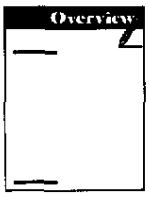
Chapter 3. Summary Comparison of Environmental Consequences

This chapter presents a summary of the programmatic environmental consequences of implementing the CALFED Bay-Delta Program that are discussed in Chapters 5, 6, and 7.

3.1 ENVIRONMENTAL RESOURCE IMPACTS AND ECONOMIC AND SOCIAL EFFECTS 3-1
3.2 SUMMARY OF GROWTH-INDUCING IMPACTS 3-3
3.3 SUMMARY OF SHORT- AND LONG-TERM RELATIONSHIPS 3-4
3.4 SUMMARY OF IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS 3-5
3.5 SUMMARY OF CUMULATIVE IMPACTS 3-5
3.6 MITIGATION STRATEGIES FOR CUMULATIVE IMPACTS .. 3-7



3. Summary Comparison of Environmental Consequences

3.1 ENVIRONMENTAL RESOURCE IMPACTS AND ECONOMIC AND SOCIAL EFFECTS

Section 3.1.1 discusses the environmental consequences of the Preferred Program Alternative and Alternatives 1, 2, and 3 compared to the No Action Alternative and existing conditions. Section 3.1.2 discusses expected benefits of the Preferred Program Alternative compared to the No Action Alternative. Section 3.1.3 discusses potentially significant avoidable and unavoidable adverse impacts of the Preferred Program Alternative compared to the No Action Alternative. Section 3.1.4 lists economic and social effects that may be caused by the Preferred Program Alternative. Some of the sections describe effects of the CALFED Bay-Delta Program (Program) by study regions, which are described in Chapter 2.

3.1.1 SUMMARY COMPARISON OF ENVIRONMENTAL IMPACTS

Table 3-1 (at the end of the chapter) provides a summary comparison of the environmental consequences of the No Action Alternative; Alternatives 1, 2, and 3; and the Preferred Program Alternative.

In general, impacts resulting from the Conveyance element vary by alternative. Impacts resulting from the other Program elements vary minimally among alternatives. The Storage element includes a wide range of storage amounts, as described in Chapter 2. In Table 3-1, therefore, the impacts associated with the Storage and Conveyance elements are described separately for each alternative, while the description of the other Program elements encompasses all the alternatives. For details of how each of the Program

In general, impacts resulting from the Conveyance element vary by alternative. Impacts resulting from the other Program elements vary minimally among alternatives.

elements would be specifically affected by the various alternatives, please see Chapters 5, 6, and 7.

The impacts identified in Table 3-1 for the Preferred Program Alternative include consequences associated with possible changes in project operations of the CVP and SWP. These project changes in operation also could be included in Alternatives 1, 2, and 3. To avoid repetition in the summary table and because, typically, the project changes in operation would cause environmental consequences that are similar among the alternatives, these environmental consequences are not listed under Alternatives 1, 2, and 3. Where analysis found that project changes in operation could cause different environmental consequences under different alternatives, the information is presented in the table.

The impacts identified in Table 3-1 for the Preferred Program Alternative include consequences associated with possible changes in project operations of the CVP and SWP.

3.1.2 SUMMARY OF BENEFICIAL IMPACTS

Table 3-2 (at the end of the chapter) summarizes the benefits to resources that are expected from implementing the Preferred Program Alternative. The benefits are estimates of effects resulting from implementing all of the proposed Program elements that make up the Preferred Program Alternative.

3.1.3 SUMMARY OF POTENTIALLY SIGNIFICANT ADVERSE ENVIRONMENTAL IMPACTS

Table 3-3 (at the end of the chapter) identifies the potentially significant avoidable and unavoidable impacts on resources resulting from implementation of the Preferred Program Alternative. For potentially significant avoidable impacts, measures are available to reduce the impacts to less-than-significant levels. For potentially significant unavoidable impacts, no feasible means have been identified to mitigate impacts to less-than-significant levels. Specific analysis of environmental impacts, their significance, and the availability and choice of specific mitigation measures will be developed and presented in future second-tier environmental documents prepared, as necessary, prior to implementation of specific Program projects and actions.

Under CEQA, economic or social effects are not treated as a significant impact on the environment unless they will lead to physical changes in the environment. This information therefore is presented in Section 3.1.4 below.

Specific analysis of environmental impacts, their significance, and the availability and choice of specific mitigation measures will be presented in future second-tier environmental documents prepared, as necessary, prior to implementation of specific Program projects and actions.

3.1.4 SUMMARY OF ECONOMIC AND SOCIAL EFFECTS

Table 3-4 below lists the economic and social effects that may result from implementation of the Preferred Program Alternative.

