainage issues.

As settlements grew, agricultural enterprises became more common. These communities may contain sites and structures of historical significance. Potential historic resources in the region are largely related to agriculture, including farmsteads, labor camps, yards for distributing agricultural produce, feedlots, canneries, pumping stations, siphons, canals, drains, unpaved roads, bridges, and ferry crossings. Labor camps generally consist of at least one wooden bunkhouse or boarding house, a dining hall, a cookhouse, a washroom, and associated buildings.

15.1.3 Sacramento-San Joaquin River Delta

The Delta has been separated out of the San Joaquin Valley cultural history since its history is distinct from that of the other areas because of its unique biophysical environment.

15.1.3.1 Prehistory

The prehistory of the Delta is based on archeological investigations that occurred primarily in the first half of the 20th century. Approximately 80 percent of the known prehistoric sites were recorded prior to 1960. The Central California Culture Sequence is based on the differences of funeral patterns, artifact types, and induration (Lillard et al. 1939). Three periods, or horizons, are recognized: the Early Period (now dated approximately 2500 to 500 BC), the Middle Period (500 BC to 300 AD), and the Late Period (300 to 1840 AD). This archeological construct has evolved into a new classification (Fredrickson 1974) that defines three major patterns: Windmiller, Berkeley, and Augustine. Isolated artifacts thought to be early Holocene to late Pleistocene in age and, thus, predating the Windmiller Pattern have been found on the surface at localities on the margin of the study area (Beck 1971; Heizer 1938).

The Windmiller Pattern is known only from the eastern Delta, middle reaches of the Mokelumne River area, and adjacent areas of the lower valley from the middle Cosumnes River to Stockton. This pattern, equivalent to the Early Period in this area, has distinctive burial patterns, diagnostic shell ornaments, and stone tool forms. Considerable debate has focused on the subsistence base of these people (Dorn 1980; Gerow 1974; Heizer 1974; Schulz 1970, 1981).

The Berkeley Pattern is equivalent to the Middle Period in the lower Sacramento Valley, although earlier phases may be coeval with the Early Period in the Bay Area. The Berkeley Pattern is characterized by flexed burial positions, diagnostic ornaments, and, in the valley, by bone fish spears or leister points and stone pestles. The diet emphasized fish and acorns.

The Augustine Pattern corresponds to the Late Period in the lower Sacramento Valley. It is marked by the appearance of small projectile points and changes in funerary patterns and ornament styles. These cultures, in general, appear to be ancestral to the ethnographic groups of the same area (Bennyhoff 1961) and practiced a similar settlement-subsistence pattern.

The Meganos Complex (Fredrickson 1974) deserves mention. This complex, assigned to the Middle and Late Periods, is characterized by extended burials and by distinct cemeteries disassociated with midden areas. Such cemeteries are known particularly from the sand mounds of the western Delta (Cook and Elsasser 1956). This complex shares the same dietary emphasis of the Berkeley Pattern.

15.1.3.2 Characteristics of Prehistoric Delta Sites

Prior to leveling for agriculture, many of the prehistoric sites in the Delta were low gentle sloping mounds, ranging in height from 6 inches to over 7 feet above the surrounding land surface (Schenck and Dawson 1929). The mounds are generally assumed to be natural rises that were enlarged by the gradual accumulation of midden, although some historical evidence suggests that they may have been intentionally modified by the inhabitants (Belcher 1843:130). Some of the mounds extend below the current ground level and some are buried entirely with no surface evidence (Heizer 1949). The composition of the cultural deposits varies greatly from black loam to yellow silty clay. Intermediate deposits contain varying amounts of fine sand, generally yellow or tan in color, and may be representative of sublevels of mound deposits. Hardpans are common in sites in the higher elevation depositional units and in some sand mounds, likely the result of long-term weathering.

15.1.3.3 Native Peoples

The native peoples of the Delta area were divided among five linguistic groups, all belonging to the Penutian language stock. The far northeastern part of the Delta region was occupied by the

Valley Nisenan, the eastern part and far western part by Plains and Bay Miwok speakers, the southern part by the Northern Valley Yokuts, and the northern shore of the Suisun Bay area by the Patwin. Despite sharing the same environment, distinct material cultural differences existed among the five groups (Bennyhoff 1977:47).

The Plains and Bay Miwok are members of the Utian family of the Penutian stock languages (Shipley 1978). The boundaries and divisions of the Miwok are based largely on linguistic evidence (Bennyhoff 1977; Kroeber 1925; Levy 1978; Schenck 1926). The Miwok were intensive collectors; they occupied large, fixed, multilineage villages (tribelets) located on high ground generally adjacent to watercourses. Most villages were occupied permanently except during short periods of harvesting. Camps for fishing and hunting were also part of the settlement system.

The Northern Valley Yokuts were semisedentary, with principle settlements on low mounds or levees on or near the banks of major watercourses. Loosely centralized tribes headed by a chief (the position of which was inherited) were tied to one or more principle villages. Secondary settlements consisted of small camps or villages of several households. Next to settlements were fishing stations, hunting camps, and lithic-tool-manufacturing sites. The early disruption of Yokut-speaking people resulted in little ethnographic information (Bennyhoff 1977; Kroeber 1925; Schenck 1926; Schulz 1981.)

The term Patwin refers to several tribelets of people who occupied the western side of Sacramento Valley extending from Suisun Bay north to just above the town of Princeton on the Sacramento River (Johnson 1978). Patwin tribelets generally occupied one primary and several satellite villages, some containing as many as 1,000 or more persons (Powers 1976). Each triblet had a sense of territoriality and autonomy (Johnson 1978). Subsistence, like that of their neighbors, was based on hunting, gathering, and fishing. Details on the Patwin lifeway are little known because they were among the earliest groups in the region to be affected by missionization and introduced diseases. By 1871–1872, when Stephen Powers surveyed the State while gathering ethnographic information, the Patwin culture no longer existed.

The destruction of native Delta cultures was the result of several factors. Even before explorers and settlers made extensive contact, the missions drew Native Americans away from their villages. An 1833 epidemic, possibly malaria, killed thousands and numerous villages were abandoned. The secularization of the missions in 1834 caused Native Americans of various cultural affinities to retreat into areas of previous cultural homogeneity (Wallace 1978). The collapse of the Delta cultures began before the Gold Rush, and ended when later waves of settlers converted native territory into agriculture fields. Village mounds of the native peoples were abandoned, reoccupied by farmhouses, buried under levees, or leveled for agriculture.

15.1.3.4 History

Prior to 1850, before significant human modification, the Delta consisted mainly of intertidal wetlands laced with about 100 square kilometers of subtidal waterways. The Delta became an Indian refuge during the Mexican Period. Under pressure from the coastal missions with their associated military garrisons, tribal domains within the Delta broke down rapidly. In hope of creating stability in the interior and to build a buffer zone for the coastal areas, Mexican governors awarded land grants in the Delta region. Within the study area Paso del Pesadero was granted in 1843 to Antonio M. Pico. While he never occupied the area, he and one of the pioneer reclaimers in the Delta, Henry M. Naglee, were claimants of the 35,546-acre tract when Mexico ceded the land to the United States.

With the discovery of gold in the mid-1800s and the ensuing Gold Rush, development and improvement of a transportation system became a necessity in the region. Between 1850 and 1880, California saw the development of hundreds of primary wagon routes, the evolution of steamboat travel along major rivers, and the completion of numerous railroads. Many of these early transportation routes traversed the Delta waterways.

Human activities since 1850 have greatly altered the Delta. Artificial levees, erected for flood control and agricultural reclamation, now surround 98 percent of the historic wetland. Waterways have been shoaled by sediment from upstream hydraulic gold mines, deepened by dredging of construction material for levees, and interconnected by dredged-cut channels. Historic Delta cultural resources consist of early farms, agricultural labor camps, food processing facilities, docks, dolphins, levees, abandoned settlements, bridges, and sunken ships.

15.1.4 South Coast Ranges

15.1.4.1 Prehistory

The prehistory of the South Coast Ranges is not as well known as adjoining areas but the archeology appears to share many of the material cultural elements of both regions. Initial occupation probably extends back to the early Holocene. Such early sites contain abundant milling tools that suggest a heavy reliance upon seeds. Many of the late period sites appear to have been seasonally occupied by small groups of hunter-gatherers. Contact with the coast is evident by the common occurrence of marine shell in the cultural deposits.

15.1.4.2 History

The Southern Coast Ranges were divided up early between mission lands and individual land grants. During the Spanish and Mexican periods the lands were used primarily for livestock grazing and little development took place. Dry land farming of grain continues today, but grape growing is becoming more important. Historic resources include early ranchos, mission lands, agricultural infrastructure, and early trails and roads.

15.1.5 Southern/Central Coast

15.1.5.1 Prehistory

The prehistory of the Southern/Central Coast area of California is one of the most intensively studied areas in the world. It has been occupied for at least 9,000 years and possibly even earlier. Subsequent habitations can be divided into four cultural periods: 6500–3500 BC, 3500–1000 BC, 1000 BC–1200 AD, and 1200 AD–contact (Jones 1992). Following initial settlement, the number of occupied sites increases dramatically between 6500 and 3500 BC. Site locations become more diversified but the range of artifacts is narrow, primarily milling tools for the grinding of seeds. Projectile points are relatively rare. By 3500 BC the mortar and pestle become the more prominent seed processing tool. Marine mammals become a more important part of the diet for many coastal and island groups. After 1000 BC populations increase and site diversity is even greater with craft specialization beginning to take hold. The Late Period (post 1200 AD) shows a still greater profusion of sites and the use of all types of marine habitats. Elaborate shell and bone fish hooks and harpoon points indicate intensive exploitation of marine resources. Trade and exchange with inland groups led to elaborate exchange systems being formulated with standardized values for shell beads and other items.

When Europeans first explored the California coast during the 1500s and 1600s they encountered some of the most populous, prosperous, and complex hunter-gatherer societies on earth (Erlandson 1997). However, within a short period these groups were decimated by genocide and introduced diseases. Their population levels collapsed to a point where they could no longer sustain their cultural systems, and only a small percentage of the descendants survived.

15.1.5.2 History

Like the Southern Coast Ranges, during the Spanish and Mexican Periods the lands were granted to the missions and individuals who used the lands for livestock grazing. Settlements occurred near the missions and government-related facilities and population numbers were low. Dry farming of various grains was initiated early on, supplementing the production of livestock, which was primarily for their hides. With the Gold Rush, the hide production switched to meat for the miners. Small-scale agriculture, primarily growing vegetables, expanded to fill an increased demand as California's population grew rapidly, but the area remained relatively isolated because of the terrain and the lack of a good harbor or roads. Historic resources include early ranchos, mission lands, agricultural infrastructure, early trails and roads, and coastal landings and fish camps.

15.2 ENVIRONMENTAL CONSEQUENCES

The effects assessment presented in this report does not focus on effects to individual cultural resources. Instead, generalized cultural resource types are described and effects to the generalized cultural resources types are assessed. The assumption here is that all significant cultural resources within the project's APE would be adversely affected and that mitigation measures would be required. However, the need for mitigation can be reduced by avoidance during the project planning stages. For this to occur coordination will need to be close between the cultural resource personnel and those planning, preparing, and implementing the project. If avoidance of some cultural resources is possible in an economically and environmentally feasible way, provisions for their continued avoidance and periodic review would be written into the Programmatic Agreement and the Historic Property Management Plan, both of which are described below.

15.2.1 Evaluation Criteria

The significance criteria for cultural resources are based on National Register of Historic Places regulations (36 CFR Part 63), NHPA and its regulations (36 CFR 800), and CEQA (CEQA Guidelines Section 15064.5). It should be noted that the eligibility criteria for listing on the California Register of Historical Resources (Public Resources Code 5024.1) closely parallel those for listing on the National Register of Historic Places, and all resources formally determined eligible for National Register are automatically listed on the California Register.