Table 3-4. Summary of Economic and Social Effects of the Preferred Program Alternative

Agricultural economics	Generally enhances or maintains agricultural revenues but may reduce agricultural income in local areas, especially in the Delta Region, due to conversion of agricultural lands to other uses.
Agricultural social issues	Generally benefits the agricultural community but may cause localized adverse social effects.
Urban water supply economics	May lower regulatory and water treatment costs and increase water supply, but may add costs through payment for Program elements. Many economic effects cannot be determined until more specific information is available.
Regional economics	Generally benefits regional economies but may cause adverse effects in the Delta Region. The amount and allocation of costs and benefits are currently uncertain.
Environmental justice	Beneficial or adverse effects to minority or low-income populations are possible. Project-specific evaluation is required to determine effects.
Indian trust assets	Adverse effects are not anticipated, but effects cannot be determined at the programmatic level of analysis. Project-specific evaluation is required to determine effects.

Qualitative methods and professional judgment were used in the evaluation of economic and social effects summarized in Table 3-4. These effects are presented in greater detail in Sections 7.2, 7.3, 7.5, 7.10, 7.14, and 7.15. Quantitative information for determining costs and economic benefits is not available. This information will be developed in future planning studies and project-specific analysis.

Quantitative information for determining costs and economic benefits is not available. This information will be developed in future planning studies and project-specific analysis.

3.2 SUMMARY OF GROWTH-INDUCING IMPACTS

Potential growth-inducing impacts are summarized in Table 3-5 (at the end of the chapter). Growth-inducing impacts are the ways in which the Program could foster (directly or indirectly) economic or population growth, or the construction of additional housing in the surrounding environment—with subsequent impacts on a variety of resources.

For this document, it was assumed that any increased water supplies or improved water supply reliability associated with the Program would stimulate growth and remove barriers to growth in the water service area. At this time, growth-inducing impacts on resources are described only broadly. Growth-inducing impacts will be analyzed in greater detail in future project-specific NEPA/CEQA documents that are tiered from this document.

For this document, it was assumed that any increased water supplies or improved water supply reliability associated with the Program would stimulate growth and remove barriers to growth in the water service area.

It is unlikely that any of the Program alternatives would result in substantial population or economic growth in the Delta, Bay, or Sacramento River Regions. Water supply, reliability, and quality would be enhanced by implementation of the Program in these regions, but other water resources are available in these regions that could be used for growth. In the San Joaquin River Region and the Other SWP and CVP Service Areas, however, fewer alternative water supply sources are available. In the San Joaquin River Region, improvements in water quality, supply, and reliability could allow additional agricultural land to be developed and could allow a shift to higher value crops. Further, it is possible that these improvements could result in urban population and economic growth. In the Other SWP and CVP Service Areas, improvements in water supply, reliability, and quality could induce urban growth.

It is unlikely that any of the Program alternatives would result in substantial population or economic growth in the Delta, Bay, or Sacramento River Regions.

Summarized in Table 3-5 are resources that could be adversely affected if growth was to take place as a result of the Program. For example, if additional growth was to take place, existing soils or air quality could be affected.

3.3 SUMMARY OF SHORT- AND LONG-TERM RELATIONSHIPS

This section provides a resource-specific summary of the balance between the short-term uses of the environment and the maintenance and enhancement of long-term productivity for the Preferred Program Alternative. Short-term uses versus long-term productivity for each resource category considered are summarized in Table 3-6 (at the end of the chapter).

Overall benefits to long-term productivity related to biological resources, water quality, water management, and flood control outweigh the short-term adverse impacts. Adverse short-term impacts caused by changes in land use are associated with geology and soils, agricultural resources, recreation, and cultural resources. However, long-term benefits to these resources also were identified.

Overall benefits to long-term productivity related to biological resources, water quality, water management, and flood control outweigh the short-term adverse impacts.

Adverse short-term impacts, primarily related to construction activities, were identified for most resources. The short-term construction-related impacts would be minor and would cease when construction was complete. Where possible, avoidance and mitigation measures would be implemented as a standard course of action to lessen impacts on these resources.

3.4 SUMMARY OF IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS

Table 3-7 (at the end of the chapter) lists the irreversible and irretrievable commitments of resources that are attributable to the Preferred Program Alternative. Irreversible and irretrievable commitments of resources result from the direct or indirect use or consumption of resources in such a way that they cannot be restored or returned to their original condition despite mitigation efforts. An irretrievable impact or commitment of resources occurs when a resource is removed or consumed. These types of impacts are evaluated to ensure that consumption is justified.

Irreversible commitments of resources could result from Program actions that involve construction and land conversion. Committed resources could include construction materials, labor, and energy needed for construction, operation, and maintenance. Land conversion due to Program use would commit agricultural, open space, and natural environments to other uses.

Irreversible commitments of resources could result from Program actions that involve construction and land conversion.

Specific resources that could be irreversibly and irretrievably committed as a result of the Program could include geology and soils, vegetation and wildlife, regional economics, agricultural resources, cultural resources, power production and energy, and visual resources. Where possible, avoidance and mitigation measures would be implemented as a standard course of action to lessen impacts on these resources. For additional discussion, refer to the resource-specific impact analyses in Chapters 5, 6, and 7.