A number of cultural resources within the APE of each alternative have been identified; however, most have not been formally evaluated for their National Register (or California Register) significance. The legal and regulatory framework for carrying out such work can be approached in a number of different ways, but all will require inventory and evaluation studies. The preferred approach is to coordinate and integrate NHPA compliance with the National Environmental Policy Act process. Furthermore, because of the compressed schedule for the National Environmental Policy Act process and the amount of time it will take to complete the cultural resources studies, it will be necessary to develop a Programmatic Agreement to comply with Section 106 of the NHPA. The Programmatic Agreement will require the development of specific Historic Property Treatment Plans to mitigate the adverse effects of the project on historic properties.

It is expected that most Section 106 compliance obligations will be met prior to project implementation by mitigation or avoidance. However, it should be noted, depending on the alternative selected, that a long-term plan for managing cultural resources within project lands may be required. That is, the protection of known historic properties must be maintained for the project life, and all inadvertent finds will need to be treated appropriately upon discovery. The preparation of a Historic Property Management Plan will provide the necessary specific guidance for the consideration and treatment of historic properties that may be accidentally affected during the course of the drainage program implementation.

Under Section 106, mitigation is a way of resolving adverse effects to historic properties and is only implemented when an effect occurs. Consequently, in using this criterion, mitigation does not result in "no effect" unless the resource can be avoided.

15.2.2 Assessment Methods

Information about the project area's cultural history and resources was developed from reviews of the relevant archeological and historical databases, literature, including an extensive collection of earlier project-related documentation, maps, and reports. Also examined were the National Register of Historic Places, California Historic Landmarks, and California Inventory of Historic Resources. A Class I records search of the conveyance alignments for the action alternatives was conducted at the various Information Centers of the California Historical Resources Information System for the appropriate counties including the Central California Information Center at California State University Stanislaus; the Central Coastal Information Center at the University of California, Santa Barbara; the Northwest Information Center at Sonoma State University; and the Southern San Joaquin Valley Information Center at California State University, Bakersfield. Results of the records search are summarized below.

15.2.3 No Action Alternative

The No Action Alternative would have both negative and positive effects on cultural resources over the 50-year planning horizon.

Changes in cropping patterns would affect cultural resources in a number of different ways. Deep ripping and leveling could further degrade archeological deposits. New irrigation techniques and drainage may further disturb cultural resources. The construction or removal of agriculture-related structures may also have a direct effect on historic properties.

An increase in land retirement, abandonment, or temporary fallowing may both reduce and increase effects to historic properties. Since many operators would be forced to fallow a portion of their fields in multiyear rotations, effects to archeological resources from plowing, leveling, and other agriculture-related activities may be reduced. Abandonment of historic structures may lead to their destruction and loss. Effects to cultural resources by conversions to nonagricultural land use would vary depending upon the change.

No new collection facilities would be constructed through the 50-year project life. The likelihood of disturbing buried archeological resources would be reduced. On-farm source control measures could increase the likelihood of disturbing cultural resources.

The exact nature of effects to cultural resources under the No Action Alternative would depend on the particular changes in land use which might occur. A Class I records search was not conducted for the No Action Alternative.

In the absence of actual cultural resource site locations, the conservative approach would be to consider that this alternative would have adverse effects on historic properties. The No Action Alternative does not require mitigation.

15.2.4 In-Valley Disposal Alternative

Implementation of the In-Valley Disposal Alternative could result in adverse effects to historic properties when compared to the No Action Alternative. Construction of reuse facilities and associated collection/conveyance systems, pumping facilities, RO and biological treatment facilities, evaporation basins, and alternative or compensation wetland habitat mitigation complexes all have the potential to affect historic properties.

No field-level cultural resource reconnaissance studies have been completed for this alternative. Virtually all the lands that would be affected by this alternative have been modified by agricultural practices: leveling, plowing, farm roads, irrigation, and drainage. Most of the conveyance alignments follow existing roads. Scatters of artifacts have been noted for the area. Such scatters are probably the remains of prehistoric archeological sites that have been obliterated by agricultural activities.

A Class I records search for the In-Valley Disposal Alternative revealed five known cultural resources within a 1-mile radius of proposed conveyance alignments. These resources include one prehistoric archaeological site, three isolated prehistoric artifacts, and the historic Crescent Canal. The prehistoric archaeological site has not been evaluated for eligibility to the National Register of Historic Places. The Crescent Canal was recommended ineligible to the National Register at the time it was recorded.

Mitigation measures would be required in the event that historic properties would be adversely affected by the In-Valley Disposal Alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of the In-Valley Disposal Alternative on cultural resources would be significant, but adverse effects to historic properties could be resolved through mitigation measures.

15.2.5 In-Valley/Groundwater Quality Land Retirement Alternative

Implementation of the In-Valley/Groundwater Quality Land Retirement Alternative could result in adverse effects to historic properties when compared to the No Action Alternative. The construction of treatment and disposal facilities, as discussed in Section 15.2.4, has the potential to affect historic properties, though the extent of the facilities necessary may be reduced with a land retirement option. Effects to resources on retired lands may vary, depending on the future use of the lands. Anticipated uses include grazing, fallowing, and dry-land farming, all of which would likely have minimal impacts to historic properties given the current land use practice of irrigated farming.

Additionally, Federal ownership or management of the retired lands may result in increased consideration for cultural resources. Federal undertakings are subject to Section 106 of the NHPA. Any such activities with the potential to affect historic properties, including sale or lease of retired lands, would require a determination of their effect on historic properties.

This alternative has not been inventoried for historic properties. It is anticipated that cultural resources such as prehistoric archaeological sites and historic structures are present on the included lands. Mitigation measures would be required in the event that historic properties would be adversely affected by this alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of this alternative on cultural resources would be significant, but adverse effects to historic properties could be resolved through mitigation measures.

15.2.6 In-Valley/Water Needs Land Retirement Alternative

As with all the land retirement options, implementation of the In-Valley/Water Needs Land Retirement Alternative could result in adverse effects to historic properties when compared to the No Action Alternative. The construction of treatment and disposal facilities, as discussed in Section 15.2.4, has the potential to affect historic properties, though the extent of the facilities necessary may be reduced with a land retirement option. Effects to resources on retired lands may vary, depending on the future use of the lands. Anticipated uses include grazing, fallowing, and dry-land farming, all of which would likely have minimal impacts to historic properties given the current land use practice of irrigated farming.

Additionally, Federal ownership or management of the retired lands may result in increased consideration for cultural resources. Federal undertakings are subject to Section 106 of the NHPA. Any such activities with the potential to affect historic properties, including sale or lease of retired lands, would require a determination of their effect on historic properties.

This alternative has not been inventoried for historic properties. It is anticipated that cultural resources such as prehistoric archaeological sites and historic structures are present on the included lands. Mitigation measures would be required in the event that historic properties would be adversely affected by this alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of this alternative on cultural resources would be significant, but adverse effects to historic properties could be resolved through mitigation measures.

15.2.7 In-Valley/Drainage-Impaired Area Land Retirement Alternative

As with all the land retirement options, implementation of the In-Valley/Drainage-Impaired Area Land Retirement Alternative could result in adverse effects to historic properties when compared to the No Action Alternative. The construction of treatment and disposal facilities, as discussed in Section 15.2.4, has the potential to affect historic properties, though the extent of the facilities necessary may be reduced with a land retirement option. Effects to resources on retired lands may vary, depending on the future use of the lands. Anticipated uses include grazing, fallowing, and dry-land farming, all of which would likely have minimal impacts to historic properties given the current land use practice of irrigated farming.

Additionally, Federal ownership or management of the retired lands may result in increased consideration for cultural resources. Federal undertakings are subject to Section 106 of the NHPA. Any such activities with the potential to affect historic properties, including sale or lease of retired lands, would require a determination of their effect on historic properties.

This alternative has not been inventoried for historic properties. It is anticipated that cultural resources such as prehistoric archaeological sites and historic structures are present on the included lands. Mitigation measures would be required in the event that historic properties would be adversely affected by this alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of this alternative on cultural resources would be significant, but adverse effects to historic properties would be resolved through mitigation measures.

15.2.8 Ocean Disposal Alternative

Implementation of the Ocean Disposal Alternative could result in adverse effects on cultural resources when compared to the No Action Alternative. These effects could result from construction of the aqueduct, tunnel portals, and pumping plants. Reuse facilities (common to all disposal alternatives) would be developed. An unspecified amount of land would also be disturbed for temporary access/haul roads, staging areas, and disposal of excavated materials from tunnel boring and pipeline construction. All of these activities could have an adverse effect on historic properties. Construction of the extensive network of canals, pipelines, and drains to collect and convey drainwater to reuse facilities could also have direct adverse effects on cultural resources.

No field-level cultural resource reconnaissance studies have been completed specifically for this alternative. Previous surveys were completed for the segment of the alignment that crosses Sunflower Valley and along the coast at Point Estero. Both areas have archeological sites that may be eligible for listing on the National Register of Historic Places. Prehistoric archeological sites common along southern Coast Range drainages and coastal areas include villages, camps, lithic scatters, and food processing areas. Cemeteries were generally associated with villages. Early historic sites, mainly related to ranching, also are present.

A Class I records search for the Ocean Disposal Alternative revealed 92 known cultural resources within a 1-mile radius of proposed conveyance alignments. These resources include 54 prehistoric archaeological sites, 14 isolated prehistoric artifacts, four sites containing both prehistoric and historic components, 16 historic sites, and four resources presently lacking documentation. Prehistoric site types associated with this alternative include occupation/village sites, burial sites, campsites, lithic scatters, and bedrock milling features. Historic site types include ranch complexes, structures, trash scatters, cemeteries, roads, canals, and a petroleum pipeline. None of the prehistoric sites are known to have been evaluated for eligibility to the National Register of Historic Places. Two of the historic resources, the Crescent Canal and the Chevron Oil petroleum pipeline, were recommended ineligible to the National Register at the time they were recorded.

Mitigation measures would be required in the event that historic properties would be adversely affected by the Ocean Disposal Alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of the Ocean Disposal Alternative on cultural resources would be significant, but unavoidable adverse effects to historic properties could be resolved through mitigation measures.

15.2.9 Delta Disposal Alternatives

Implementation of either of the Delta Disposal Alternatives could result in adverse effects on cultural resources when compared to the No Action Alternative. These effects could result from construction of the aqueduct (whether fully or partially piped) and pumping plants. An unspecified amount of land would also be disturbed for use as temporary access/haul roads and construction staging areas. A biological treatment facility would be constructed and reuse facilities with their associated collection systems (common to all action alternatives) would be developed. All these actions have the potential to have adverse effects on historic properties.

A substantial amount of previous cultural resource inventory work has been conducted within the study limits of alternatives that dispose of drainwater into the Delta. The previous cultural resources studies, conducted between 1980 and 1983, were completed either by contractors for the Bureau of Reclamation or done in-house. The work was conducted in accordance with the requirements of Section 106 of the NHPA and its implementing regulations (CFR 800) at that time. Since then, the NHPA has been amended (1986, 1992) and its implementing regulations revised (1999, 2000).

Cultural resource investigations conducted to date for the Delta Disposal Alternatives covered the area from the northern margins of Tulare Lake to the Chipps Island outlet. The study alignment of these past investigations is similar to, though not identical with, the currently proposed alignment. No specific studies have been completed for the alignment and drainage outfalls west of the Chipps Island outlet (Carquinez Strait outlet). In the previous investigations, a literature and records search was conducted and the data tabulated and mapped. Emphasis was placed on the identification of prehistoric and Native American historic age archeological sites, although databases and records for historic properties were also examined. From these data an attempt was made to find relationships between environmental variables (soils, vegetation, or watercourses) and prehistoric and Native American historic site locations to determine areas that would be most likely to contain such sites. Most of the currently proposed alignment and reuse areas have been greatly altered by agricultural activities and few of the natural contours or drainages remain.

A Class I records search for the Delta Disposal Alternatives revealed 197 known cultural resources within a 1-mile radius of proposed conveyance alignments. The portion of the alignment shared by both the Chipps Island and Carquinez Strait alternatives includes a total of 166 known resources consisting of 42 prehistoric archaeological sites, 13 isolated prehistoric artifacts, two sites containing both prehistoric and historic components, 106 historic sites, one isolated historic artifact, and two additional resources presently lacking documentation. Prehistoric site types include occupation/village sites, burial sites, campsites, and lithic scatters. Historic site types include town sites, ranch complexes, farms, residences, a school, a church, other structures, trash scatters, cemeteries, ferry locations, roads, canals, bridges, railroads, transmission lines, pumping plants, and power facilities.

One prehistoric occupation/burial site along this portion of the conveyance alignment has been formally determined eligible to the National Register. A second burial location was recommended eligible at the time it was recorded. One historic site, the John Ohm House in Tracy, is listed on the National Register, while bridge 38C-9999 at River Road over Orestimba Creek has also been determined eligible. Five additional historic resources were recommended eligible to the National Register at the time they were recorded. A total of 66 historic sites along this portion of the alignment have been recommended or determined ineligible for listing on the National Register.

There are no known cultural resources recorded along the conveyance alignment specific to the Chipps Island outlet. However, the portion of the Delta Disposal Alternative specific to the Carquinez Strait outlet contains a total of 31 known cultural resources within a 1-mile radius of the alignment. These resources include nine prehistoric sites, one site containing both prehistoric and historic components, and 21 historic sites. Prehistoric site types include occupation sites, burial sites, and lithic scatters. Historic site types include homesteads, residences, pumping stations, a school, structures, bridges, trash scatters, and the remnants of wooden piers. None of the prehistoric sites along this portion of the alignment appear to have been evaluated for eligibility to the National Register. One historic site, the Southern Pacific Railroad Martinez-Benicia Bridge has been formally determined eligible for the National Register, while nine other historic sites have been recommended ineligible.

Mitigation measures would be required in the event that historic properties would be adversely affected by either of the Delta Disposal Alternatives. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of either of the Delta Disposal Alternatives on cultural resources would be significant, but unavoidable adverse effects to historic properties could be resolved through mitigation measures.

15.2.10 Cumulative Effects

Cumulative effects to cultural resources could be associated with changes in land use, agricultural land retirement, and potential on-farm treatment options. However, without knowing the exact nature and location of these potential actions, it is not feasible to assess the effect on cultural resources.

Should any of the alternatives lead to an expansion of urbanization in the region, they could contribute incrementally to a larger pattern of impacts to cultural resources resulting from increased development (such as the construction of housing, roads, and other infrastructure). However, none of the alternatives being analyzed is expected to contribute to a pattern of increased development in the area. Instead, either the current land use of irrigated agriculture is expected to continue, or other potential uses including grazing, fallowing, and dryland farming, which are less intensive than the irrigated farming that has already occurred, may be implemented. Furthermore, drainage service supports continued agricultural production and does not encourage urban growth.

While the action alternatives are all likely to have significant adverse effects to historic properties, they are the result of anticipated construction impacts. Cumulative effects to cultural resources in the region beyond the construction impacts are not anticipated from any of the alternatives.

15.2.11 Environmental Effects Summary

Significant effects from the project would occur if resources eligible to the National Register of Historic Places (historic properties), or those considered historical resources under CEQA, were affected in a manner that diminished their integrity or that caused substantial adverse changes in their significance.

Results of the Class 1 records search of known cultural resources within 1 mile of the proposed conveyance alignments are summarized below:

No Action	Undetermined
Proposed Action–In-Valley	5
Ocean Disposal	92
Delta Disposal-Chipps Island	166
Delta Disposal-Carquinez Strait	197

15.2.11.1 No Action Alternative

Changes in cropping patterns, irrigation and drainage methods, and land retirement, abandonment, or temporary fallowing are likely to occur under the No Action Alternative. While such activities may result in effects to cultural resources, the exact location and nature of the effects are not presently known. In the absence of actual cultural resource site locations, the conservative approach would be to consider that this alternative would have adverse effects on historic properties. However, the No Action Alternative does not meet the definition of a Federal undertaking subject to Section 106 of the NHPA; therefore, it does not require mitigation for adverse effects.

15.2.11.2 In-Valley Disposal Alternative

Implementation of the In-Valley Disposal Alternative may result in adverse effects to historic properties through construction of reuse facilities and associated collection/conveyance systems, pumping facilities, RO and biological treatment facilities, evaporation basins, and alternative wetland habitat mitigation complexes. Mitigation measures would be required in the event that historic properties would be adversely affected by the In-Valley Disposal Alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of the In-Valley Disposal Alternative on cultural resources would be significant, but unavoidable adverse effects to historic properties could be resolved through mitigation measures.

15.2.11.3 In-Valley/Groundwater Quality Land Retirement Alternative

Implementation of the In-Valley/Groundwater Quality Land Retirement Alternative may result in adverse effects to historic properties through construction of collection/conveyance systems, pumping facilities, RO and biological treatment facilities, and evaporation basins necessary for the treatment and disposal of remaining drainage. However, cultural resources on retired lands may receive increased consideration if the lands are acquired or managed by the Federal government. Mitigation measures would be required in the event that historic properties would be adversely affected by this alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of the In-Valley/Groundwater Quality Land Retirement Alternative on cultural resources would be significant, but unavoidable adverse effects to historic properties could be resolved through mitigation measures.

15.2.11.4 In-Valley/Water Needs Land Retirement Alternative

Implementation of the In-Valley/Water Needs Land Retirement Alternative may result in adverse effects to historic properties through construction of collection/conveyance systems, pumping facilities, RO and biological treatment facilities, and evaporation basins necessary for the treatment and disposal of remaining drainage. However, cultural resources on retired lands may receive increased consideration if the lands are acquired or managed by the Federal government. Mitigation measures would be required in the event that historic properties would be adversely affected by this alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of the In-Valley/Water Needs Land Retirement Alternative on cultural resources would be significant, but unavoidable adverse effects to historic properties could be resolved through mitigation measures.

15.2.11.5 In-Valley/Drainage-Impaired Area Land Retirement Alternative

Implementation of the In-Valley/Drainage-Impaired Area Land Retirement Alternative may result in adverse effects to historic properties through construction of collection/conveyance systems, pumping facilities, RO and biological treatment facilities, and evaporation basins necessary for the treatment and disposal of remaining drainage. However, cultural resources on retired lands may receive increased consideration if the lands are acquired or managed by the Federal government. Mitigation measures would be required in the event that historic properties would be adversely affected by this alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of the In-Valley/Drainage-Impaired Area Land Retirement Alternative on cultural resources would be significant, but unavoidable adverse effects to historic properties could be resolved through mitigation measures.

15.2.11.6 Ocean Disposal Alternative

Implementation of the Ocean Disposal Alternative may result in adverse effects to historic properties through construction of the aqueduct, tunnel portals, pumping plants, and reuse facilities, as well as disturbance to areas used for temporary access/haul roads, staging areas, and disposal of excavated materials. Mitigation measures would be required in the event that historic properties would be adversely affected by the Ocean Disposal Alternative. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of the Ocean Disposal Alternative on cultural resources would be significant, but unavoidable adverse effects to historic properties could be resolved through mitigation measures.

15.2.11.7 Delta Disposal Alternatives

Implementation of either of the Delta Disposal Alternatives may result in adverse effects to historic properties from construction of the aqueduct, pumping plants, treatment and reuse facilities, and areas disturbed for use as temporary access/haul roads and construction staging areas.

Mitigation measures would be required in the event that historic properties would be adversely affected by either of the Delta Disposal Alternatives. However, the need for mitigation can be reduced by avoidance during the planning process and periodic review, as written into the Programmatic Agreement and Historic Property Management Plan. Thus, the effect of either of the Delta Disposal Alternatives on cultural resources would be significant, but unavoidable adverse effects to historic properties could be resolved through mitigation measures.

Tables 15-1 through 15-8 summarize the effects that the No Action Alternative and action alternatives have on cultural resources. As the exact nature of effects to cultural resources under the No Action Alternative are unknown, it is not possible to differentiate between the No Action Alternative and existing conditions as compared to any of the alternatives, and the two baselines are assumed to be similar.

The action alternatives are all likely to have adverse effects on historic properties; however, mitigation measures could be used to resolve the adverse effects.

Table 15-1
Summary Comparison of Effects of No Action Alternative

Affected Resource and Area of Potential Effect	No Action Alternative Compared to Existing Conditions
Cultural Resources	Undetermined number of known cultural resources. Effects would depend on the changes in land use that might occur. In the absence of actual cultural resource site locations, this alternative would have adverse effects on historic properties. The No Action Alternative does not require mitigation.

Table 15-2
Summary Comparison of Effects of In-Valley Disposal Alternative

Affected Resource and Area of Potential Effect	In-Valley Disposal Compared to No Action	In-Valley Disposal Compared to Existing Conditions
Cultural Resources	Five known cultural resources within a 1-mile radius of proposed conveyance alignments. Significant effect; with mitigation = no significant effect.	Five known cultural resources within a 1-mile radius of proposed conveyance alignments. Adverse effect.

Table 15-3
Summary Comparison of Effects of
In-Valley/Groundwater Quality Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Groundwater Quality Land Retirement Compared to No Action	In-Valley/Groundwater Quality Land Retirement Compared to Existing Conditions
Cultural Resources	Undetermined number of known cultural resources. Significant effect; with mitigation = no significant effect.	Undetermined number of known cultural resources. Adverse effect, also possible increased consideration for cultural resources.

Table 15-4
Summary Comparison of Effects of
In-Valley/Water Needs Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Water Needs Land Retirement Compared to No Action	In-Valley/Water Needs Land Retirement Compared to Existing Conditions
Cultural Resources	Undetermined number of known cultural resources. Significant effect; with mitigation = no significant effect.	Undetermined number of known cultural resources. Adverse effect, also possible increased consideration for cultural resources.

Table 15-5
Summary Comparison of Effects of
In-Valley/Drainage-Impaired Area Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Drainage-Impaired Area Land Retirement Compared to No Action	In-Valley/Drainage-Impaired Area Land Retirement Compared to Existing Conditions
Cultural Resources	Undetermined number of known cultural resources. Significant effect; with mitigation = no significant effect.	Undetermined number of known cultural resources. Adverse effect, also possible increased consideration for cultural resources.

Table 15-6
Summary Comparison of Effects of Ocean Disposal Alternative

Affected Resource and Area of Potential Effect	Ocean Disposal Compared to No Action	Ocean Disposal Compared to Existing Conditions
Cultural Resources	92 known cultural resources within a 1-mile radius of proposed conveyance alignments. Significant effect; with mitigation = no significant effect.	92 known cultural resources within a 1-mile radius of proposed conveyance alignments. Adverse effect.

Table 15-7
Summary Comparison of Effects of Delta-Chipps Island Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Chipps Island Disposal Compared to No Action	Delta-Chipps Island Disposal Compared to Existing Conditions
Cultural Resources	166 known cultural resources within a 1-mile radius of proposed conveyance alignments. Significant effect; with mitigation = no significant effect.	166 known cultural resources within a 1-mile radius of proposed conveyance alignments. Adverse effect.

Table 15-8
Summary Comparison of Effects of Delta-Carquinez Strait Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Carquinez Strait Disposal Compared to No Action	Delta-Carquinez Strait Disposal Compared to Existing Conditions
Cultural Resources	197 known cultural resources within a 1-mile radius of proposed conveyance alignments. Significant effect; with mitigation = no significant effect.	197 known cultural resources within a 1-mile radius of proposed conveyance alignments. Adverse effect.

15.2.12 Mitigation Recommendations

The action alternatives may all result in adverse effects to historic properties through direct disturbance during construction activities. Such effects may be addressed through mitigation measures designed to eliminate or reduce the adverse effects. Measures that could be taken to resolve adverse effects or reduce effects to not significant levels include inventory, evaluation, and treatment activities conducted in accordance with Section 106 of the NHPA.

Upon selection of an action alternative, a Class III (intensive) cultural resources survey will be undertaken for any areas of the APE which have not been subject to prior survey coverage meeting current professional standards. The purpose of the Class III survey is to locate and record cultural resources that may be affected by project activities. Once cultural resources within the APE have been identified and recorded, ground-disturbing activities can be planned to avoid these resources whenever feasible.

When it is not possible to avoid cultural resources during project implementation, it may be necessary to evaluate the significance of the resources through further research or test excavations. Evaluation would be undertaken to determine whether the resources meet National Register and/or CEQA significance criteria.

Treatment processes can be developed to mitigate the effects of the project on significant resources. Effects to significant cultural resources may be mitigated by a variety of methods, depending on the nature of the particular resource. Such methods may include data recovery, public interpretation, further documentation and recordation, or preservation by other means. Treatment measures would follow specific Historic Property Treatment Plans developed for the project, or would adhere to procedures outlined in a Memorandum of Agreement developed between Reclamation, the State Historic Preservation Officer, and other consulting parties in the Section 106 process.

SECTIONSIXTEEN

AESTHETICS

This section describes the existing aesthetics of the San Luis Drainage Feature Re-evaluation project area lands and evaluates potential alterations to regional aesthetics arising from implementation of any of the action alternatives.

16.1 AFFECTED ENVIRONMENT

16.1.1 General Environmental Setting

The SLDFR alternatives cut across a wide swath of central California, an area that includes a diversity of landscape and visual resources. The predominating visual feature in the vicinity of the SLDFR drainage study area lands (SLDFR lands) is the relatively flat landscape of the Central Valley. Most of this area is intensively farmed, with irrigated row crops, pastures, and associated agricultural infrastructure being the dominant visual features. Small communities dot the landscape with the riparian woodland along the San Joaquin River, Fresno Slough, and various forks of the Kings River roughly bounding the SLDFR lands on the east. Due to the minimal variation in elevation within the Central Valley, vantage points from which to gain expansive vistas are very few and far between.

To the west of the Central Valley lowlands lie the Coast Ranges, a vast network of individual mountain ranges and valleys extending westward to the Pacific Ocean. Elevations of the ridge tops in the section of the Coast Ranges to the west of the SLDFR lands average between 3,000 and 5,000 feet above sea level. The Salinas Valley is a relatively broad river valley that separates the main body of the Coast Ranges from the Santa Lucia Range immediately adjacent to the Pacific Ocean. Elevations in the Santa Lucia Range are the highest in this section of the Coast Ranges and reach nearly 6,000 feet before plunging to the coastline. Portions of the Santa Lucia Range are included in the Los Padres National Forest. Land uses in the Coast Ranges largely consist of ranching, grazing, and recreation, with expansive vistas of open rangeland, oak-dominated woodland, and undeveloped mountainsides predominating. With the exception of the Salinas Valley, towns are small and widely dispersed. Larger communities are located along the Salinas River from Salinas in the north to Paso Robles, Atascadero, and Santa Margarita to the south. Due to the significant variation in elevation throughout this area, vantage points from which to observe the surrounding countryside are numerous, though are often relatively difficult to access.

West of the Coast Ranges lies the Pacific Ocean. The coastline in this portion of central California is extremely rugged, with the mountains sometimes plunging over 5,000 feet directly to the sea. South of San Simeon, the Santa Lucia Range veers inland, resulting in a relatively flat coastal shelf between the mountains and the sea. Morro Bay is a broad, crescent-shaped indentation in the coastline in this vicinity, bounded to the north by the promontory of Point Estero. Land uses along this coastal shelf are largely comprised of grazing, ranching, and recreation. Commercial fishing is conducted out of both San Simeon and Morro Bay as well as other smaller coastal communities. The unusual rock outcropping known as Morro Rock dominates vistas seaward from the hills along Morro Bay, as does a large power plant located near the base of the rock. Towns in this area are small in population and light in terms of development intensity. Several state parks are located along the coastline in this region. Due to the significant variation in elevation throughout this area, vantage points from which to observe the surrounding countryside are numerous, though are often relatively difficult to access.

To the north and west of the SLDFR lands, the Coast Ranges bifurcate into two branches: the Santa Cruz Mountains located between the Pacific Ocean and San Francisco Bay and the Diablo Range, separating San Francisco Bay and the Santa Clara Valley from the Central Valley. The Sacramento-San Joaquin Delta, formed at the confluence of those two rivers, is located in the Central Valley to the east of a narrow gap in the Diablo Range, generally to the north of Tracy and west of Stockton. The combined flow of the Delta rivers moves westward through this gap, known as the Carquinez Strait, into San Pablo and San Francisco Bays. Land uses in the Delta are largely related to agriculture and industry while areas bordering both the Carquinez Strait and San Pablo/San Francisco Bay are largely industrial and urban and include such communities as Brentwood, Antioch, Pittsburg, Benicia, and Martinez. Much of the land in the Diablo Range south of the Carquinez Strait is comprised of set-aside open space, state park land, and other defined open land. The valleys of the Diablo Range in this area are largely urban and include such communities as Walnut Creek, Concord, Livermore, San Ramon, and Pleasanton. Due to the significant variation in elevation throughout this area, vantage points from which to observe the surrounding countryside are numerous and, in many places, relatively easy to access.

The visual environment in the immediate vicinity of the SLDFR lands is dominated by the presence of irrigated agriculture and its associated industrial infrastructure. Vistas are more extensive in parts of the area dominated by cover crops such as alfalfa and field crops such as cotton. In other areas where orchard crops are more common, vistas are reduced in scope. Figure 16-1 illustrates a typical vista of Central Valley farmland in the vicinity of the SLDFR lands.

Figure 16-1 Central Valley Farmland

Cropping patterns within the SLDFR lands have changed over the years. Some formerly irrigated lands are now used for dryland pasture, wildlife habitat, dryland grain, drainwater reuse areas, and sediment settling basins. Facilities to both deliver water to farms for irrigation (Delta Mendota Canal, California Aqueduct) and remove excess drainage from fields (San Luis Drain, numerous evaporation basins) are interwoven throughout the area and constitute a portion of its predominating visual character.

With the exception of the area adjacent to the Carquinez Strait and the valleys of the Diablo Range, the majority of this section of central California is characterized by a relatively low population density.

16.1.2 Relevant Regulations

Outside of Federal land administered by the U.S. Forest Service and National Park Service, few regulations concern aesthetic resources. Since the land areas being evaluated for the action alternatives fall outside of these lands, applicable regulations are limited to those at the State and local level.

At the State level, the California Scenic Highway Program has the goal of preserving and enhancing the natural beauty of California. Highways designated as scenic offer passing motorists pristine views of natural landscapes devoid of visual intrusions (e.g., buildings, unsightly land uses, noise barriers). The California Scenic Highway Program designates travel routes that are to receive some level of protection for the scenic resources visible from them. Routes are nominated by local governments, generally counties, and must receive approval from the California Scenic Highway Program prior to being officially designated. Standards applicable to designated scenic highways include the regulation of land use and the intensity of development within the scenic corridor (1/4 mile on each side of the highway) through detailed site planning, the control of outdoor advertising, attention to landscaping, and the design and appearance of structures and equipment (California Department of Transportation 1996). Officially designated state scenic highways are listed below under each of the three counties containing SLDFR drainage study area lands.

Local policies articulating visual resource management objectives are typically contained in the General Plans/Comprehensive Plans and Elements adopted by each county and incorporated city in California. Each of the counties that the SLDFR lands are located in has adopted a Scenic Highways Element as part of its General Plan: Kings, Fresno, and Merced counties.

The *Kings County General Plan* (Kings County Planning Department 1998) seeks to ensure that future land uses are compatible with the preservation of scenic highways, protect and enhance those roadways which cross scenic areas or serve as scenic entranceways to cities and communities, preserve roadside landscapes which have high visual quality and contribute to the local environment, assure that overhead utility lines located along scenic routes are placed underground wherever feasible, and design public works projects to minimize tree damage and removal along scenic corridors. Kings County designates the following routes within the general vicinity of the SLDFR lands as a scenic highway:

- State Highway 41 from State Highway 33 south to the county line

The *Fresno County General Plan* (Fresno County Planning and Resource Management Department 1995) seeks to identify a system of scenic roads which traverse land with outstanding or unique natural scenic quality or provide access to regionally significant scenic or recreational areas, and preserve the scenic quality of land adjacent to scenic roads. The use of land adjacent to scenic highways and scenic drives shall be planned in such a manner to preserve scenic amenities. The General Plan prescribes several land use policies designed to achieve this stated goal, including the following: proposed overhead transmission lines and towers shall be routed to minimize detrimental effects on scenic amenities visible from the right-of-way and the installation of signs visible from the right-of-way shall be limited to business identification, on-site real estate, and traffic control signs. Fresno County designates the following routes within the general vicinity of the SLDFR lands as a scenic highway:

- State Highway 198 from Interstate 5 west to the county line (excluding the city of Coalinga);
- Interstate 5 within the county

The *Merced County General Plan* (Merced County Planning and Community Development Department 1990) adopts state standards for protecting designated scenic corridors, including the regulation of land use and the intensity of development through detailed site planning, the control of outdoor advertising, attention to landscaping, and the design and appearance of structures and equipment. Merced County designates the following routes within the general vicinity of the SLDFR lands as a scenic highway:

- State Highway 152 from Interstate 5 west to the county line;
- Interstate 5 from State Highway 152 north to the county line

State- and/or county-designated scenic highways are shown on Figure 16-2.

16.2 ENVIRONMENTAL CONSEQUENCES

This section focuses on effects of the No Action and action alternatives on the visual character of the region. Where applicable, assumptions made regarding construction method, post-construction site restoration, and the effects of potentially required mitigation actions on visual resources are clearly stated.

San Luis Drainage Feature Re-evaluation	Scenic Highways in Vicinity of Alternatives	Figure 16-2
17324004		

16.2.1 Evaluation Criteria

Aesthetic effects are evaluated through an examination of the action's effects on the visual character of a site (or area) and related viewsheds. Visual character is comprised of a combination of elements, including land use, architecture, design, and building height and/or mass. The visual character of a project site is typically evaluated both to the exclusivity of surrounding land uses and within the context of its neighborhood. It is recognized, however, that issues relating to visual character and the degree of associated environmental effects are inherently subjective due to the wide range of possible opinions regarding aesthetic values and qualities.

The scope of the aesthetic effect analysis is confined to the physical effects on viewsheds and on physical attributes of landscape features that define important views. Related effects on ambient air quality (including odors) are examined in Section 11 of this EIS.

Visual effects are also analyzed through an examination of views and/or viewsheds. Viewshed effects are typically characterized by the loss and/or obstruction of scenic vistas or other major views available to the public. View analysis is also based upon the relative visibility of the project feature with regard to viewing location and existing and future development on the site. Effects considered to be significant typically consist of the loss or obstruction of views to the horizon or scenic vistas. Significant effects can also include changes in the character of the viewshed, such as the elimination of natural features, changes to the style or ambience of the community, or the insertion of a prominent feature that challenges the original aesthetic values of the site.

Effects of the action alternatives on aesthetics were examined by (1) comparing the existing visual character of the landscape and the degree to which actions that are associated with each of the alternatives would affect (either contrast or conform with) this character and (2) analyzing changes in the aesthetic experience offered to the public, such as whether a given action would result in a visible change, the duration of any change in the visual character, the distance and viewing conditions under which the change would be visible, and the number of viewers that would be affected.

The *intensity* of the effect can be classified as negligible, minor, moderate, or major. The intensity of the effect is comprised of both the extent and duration of the physical effect:

- A negligible effect would be barely perceptible and confined to a limited viewpoint.
- A minor effect would result in little change to the existing landscape character and minor or temporary effects on viewers.
- A moderate effect would be noticeable to viewers from one or more scenic viewpoints.
- A major effect would cause a substantial change in landscape character or a permanent change to existing viewpoints.

Effect duration can be either short-term (temporary) or long-term (permanent). Though most aesthetics effects are considered to be negative, some can be positive in that the implementation of a specific feature of an alternative would result in an improvement to existing visual character or specific views. For purposes of this evaluation, significant effects will be defined as those of a major intensity and permanent duration. All other effects are considered not significant.

16.2.2 No Action Alternative

The No Action Alternative assumes that the SLDFR project facilities would not be implemented to address drainage and water quality problems within and downslope of the SLDFR lands. Under this alternative, no new Federal drainage conveyance facilities would be constructed, nor would additional regional drainwater treatment, conveyance, and disposal facilities be developed beyond those that either existed in 2001 or are currently authorized, funded projects. Thus, visual effects would be limited to changes in existing patterns of land use within the SLDFR lands.

A total of 109,106 acres would be expected to be retired from active agricultural production under this alternative by the year 2050. Given the assumed salt buildup in the soil of these areas, it is assumed that much of this land would convert to unmanaged open space or be used for dry pasture, dryland summer fallow grain operations, fallowing, and other uses consistent with local plans and zoning. Lands remaining in production within drainage-impaired areas would likely be switched over to salt tolerant, low water use crops such as cotton, barley, safflower, and winter annual dairy support crops such as triticale. An increase would likely be seen in fallowed lands during low water supply years. This increase would be in addition to the land retirement described above.

None of these changes in land use would result in the introduction of new visual elements that are not currently present within the SLDFR lands. However, these changes in land use could produce some visual effect, particularly if the retired acres are located in contiguous tracts. This effect would be potentially minor and permanent.

Certain components of the GDA's proposed In-Valley Treatment/Drainage Reuse Facility are included under No Action. These components would result in an increase in the area planted with salt-tolerant crops and serviced by subsurface drainage systems. However, in the absence of the SLDFR, none of the other components are expected to be implemented. Other on-farm, in-district activities are assumed to occur under No Action, including ongoing use of existing drainage control/reuse measures, on-farm irrigation system improvements, changes in irrigation practices, reallocation of water from drainage-impaired areas to unaffected areas, and other drainwater reduction measures. None of these activities would alter the characteristics of viewsheds within the SLDFR lands, nor would they introduce new visual elements that are not currently present. The visual effects associated with these activities would, at most, consist of a change in cropping patterns on lands that have been historically in agricultural production. This effect would be potentially minor and permanent.

16.2.3 In-Valley Disposal Alternative

Under this alternative, aesthetic effects would be limited to the SLDFR lands in Merced, Fresno, and Kings counties. Drainage service would be provided to each of the four subareas: Westlands North, Westlands Central, Westlands South, and Northerly Area. Facilities installed under this alternative would be sized to handle a drainwater volume of 69,645 AF/year. They include a drainwater collection system within each subarea, regional reuse facilities within each subarea (up to 16), four evaporation basins (one in each subarea), an RO treatment facility and Se biotreatment plant adjacent to each of the four evaporation basins, and a conveyance system for collecting reused drainwater from each subarea and delivering it to the RO and Se biotreatment facilities. A system to collect groundwater from existing sumps adjacent to the unlined section of the Delta-Mendota Canal and convey it to the Northerly Reuse Area would also be installed.

Approximately 44,106 acres of land would be retired from irrigated agricultural use under this alternative.

The visual character of the areas that would contain these facilities is largely defined by the dominating presence of large agricultural operations and open cropland. The topographic gradient in these areas is virtually flat, offering little opportunity for expansive public viewpoints. Population density in this portion of San Joaquin Valley west of the Fresno Slough and San Joaquin River is very low. The small communities of Firebaugh and Mendota are located in proximity to some of the project facilities. As a result, some residences in these towns could experience some degree of visual effect during both construction and operation.

Aesthetic effects anticipated to be associated with each of the major components of this alternative are as follows:

- Effects caused by installation of the drainage collection system, including the Delta-Mendota Canal drain, are expected to be negligible and temporary during construction only with some elements causing minor and permanent visual effects. These systems would be composed of subsurface pipelines and, following installation, would not be visible above the ground surface except where they cross the canal. The pipeline canal crossing, as well as drain sumps and pumps utilized as part of the collection system, would be visible but consistent with the existing visual character of the area.
- Effects of the up to 16 drainage reuse facilities would be minor and permanent. These facilities would each be comprised of large acreages (totaling 19,000 acres) of farmland underlain by the system of subsurface tile drains delivering drainage from upland fields and a pipeline to convey the reused drainwater to treatment and/or disposal facilities. Above ground level, these facilities would consist of cropland planted with salt-tolerant crops including perennial pasture grasses and legumes. The potential reuse areas consist of lands that either have been or are currently irrigated. Other than a potential permanent change in the type of crop planted on these acres, no changes to the visual character of these sites are anticipated.
- Effects caused by construction and operation of the four RO treatment plants (8 acres) and four Se biotreatment plants (6 acres) (one complex in each subarea) would be minor and permanent. At each of the four locations, the RO treatment and Se biotreatment plants may be visible from surrounding residences and local roads and may alter the overall visual character of the location somewhat. The effect is expected to be minor only because other industrial facilities associated with existing agriculture are already located within the general vicinity.
- Effects associated with installation of the drainwater conveyance system connecting the reuse facilities with the four treatment and disposal facilities are likely to be moderate and permanent. A total of approximately 70.8 miles of buried pipeline would convey reused drainwater from each of the reuse areas to the treatment and disposal facility locations. A total of 16 pumping plants and sumps would be included as part of this conveyance system. Effects associated with the pipeline network would be temporary during construction only. The pumping plants, however, may be visible from surrounding residences and local roads and may alter the overall visual character of each location somewhat. Their effect is expected to be moderate only because other industrial facilities associated with existing agriculture are already located within the general vicinity of each site.

- Effects associated with the four evaporation basins would likely be moderate and permanent. The evaporation basins would cover a maximum potential total of approximately 3,290 acres. Where practical, basins would be located on existing lands that have been retired from agricultural production. Most basins would be surrounded by reuse areas that would act as a buffer zone between the basins and nearby commercial irrigated agriculture. Effects would be permanent as each basin would be visible from ground-level vantage points surrounding the sites. Some of the basins may be visible from nearby residences and local farm roads and may alter the overall visual character of each location somewhat. Their effect is expected to be moderate only because other industrial facilities associated with existing agriculture and other evaporation basins are already located within the general vicinity of each potential site.
- Effects associated with the mitigation wetland complexes anticipated to be constructed as part of this alternative would likely be minor and permanent. The mitigation wetlands could be located in proximity to the evaporation basins or elsewhere in the valley. Their size depends on mitigation requirements negotiated with the U.S. Fish and Wildlife Service (see Sections 20.10.4 and 20.10.5). Effects would be permanent, as each wetland complex would be visible from ground-level vantage points surrounding the sites. Depending on existing land uses in and surrounding these locations, the wetlands may alter the overall visual character of each location somewhat. Natural wetlands do not currently exist in either area, but some are located along Fresno Slough a few miles to the northeast of each site. Effects are expected to be minor only because visibility would be limited to immediately adjacent vantage points and wetlands are located within the general vicinity of each site. In addition, depending on existing land uses at each site, the change to a wetland use for the purpose of providing wildlife habitat may be considered to be a beneficial visual alteration.
- The retirement of approximately 44,106 acres of farmland is expected to occur by the year 2050 under this alternative. Given the assumed salt buildup in the soil of these areas, it is assumed that much of this land would convert to managed open space, primarily dryland farming, grazing, and fallowing. None of these changes in land use/management would result in the introduction of new visual elements that are not currently present within the SLDFR lands. However, these changes in land use could produce some visual effect, particularly if the retired acres are located in contiguous tracts. This effect would be potentially minor and permanent.

The In-Valley Disposal Alternative would be generally consistent with the overall visual character of the SLDFR lands and would produce permanent changes at only a few specific locations. The Phase 1 construction period is estimated at 5 years, though individual facilities causing temporary visual effects would be built over a shorter time frame (varies by facility). The effects are not significant when compared to the No Action Alternative.

Designated scenic highways within the general vicinity of the SLDFR lands include Interstate 5, which is located between 8 and 10 miles west of the facility locations and State Highway 152, which passes within 10 miles north of the Northerly Area treatment plant/evaporation basin location. Given the flat topography of the area and the distance of project facilities from each corridor, no visual effects to motorists along these routes are expected.

Figures 16-3 through 16-5 show existing features of the SLDFR lands that are visually similar to some of the features proposed under this alternative (and the other action alternatives) and provide an indication of how elements of this alternative may appear following implementation.

Figure 16-3 Existing San Luis Drain

Figure 16-4 Drainwater Treatment Facility at Panoche Water District

Figure 16-5 Buried Pipeline Alignment

16.2.4 In-Valley/Groundwater Quality Land Retirement Alternative

Under this alternative, aesthetic effects would be limited to the SLDFR lands in Merced, Fresno, and Kings counties. Lands within Westlands having an Se concentration greater than 50 ppb in the shallow groundwater, as well as lands acquired by Westlands, would be retired. Some land in the Northerly Area (Broadview Water District) would also be retired for a total of 92,592 acres of land retirement (including the 44,106 acres to be retired under the In-Valley Disposal Alternative). Drainage service would be provided to lands remaining in production within each of the four subareas: Westlands North, Westlands Central, Westlands South, and Northerly Area. Facilities installed under this alternative would be similar to those for the In-Valley Disposal Alternative but scaled down in size to handle the reduced drainage volume (61,036 AF/year). They would include a drainwater collection system within each subarea, regional reuse facilities within each subarea (up to 16), four evaporation basins (one in each subarea), an RO treatment facility and Se biotreatment plant adjacent to each of the four evaporation basins, and a conveyance system for collecting reused drainwater from each subarea and delivering it to the RO and Se biotreatment facilities. A system to collect groundwater from existing sumps adjacent to the unlined section of the Delta-Mendota Canal and convey it to the Northerly Reuse Area would also be installed.

The visual character of the areas that would contain these facilities is largely defined by the dominating presence of large agricultural operations and open cropland. The topographic gradient in these areas is virtually flat, offering little opportunity for expansive public viewpoints. Population density in this portion of the San Joaquin Valley west of Fresno Slough and the San Joaquin River is very low. The small communities of Firebaugh and Mendota are located in proximity to some of the project facilities. As a result, some residences in these towns could experience some degree of visual effect during both construction and operation.

Aesthetic effects anticipated to be associated with each of the major components of this alternative are similar to those for the In-Valley Disposal Alternative, except:

- Effects associated with the four evaporation basins would likely be moderate and permanent. The evaporation basins would cover a maximum potential total of approximately 2,890 acres. Where practical, basins would be located on existing lands that have been retired from agricultural production.
- The retirement of approximately 92,592 acres of farmland is expected to occur by the year 2050 under this alternative. Given the assumed salt buildup in the soil of these areas, it is assumed that much of this land would convert to managed open space, primarily dryland farming, grazing, and fallowing (Figures 16-6, 16-7, and 16-8). None of these changes in land use/management would result in the introduction of new visual elements that are not currently present within the SLDFR lands. However, these changes could produce some visual effect, particularly if the retired acres are located in contiguous tracts, as would likely be the case. The spatial distribution of the lands expected to be retired under this alternative would likely result in contiguous areas within the Westlands North, Westlands Central, and Westlands South subareas being removed from irrigated agriculture. This effect would be potentially minor and permanent.

Source: Reclamation Land Retirement Program

Figure 16-6 Dryland Farming
(Barley Grown in a Good Rainfall Year in Tranquility Area)

Source: Reclamation Land Retirement Program

Figure 16-7 Example of Grazing (Sheep in Background)

Source: Reclamation Land Retirement Program

Figure 16-8 Disked Fallow Land in Westlands

The In-Valley/Groundwater Quality Land Retirement Alternative would be generally consistent with the overall visual character of the SLDFR lands and would produce permanent changes at only a few specific locations. The construction period is estimated at approximately 4 years, though individual facilities causing temporary visual effects would be built over a shorter time frame (varies by facility). The effects are not significant when compared to the No Action Alternative.

Designated scenic highways within the general vicinity of the SLDFR lands include Interstate 5, which is located between 8 and 10 miles west of the facility locations, and State Highway 152, which passes within 10 miles north of the Northerly Area treatment plant/evaporation basin location. Given the flat topography of the area and the distance of project facilities from each corridor, no visual effects to motorists along these routes are expected.

16.2.5 In-Valley/Water Needs Land Retirement Alternative

Under this alternative, aesthetic effects would be limited to the SLDFR lands in Merced, Fresno, and Kings counties. Lands within Westlands having an Se concentration greater than 20 ppb, as well as lands acquired by Westlands, would be retired. Some land in the Northerly Area (Broadview Water District) would also be retired for a total of 193,956 acres of land retirement (including the 44,106 acres to be retired under the In-Valley Disposal Alternative). Drainage service (for 45,287 AF/year) would be provided to lands remaining in production within each of the four subareas: Westlands North, Westlands Central, Westlands South, and Northerly Area. Facilities installed under this alternative would be similar to those for the In-Valley Disposal Alternative but scaled down to handle the reduced drainage volume. Facilities would include a drainwater collection system within each subarea, regional reuse facilities within each subarea (up to 16), four evaporation basins (one in each subarea), an RO treatment facility and Se biotreatment plant adjacent to each of the four evaporation basins, and a conveyance system for collecting reused drainwater from each subarea and delivering it to the RO and Se biotreatment facilities. A system to collect groundwater from existing sumps adjacent to the unlined section of the Delta-Mendota Canal and convey it to the Northerly Reuse Area would also be installed.

The visual character of the areas that would contain these facilities is largely defined by the dominating presence of large agricultural operations and open cropland. The topographic gradient in these areas is virtually flat, offering little opportunity for expansive public viewpoints. Population density in this portion of the San Joaquin Valley west of Fresno Slough and the San Joaquin River is very low. The small communities of Firebaugh and Mendota are located in proximity to some of the project facilities. As a result, some residences in these towns could experience some degree of visual effect during both construction and operation.

Aesthetic effects anticipated to be associated with each of the major components of this alternative are similar to those for the In-Valley Disposal Alternative, except:

- Effects associated with the four evaporation basins would likely be moderate and permanent. The evaporation basins would cover a maximum potential total of approximately 2,150 acres. Where practical, basins would be located on existing lands that have been retired from agricultural production.
- The retirement of approximately 193,956 acres of farmland is expected to occur by the year 2050 under this alternative. Given the assumed salt buildup in the soil of these areas, it is

assumed that much of this land would convert to managed open space, primarily dryland farming, grazing, and fallowing. None of these changes in land use/management would result in the introduction of new visual elements that are not currently present within the project area lands. However, these changes could produce some visual effect, particularly if the retired acres are located in contiguous tracts, as would likely be the case. The spatial distribution of the lands expected to be retired under this alternative would likely result in contiguous areas within the Westlands North, Westlands Central, and Westlands South subareas being removed from irrigated agriculture. This effect would be potentially moderate and permanent.

The In-Valley/Water Needs Land Retirement Alternative would be generally consistent with the overall visual character of project area lands. Permanent changes would occur throughout the project area lands, however, due to extensive land retirement. The construction period is estimated at approximately 3 years, though individual facilities causing temporary visual effects would be built over a shorter time frame (varies by facility). The effects are not significant when compared to the No Action Alternative.

Designated scenic highways within the general vicinity of project area lands include Interstate 5, which is located between 8 and 10 miles west of the facility locations, and State Highway 152, which passes within 10 miles north of the Northerly Area treatment plant/evaporation basin location. Given the flat topography of the area and the distance of project facilities from each corridor, no visual effects to motorists along these routes are expected.

16.2.6 In-Valley/Drainage-Impaired Area Land Retirement Alternative

Under this alternative, aesthetic effects would be limited to project area lands in Merced, Fresno, and Kings counties. All drainage-impaired lands within the Westlands would be retired. Some land in the Northerly Area (Broadview Water District) would also be retired for a total of 308,000 acres of land retirement (including the 44,106 acres to be retired under the In-Valley Disposal Alternative). Drainage service would be provided to lands remaining in production within the Northerly Area. Facilities installed under this alternative would handle 26,830 AF/year of drainwater and include a drainwater collection system within the Northerly Area, regional reuse facilities within the Northerly Area, one evaporation basin, an RO treatment facility and Se biotreatment plant adjacent to the evaporation basin, and a conveyance system for collecting reused drainwater from each reuse area and delivering it to the RO and Se biotreatment facility. A system to collect groundwater from existing sumps adjacent to the unlined section of the Delta-Mendota Canal and convey it to the Northerly Reuse Area would also be installed.

The visual character of the areas that would contain these facilities is largely defined by the dominating presence of large agricultural operations and open cropland. The topographic gradient in these areas is virtually flat, offering little opportunity for expansive public viewpoints. Population density in this portion of the San Joaquin Valley west of Fresno Slough and the San Joaquin River is very low. The small communities of Firebaugh and Mendota are located in proximity to some of the project facilities. As a result, some residences in these towns could experience some degree of visual effect during both construction and operation.

Aesthetic effects anticipated to be associated with each of the major components of this alternative are similar to those of the In-Valley Disposal Alternative for the Northerly Area, with no effect in Westlands because drainage service would not be provided:

- Effects associated with installation of the drainwater conveyance system connecting the reuse facilities with the treatment facility are likely to be negligible and temporary. A total of approximately 1.1 miles of buried pipeline would convey reused drainwater from each of the reuse areas to the treatment and disposal facility location. Effects associated with the pipeline network would be temporary during construction only.
- Effects associated with the evaporation basin would likely be moderate and permanent. The evaporation basin would cover a maximum potential area of approximately 1,270 acres. The Northerly Area evaporation basin would be contiguous to an existing drainwater reuse site (Grassland Bypass Project) that would act as a buffer zone between the basin and nearby commercial irrigated agriculture. Effects would be permanent as the basin would be visible from ground-level vantage points surrounding the site. The basin may be visible from nearby residences and local farm roads and may alter the overall visual character of the location to some degree. This effect is expected to be moderate only because other industrial facilities associated with existing agriculture and other evaporation basins are already located within the general vicinity of the site.
- The retirement of approximately 308,000 acres of farmland is expected to occur by the year 2050 under this alternative. Given the assumed salt buildup in the soil of these areas, it is assumed that much of this land would convert to managed open space, primarily dryland farming, grazing, and fallowing. None of these changes in land use would result in the introduction of new visual elements that are not currently present within the project area lands. However, these changes in land use would likely produce a visual effect simply due to the large number of acres to be retired from irrigated agriculture. The majority of this acreage would be located in contiguous tracts, with the result being that all of the drainage-impaired lands within the Westlands North, Westlands Central, and Westlands South subareas would be removed from irrigated agriculture. This effect would be potentially moderate and permanent.

The In-Valley/Drainage-Impaired Area Land Retirement Alternative would be generally consistent with the overall visual character of the project area lands. Permanent changes would occur throughout the SLDFR lands, however, due to extensive land retirement. The construction period is estimated at 2 years (by 2009), though individual facilities causing temporary visual effects would be built over a shorter time frame (varies by facility). The effects are not significant when compared to the No Action Alternative.

Designated scenic highways within the general vicinity of the SLDFR lands include Interstate 5, which is located between 8 and 10 miles west of the facility locations, and State Highway 152, which passes within 10 miles north of the Northerly Area treatment plant/evaporation basin location. Given the flat topography of the area and the distance of project facilities from each corridor, no visual effects to motorists along these routes are expected.

16.2.7 Ocean Disposal Alternative

Under this alternative, potential aesthetic effects would extend from the SLDFR lands south and west from San Joaquin Valley through the Coast Ranges to Estero Bay at the Pacific Ocean. Areas potentially affected would include portions of Kings, Fresno, Merced, Kern, and San Luis Obispo counties. Drainage service would be provided to each of the four subareas: Westlands North, Westlands Central, Westlands South, and Northerly Area. Facilities installed under this alternative would include a drainage collection system within each subarea, drainwater reuse facilities within each subarea, a conveyance system for collecting reused drainwater from each subarea and delivering it to the pipeline, and a system of buried pipelines and tunnels to deliver drainwater from the SLDFR lands to Estero Bay.

The visual character of the areas that would contain these facilities varies greatly along the route of the system. The northern segment of the system, in and around the SLDFR lands, is largely defined by the dominating presence of large agricultural operations and open cropland. Moving to the south, the dominance of irrigated agriculture lessens and the land is largely in undeveloped open space used for ranching, grazing, and oil/gas production. The Kettleman Hills, Temblor Range, and Santa Lucia Range form the major topographic barriers comprising the Coast Ranges along the system route. Elevations reach as high as 3,000 to 4,000 feet in the vicinity of the route, offering the potential for expansive vistas of the construction zone at various points along the route. The Coast Ranges are largely open space with ranching, grazing, and some vineyard land use dominating. Closer to the ocean, the mountains are more heavily forested (oak woodland). A few small settlements are located along the potential route (Firebaugh, Mendota, Kettleman City, Cholame, Shandon, and Cayucos). The larger urban center of Paso Robles is located approximately 5 miles north of the route. Population density along the entire route is low, with the exception of the aforementioned communities. Some residences in these communities could experience some degree of visual effect during both construction and operation.

Aesthetic effects anticipated to be associated with each of the major components of this alternative are as follows:

- Effects caused by installation of the drainage collection system, including the Delta-Mendota Canal drain, are expected to be negligible and temporary during construction only with some elements causing minor and permanent visual effects. These systems would be composed of subsurface pipelines and, following installation, would not be visible above the ground surface except where they cross the canal. The pipeline canal crossing, as well as drain sumps and pumps utilized as part of the collection system, would be visible but consistent with the existing visual character of the area.
- Effects of the up to 16 drainage reuse facilities would be minor and permanent. These facilities would each be comprised of large acreages (totaling 19,000 acres) of farmland underlain by the system of subsurface tile drains delivering drainage from upland fields and a pipeline to convey the reused drainwater to treatment and/or disposal facilities. Above ground level, these facilities would consist of cropland planted with salt-tolerant crops including perennial pasture grasses and legumes. The potential reuse areas consist of lands that either have been or are currently irrigated. Other than a potential permanent change in the type of crop planted on these acres, no changes to the visual character of these sites are anticipated.

- Effects associated with installation of the drainwater conveyance system connecting the reuse facilities with the aqueduct are likely to be moderate and permanent. A series of pumping plants and an associated network of buried pipelines would be constructed to convey drainwater from the reuse facilities upgradient to the aqueduct. Effects associated with the pipeline network would be temporary during construction only. The pumping plants, however, may be visible from surrounding residences and local roads and, may alter the overall visual character of each location somewhat. Their effect is expected to be moderate only because other industrial facilities associated with existing agriculture are already located within the general vicinity of each site.
- Effects associated with installation of the Kettleman City aqueduct to convey drainwater from the San Luis Unit over the Kettleman Hills and across Kettleman Plain to the Temblor Range are anticipated to be moderate and permanent. This 46-mile-long facility would include the construction of five pumping plants and would be located in an area of open cropland, grazing land, and foothills. Effects associated with the buried pipeline would be temporary during the construction phase only. However, the five pumping plants may be visible from surrounding residences and local or State highways and may alter the overall visual character of each location somewhat. Their effect is expected to be moderate only because of their relatively small size and distance from viewing corridors.
- Bluestone Tunnel would connect the western end of the Kettleman City pipeline with the eastern end of the Paso Robles pipeline and would pass under Bluestone Ridge in the Temblor Range at an elevation of 1,850 feet. The eastern portal of this 1.23-mile-long tunnel may be visible from State Highway 41, while the western portal would likely be concealed from regional vantage points. Effects associated with this facility are expected to be minor and permanent.
- Effects associated with installation of the Paso Robles pipeline to convey drainwater from Bluestone Tunnel through Cholame Valley to the Santa Lucia Range are anticipated to be moderate and permanent. This 43-mile-long facility would include the construction of one pumping plant and would be located in an area of open cropland, grazing land, and vineyards with some rural residential development. Effects associated with the buried pipeline would be temporary during the construction phase only. However, the pumping plant may be visible from State Highway 46 and may alter the overall visual character of the location due to the undeveloped nature of the surrounding area and its proximity to the highway corridor. The Salinas River crossing south of Paso Robles would also be visible from along the river corridor. However, effects are expected to be moderate only as similar landscape features are present in these areas.
- Two tunnels, Santa Rita and Santa Lucia tunnels, would convey the drainwater through the Santa Lucia Range at an approximate elevation of 1,300 feet. A 1.11-mile-long siphon would connect these two tunnels. Both portals of Santa Rita Tunnel may be visible from State Highway 46. The Santa Lucia Tunnel would be concealed from regional vantage points. Effects associated with these facilities would be expected to be minor and permanent.
- Effects associated with the 11.35-mile-long buried Cottontail pipeline conveying drainwater from Santa Lucia Tunnel to Estero Bay at the Pacific Ocean would be moderate and temporary during construction only.

- Effects associated with the Point Estero outfall would be moderate and temporary. Construction of this pipe (including a 1.44-mile-long underwater segment leading to the outfall) would temporarily alter the existing visual character of the construction zone but would not result in any permanent changes to views of the location.
- The retirement of approximately 44,106 acres of farmland is expected to occur by the year 2050 under this alternative. Given the assumed salt buildup in the soil of these areas, it is assumed that much of this land would convert to managed open space, primarily dryland farming, grazing, and fallowing. None of these changes in land use/management would result in the introduction of new visual elements that are not currently present within the SLDFR lands. However, these changes in land use could produce some visual effect, particularly if the retired acres are located in contiguous tracts. This effect would be potentially minor and permanent.

The Ocean Disposal Alternative would be generally consistent with the overall visual character of the SLDFR lands and adjacent areas in San Joaquin Valley but may visually conflict with some open space land uses in the trans-Coast Ranges portion of the route. Nonetheless, permanent effects would be generated at only a few specific locations. The construction period is estimated at about 7 years, though individual facilities causing temporary visual effects would be built over a shorter time frame (varies by facility). Except in wooded areas intersecting the pipeline corridor, the land surface along the pipeline route would be restored to pre-construction conditions and visual effects would be temporary. In wooded areas, trees removed during pipeline construction would not be replanted, resulting in a permanent alteration of the visual character. Overall, the effect on visual resources is not significant when compared to the No Action Alternative.

Designated scenic highways within the general vicinity of the area of effect under this alternative include Interstate 5, which is located between 8 and 10 miles west of the facility locations; State Highway 152, which passes within 10 miles north of the Northerly Area reuse facility location; State Highway 41 and State Highway 46, which parallel the pipeline and tunnel route through the Coast Ranges; U.S. Highway 101, which crosses the pipeline route south of Paso Robles; and State Highway 1, which crosses the Cottontail pipeline portion of the route north of Cayucos. Given the relatively flat topography of the area along State Highway 152 and the distance of project facilities from this corridor and from the designated portion of the Interstate 5 corridor, no visual effects to motorists along either route are expected. Potential visual effects to motorists along State Highways 41 and 46 are expected to be moderate but permanent. Potential visual effects to motorists along U.S. Highway 101 are expected to be minor and permanent at the point of crossing only. Potential visual effects to motorists along State Highway 1 are expected to be minor and temporary during construction only. Overall, the effect on visual resources is not significant when compared to the No Action Alternative.

16.2.8 Delta-Chipps Island Disposal Alternative

Under this alternative, potential aesthetic effects would occur from the SLDFR lands north and west down San Joaquin Valley and into the vicinity of the Delta. Areas potentially affected would include portions of Kings, Fresno, Merced, Stanislaus, San Joaquin, Alameda, and Contra Costa counties. Drainage service would be provided to each of the four subareas: Westlands North, Westlands Central, Westlands South, and Northerly Area. Facilities installed under this alternative would include a drainage collection system within each subarea, drainage reuse facilities within each subarea, a conveyance system for collecting reused drainwater from each subarea and delivering it to the Delta conveyance system, a Se biotreatment facility, and the Delta conveyance system consisting of a network of open canals, pumping plants, and buried pipelines and incorporating the existing San Luis Drain.

The visual character of the areas that would contain these facilities is largely defined by the dominating presence of large agricultural operations and open cropland, particularly in the San Joaquin Valley portion of the system. The northwestern quarter of the route contains significant urban and industrial development, particularly around the communities of Tracy, Brentwood, and Antioch. The topographic gradient in the San Joaquin Valley portion of the system is virtually flat, offering little opportunity for expansive public viewpoints. West of Tracy, however, the system's route would lie adjacent to the eastern edge of the Diablo Range and could be visible from elevated vantage points in the mountains from this area north and west to Antioch, though features would not be visually prominent. Population density in the San Joaquin Valley portion of the route is low, with the exception of the area around Tracy. The small communities of Firebaugh, Mendota, Los Banos, and Westley are located in proximity to some of the project facilities in San Joaquin Valley. As a result, some residences in these towns could experience some degree of visual effect during both construction and operation. The system would pass to the south and west of the growing Tracy area and would go directly through Byron, Brentwood, Antioch, and Pittsburg. Residents in each of these urban areas could experience some degree of visual effect during both project construction and operation.

Aesthetic effects anticipated to be associated with each of the major components of this alternative are as follows:

- Effects caused by installation of the drainage collection system, including the Delta-Mendota Canal drain, are expected to be negligible and temporary during construction only with some elements causing minor and permanent visual effects. These systems would be composed of subsurface pipelines and, following installation, would not be visible above the ground surface except where they cross the canal. The pipeline canal crossing, as well as drain sumps and pumps utilized as part of the collection system, would be visible but consistent with the existing visual character of the area.
- Effects of the up to 16 drainage reuse facilities would be minor and permanent. These facilities would each be comprised of large acreages (totaling 19,000 acres) of farmland underlain by the system of subsurface tile drains delivering drainage from upland fields and a pipeline to convey the reused drainwater to treatment and/or disposal facilities. Above ground level, these facilities would consist of cropland planted with salt-tolerant crops including perennial pasture grasses and legumes. The potential reuse areas consist of lands that either have been or are currently irrigated. Other than a potential permanent change in the type of crop planted on these acres, no changes to the visual character of these sites are anticipated.
- Effects associated with installation of the drainwater conveyance system connecting the reuse facilities with the Delta conveyance system are likely to be moderate and permanent. A series of pumping plants and an associated network of buried pipelines would be constructed to convey drainwater from the reuse facilities upgradient to the Delta conveyance system. Effects associated with the pipeline network would be temporary during construction only.

The pumping plants, however, may be visible from surrounding residences and local roads and may alter the overall visual character of each location somewhat. Their effect is expected to be moderate only because other industrial facilities associated with existing agriculture are already located within the general vicinity of each site.

- Effects caused by construction and operation of the Se biotreatment plant (8 acres) would be minor and permanent. The Se biotreatment plant may be visible from surrounding residences and local roads and may alter the overall visual character of the location somewhat. The effect is expected to be minor only because other industrial facilities associated with existing agriculture are already located within the general vicinity.
- Effects associated with installation of a canal and associated pumping plant to convey drainwater from the Westlands South reuse areas to the southern end of the San Luis Drain are anticipated to be minor and permanent. This facility would be located in an area of open cropland. As other open canals exist in the vicinity, the new canal would be expected to alter the existing visual character of the locale.
- Effects associated with the use of the existing San Luis Drain to convey the collected drainwater north to Salt Slough in Kesterson National Wildlife Refuge (northern end of existing drain) would be expected to be negligible and permanent. Other than a change in the quantity of water in the Drain at different times of the year, no visual effects would be expected. Three pumping plants would be constructed along the Drain. These plants may be visible from surrounding residences and local roads and may alter the overall visual character of each location somewhat. Their effect is expected to be moderate only because other industrial facilities associated with existing agriculture are already located within the general vicinity of each site.
- The conveyance system from the northern end of the San Luis Drain to the discharge point in Pittsburg would be comprised of a combination of buried pipeline and open canals. Visual effects associated with this portion of the system are expected to be moderate and permanent. The portions of the route that would consist of open canals are generally in sparsely populated areas of agricultural or open space land west of the San Joaquin River in Stanislaus and southern San Joaquin counties. Another canal segment is in a marginally more densely populated area of eastern Contra Costa and Alameda counties and western San Joaquin County (from Brentwood to Bethany). As other open canals exist in these areas, this alternative would not be expected to alter the existing visual character of the locale. However, views from some residences along the route could be affected. For the pipeline segments, effects would be temporary during construction only. In addition to the linear facilities, two pumping plants would be constructed (one east of Interstate 5 north of Vernalis and another at Brentwood). These plants may be visible from surrounding residences and local roads and may alter the overall visual character of each location somewhat. Their effect is expected to be moderate only because other industrial facilities associated with existing agriculture are already located within the general vicinity of each site.
- Effects associated with the discharge pipe at Chipps Island in the Delta (at Pittsburg) would be moderate and temporary. Construction of this pipe (including an 1-mile-long underwater segment leading to the outfall) would temporarily alter the existing visual character of the construction zone but would not result in any permanent aesthetic change.

- The retirement of approximately 44,106 acres of farmland is expected to occur by the year 2050 under this alternative. Given the assumed salt buildup in the soil of these areas, it is assumed that much of this land would simply convert to unmanaged open space. The remainder would be used for dry pasture, dryland summer fallow grain operations, recreation, wildlife habitat, or flood detention basins. None of these changes in land use would result in the introduction of new visual elements that are not currently present within the SLDFR lands. However, these changes in land use could produce some visual effect, particularly if the retired acres are located in contiguous tracts. This effect would be potentially minor and permanent.

The Delta-Chipps Island Disposal Alternative would be generally consistent with the overall visual character of the SLDFR lands and adjacent areas in San Joaquin Valley but may visually conflict with some urban land uses in the Tracy, Brentwood, Antioch, and Pittsburg areas. Nonetheless, permanent effects would be generated at only a few specific locations. The construction period is estimated at about 6 years, though individual facilities causing temporary visual effects would be built over a shorter time frame (varies by facility). The overall effect is not significant when compared to the No Action Alternative.

Designated scenic highways within the general vicinity of the lands to be affected under this alternative include Interstate 5, which is located between 8 and 10 miles west of the facility locations; State Highway 152, which passes within 10 miles north of the Northerly Area pumping plant location; Interstate 580, which is located between 1 and 3 miles west of the pipeline location; and State Highway 4, which crosses the pipeline/open canal route near Brentwood. Given the relatively flat topography of the area along State Highway 152 and the distance of facilities from this corridor, no visual effects to motorists along this route are anticipated. Potential visual effects to motorists along Interstates 5 and 580 may occur as segments of these highways are located at higher elevations along the eastern foothills of the Diablo Range. It is possible that some project features may be visible from parts of each route. However, any effects are expected to be minor and permanent only as facilities constructed under this alternative would be similar in appearance to other visual features observable from these corridors and would be located at some distance from travelers on these routes. Potential visual effects to motorists along State Highway 4 would either be minor and temporary during construction only (buried pipeline) or minor and permanent (open canal). The overall effect on scenic highways is not significant when compared to the No Action Alternative.

16.2.9 Delta-Carquinez Strait Disposal Alternative

This alternative is the same as the Chipps Island outfall with the exception that the buried pipeline would extend west from Pittsburg to Crockett along Suisun Bay and an outfall in Carquinez Strait would be constructed.

Effects associated with this alternative would be the same as those associated with the Delta – Chipps Island Disposal Alternative except that moderate and temporary effects associated with installation of the pipeline segment from Pittsburg to Crockett would occur. Though most of the area along this route is currently industrial and/or commercial, views from some residences in Martinez and Crockett could be affected during construction. Similarly, views from East Bay Regional Park District lands along the Carquinez Strait could be affected during pipeline and outfall construction.

Six years of construction time is currently anticipated for this alternative (similar to the Chipps Island discharge), and no other designated scenic highways would be affected.

16.2.10 Cumulative Effects

Under the No Action Alternative, lands remaining in production within drainage-impaired areas would likely be switched over to salt-tolerant, low-water-use crops such as cotton, barley, safflower, and winter annual dairy support crops such as triticale. An increase would also likely be seen in acreage fallowed during low-water-supply years. These effects, in concert with other potential actions affecting cropping patterns within the San Joaquin Valley portion of the project area, could over time cumulatively affect the visual character of the western valley. However, due to the lack of current urban growth pressure along the western side of the San Joaquin Valley, potential cumulative effects on aesthetics are not likely to be significant.

The cumulative effects of the action alternatives with other actions affecting land uses and the visual character of the areas described in this EIS are expected to be minor. The conversion of land in active agricultural production on the western side of San Joaquin Valley to drainage management facilities is not expected to result in significant alterations to the existing visual character of the region because new uses and land management activities are expected to be largely consistent with existing agricultural and other open-space land uses in the area. Land retirement associated with the action alternatives would not convert any acreage to nonagricultural uses and, thus, would not be expected to contribute to the incremental effects of other actions on viewshed character. Similarly, no features of the action alternatives are expected to contribute to local or regional population growth or facilitate additional industrial development. Most of the aesthetics-related effects of the action alternatives would occur in comparatively remote areas where little growth pressure occurs. As such, the likelihood that any cumulative aesthetic effects would accrue to the action alternatives along with other reasonably foreseeable future actions is low.

16.2.11 Environmental Effects Summary

16.2.11.1 No Action Alternative

- The No Action Alternative would not introduce any new visual elements when compared to existing land uses in the SLDFR area. However, changes in agricultural land use could produce some minor permanent visual effect, particularly if the retired acres are located in contiguous tracts.

16.2.11.2 In-Valley Disposal Alternative

- The In-Valley Disposal Alternative would alter the visual character at the specific sites where the reuse, treatment, and evaporation basin facilities would be located, but would not introduce any new visual elements to these areas when compared to existing land uses in the SLDFR area. Changes in agricultural land use could produce some visual effect, particularly if the retired acres are located in contiguous tracts. None of these effects would be significant when compared to the No Action Alternative.

16.2.11.3 In-Valley/Groundwater Quality Land Retirement Alternative

- The In-Valley/Groundwater Quality Land Retirement Alternative would alter the visual character at the specific sites where the reuse, treatment, and evaporation basin facilities would be located, but would not introduce any new visual elements to these areas when compared to existing land uses in the SLDFR area. Changes in agricultural land use could produce some visual effect, particularly if the retired acres are located in contiguous tracts. None of these effects would be significant when compared to the No Action Alternative.

16.2.11.4 In-Valley/Water Needs Land Retirement Alternative

- The In-Valley/Water Needs Land Retirement Alternative would alter the visual character at the specific sites where the reuse, treatment, and evaporation basin facilities would be located, but would not introduce any new visual elements to these areas when compared to existing land uses in the SLDFR area. Changes in agricultural land use could produce some visual effect, particularly where the retired acres are located in contiguous tracts. None of these effects would be significant when compared to the No Action Alternative.

16.2.11.5 In-Valley/Drainage-Impaired Area Land Retirement Alternative

- The In-Valley/Drainage-Impaired Area Land Retirement Alternative would alter the visual character at the specific site in the Northerly Area where the reuse, treatment, and evaporation basin facilities would be located, but would not introduce any new visual elements to these areas when compared to existing land uses in the SLDFR area. Extensive changes in agricultural land use patterns caused by land retirement could produce some visual effect, particularly where retired acres are located in contiguous tracts within Westlands. None of these effects would be significant when compared to the No Action Alternative.

16.2.11.6 Ocean Disposal Alternative

- The Ocean Disposal Alternative would alter the visual character at the specific sites where the pumping station, pipeline, and tunnel facilities would be located, but would not introduce any new readily visible features to these areas when compared to existing land uses in the SLDFR area and along the alternative route. Changes in agricultural land use could produce some visual effect, particularly if the retired acres are located in contiguous tracts. Effects to motorists along some designated scenic highways would occur. None of these effects would be significant when compared to the No Action Alternative.

16.2.11.7 Delta – Chipps Island Disposal Alternative

- The Delta – Chipps Island Disposal Alternative would alter the visual character at the specific sites where the pumping station, pipeline, and canal facilities would be located, but would not introduce any new readily visible features to these areas when compared to existing land uses in the project area. Changes in agricultural land use could produce some visual effect, particularly if the retired acres are located in contiguous tracts. Effects to motorists along some designated scenic highways would occur. None of these effects would be significant when compared to the No Action Alternative.

16.2.11.8 Delta – Carquinez Strait Disposal Alternative

- The Delta – Carquinez Strait Disposal Alternative would alter the visual character at the specific sites where the pumping station, pipeline, and canal facilities would be located, but would not introduce any new readily visible features to these areas when compared to existing land uses in the project area. Changes in agricultural land use could produce some visual effect, particularly if the retired acres are located in contiguous tracts. Effects to motorists along some designated scenic highways would occur. None of these effects would be significant when compared to the No Action Alternative.

Tables 16-1 through 16-8 summarize the effects that the No Action Alternative and the Action Alternatives have on aesthetics.

Table 16-1
Summary Comparison of Effects of No Action Alternative

Affected Resource and Area of Potential Effect	No Action Alternative Compared to Existing Condition
Overall Visual Characteristics	No new visual elements introduced. Changes in agricultural land use. Minimal effect.
Scenic Highways	No new visual elements introduced.

Table 16-2
Summary Comparison of Effects of In-Valley Disposal Alternative

Affected Resource and Area of Potential Effect	In-Valley Disposal Compared to No Action	In-Valley Disposal Compared to Existing Condition
Overall Visual Characteristics	No new visual elements introduced. No significant effect.	Minor or moderate visual effects due to facility development. Minimal effect.
Scenic Highways	No new visual elements introduced along Highways 5 and 152. No significant effect.	No visual effects to motorists along Highways 5 and 152. No effect.

Table 16-3
Summary Comparison of Effects of
In-Valley/Groundwater Quality Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Groundwater Quality Land Retirement Compared to No Action	In-Valley/Groundwater Quality Land Retirement Compared to Existing Condition
Overall Visual Characteristics	No new visual elements introduced. No significant effect.	Minor or moderate visual effects due to facility development. Minimal effect.
Scenic Highways	No new visual elements introduced along Highways 5 and 152. No significant effect.	No visual effects to motorists along Highways 5 and 152. No effect.

Table 16-4
Summary Comparison of Effects of
In-Valley/Water Needs Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Water Needs Land Retirement Compared to No Action	In-Valley/Water Needs Land Retirement Compared to Existing Condition
Overall Visual Characteristics	No new visual elements introduced. No significant effect.	Minor or moderate visual effects due to facility development. Minor visual effects due to land retirement. Minimal effect.
Scenic Highways	No new visual elements introduced along Highways 5 and 152. No significant effect.	No visual effects to motorists along Highways 5 and 152. No effect.

Table 16-5
Summary Comparison of Effects of
In-Valley/Drainage-Impaired Area Land Retirement Alternative

Affected Resource and Area of Potential Effect	In-Valley/Drainage-Impaired Area Land Retirement Compared to No Action	In-Valley/Drainage-Impaired Area Land Retirement Compared to Existing Condition
Overall Visual Characteristics	No new visual elements introduced. No significant effect.	Minor or moderate visual effects due to facility development. Moderate visual effects due to land retirement in Westlands. Moderate effect.
Scenic Highways	No new visual elements introduced along Highways 5 and 152. No significant effect.	No visual effects to motorists along Highways 5 and 152. No effect.

Table 16-6
Summary Comparison of Effects of Ocean Disposal Alternative

Affected Resource and Area of Potential Effect	Ocean Disposal Compared to No Action	Ocean Disposal Compared to Existing Condition
Overall Visual Characteristics	No new visual elements introduced. No significant effect.	Minor or moderate visual effects due to facility development. Minimal effect.
Scenic Highways	No new visual elements introduced along Highways 5, 152, 41, 46, 101, and 1. No significant effect.	Minor visual effects to motorists along Highways 5, 152, 41, 46, 101, and 1. Minimal effect.

Table 16-7
Summary Comparison of Effects of Delta-Chipps Island Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Chipps Island Disposal Compared to No Action	Delta-Chipps Island Disposal Compared to Existing Condition
Overall Visual Characteristics	No new visual elements introduced. No significant effect.	Minor or moderate visual effects due to facility development. Minimal effect.
Scenic Highways	No new visual elements introduced along Highways 5, 152, 580, and 4. No significant effect.	Minor visual effects to motorists along Highways 5, 152, 580, and 4. Minimal effect.

Table 16-8
Summary Comparison of Effects of Delta-Carquinez Strait Disposal Alternative

Affected Resource and Area of Potential Effect	Delta-Carquinez Strait Disposal Compared to No Action	Delta-Carquinez Strait Disposal Compared to Existing Condition
Overall Visual Characteristics	No new visual elements introduced. No significant effect.	Minor or moderate visual effects due to facility development. Minimal effect.
Scenic Highways	No new visual elements introduced along Highways 5, 152, 580, and 4. No significant effect.	Minor visual effects to motorists along Highways 5, 152, 580, and 4. Minimal effect.

16.2.12 Mitigation Recommendations

None of the effects on visual resources are significant, so no mitigation is required.