3.5 SUMMARY OF CUMULATIVE IMPACTS

Under NEPA and CEQA, cumulative impacts must be analyzed and discussed. A cumulative impact is created as a result of the combination of the project or program being evaluated together with other projects that may cause related impacts. Table 3-7 (at the end of the chapter) presents, by resource category and region, the potentially significant cumulative impacts of the Preferred Program Alternative and the projects and activities listed in Attachment A. The table identifies the environmental resource categories that potentially could experience cumulative impacts because of implementing the projects listed in Attachment A, in addition to the Program. If implementing the Program would not result in a potentially significant impact on a resource, potentially significant adverse cumulative effects for that resource are not noted in the Table 3-8—even if other actions would result in a potentially significant impact. A narrative discussion of the cumulative effects is provided below. The cumulative impact analysis is qualitative. Impact analysis was based on information from available environmental documents and studies, and based on knowledge of the generally expected kinds

Because of the preliminary phase of most of the projects (environmental reviews have not been initiated, drafted, or finalized), comparable environmental information for identifying cumulative impacts was not available.

of effects of similar projects in the study area. Because of the preliminary phase of most of the projects (environmental reviews have not been initiated, drafted, or finalized), comparable environmental information for identifying cumulative impacts was not available.

3.5.1 DELTA REGION

In the Delta Region, potentially significant adverse cumulative impacts could occur in all resource categories that are addressed in this document from the development of water management projects, environmental restoration projects, and urbanization listed in Attachment A, in concert with implementation of the Program.

Potentially significant adverse cumulative impacts could occur in all resource categories in the Delta Region.

3.5.2 BAY REGION

In the Bay Region, potentially significant adverse cumulative impacts could occur due to the development of water management projects, environmental restoration projects, and urbanization listed in Attachment A, in concert with implementation of the Program. These projects could potentially cause adverse impacts on all resource categories, except transportation, agricultural land and water uses, utilities and public resources, and flood control resources.

In the Bay Region, potentially significant adverse cumulative impacts related to Bay-Delta hydrodynamics, water quality, water supply and management, groundwater, geology and soils, and power production and energy could occur.

3.5.3 SACRAMENTO RIVER AND SAN JOAQUIN RIVER REGIONS

In the Sacramento River Region, potentially significant adverse cumulative impacts could occur due to the development of water management projects, environmental restoration projects, and urbanization listed in Attachment A, in concert with implementation of the Program. These projects could potentially cause adverse impacts on all environmental resource categories except urban land use resources.

Potentially significant adverse cumulative impacts could occur in all resource categories except urban land use resources in the Sacramento River and San Joaquin River Regions.

3.5.4 OTHER SWP AND CVP SERVICE AREAS

In the Other SWP and CVP Service Areas, potentially significant adverse cumulative impacts are expected from the development of water management projects, environmental restoration projects, and urbanization listed in Attachment A, in concert with the Program. Resources potentially affected include water quality, water supply and water management, groundwater, and power and energy.

Potentially significant adverse cumulative impacts could occur in the water quality, water supply and water management, groundwater, and power and energy resource categories in the Other SWP and CVP Service Areas.

3.6 MITIGATION STRATEGIES FOR CUMULATIVE IMPACTS

Mitigation strategies are available to reduce the severity of cumulative impacts. The mitigation strategies generally consist of safeguards by law, regulations, and water rights standards; contracts; physical measures; and water management programs.

A number of water management programs are in place to address potential conflicts between agricultural and urban water use and ecosystem restoration activities. Many of the specific impacts will be identified in these studies, and potential mitigation will be incorporated into the design and project-specific environmental review conducted for each project. Any action-specific mitigation will be identified in subsequent tiered, site- and action-specific analyses. Some of the studies and management programs in place include:

A number of water management programs are in place to address potential conflicts between agricultural and urban water use and ecosystem restoration activities.

- Formation of the federal/state Bay-Delta Advisory Council
- SWRCB Water Quality Control Plan
- Formation of the Delta Protection Commission
- San Joaquin River Management Plan
- Sacramento River 1086 Plan
- EPA's Comprehensive Conservation Management Plan for the Bay-Delta Estuary
- Striped Bass Recovery Plan
- Native Fisheries Recovery Plan
- Anadromous Fish Restoration Program
- Interagency Ecological Program
- Regional Water Quality Control Board Basin Plans

State and federal laws that provide safeguards for cumulative impacts include the:

Several state and federal laws provide safeguards for cumulative impacts.

- Area of Origin Law
- Delta Protection Act
- California Environmental Quality Act
- National Environmental Policy Act
- National Fish and Wildlife Coordination Act
- Clean Water Act
- Central Valley Project Improvement Act
- National Historic Preservation Act
- Archeological and Historical Preservation Act
- Federal Endangered Species Act
- California Endangered Species Act
- Provisions in congressional authorization of federal water projects

General physical mitigation strategies are presented in Chapters 5, 6, and 7 for each resource category.

Table 3-1. Summary Comparison of Environmental Consequences

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
WATER SUPPLY AND WATER MANAGEMENT					
Annual Delta exports could decrease by as much as 570 TAF or could increase by as much as 370 TAF over the long-term period. Reductions in annual Delta exports would result from more protective Delta water management criteria; increases in annual Delta exports would result from higher demands on the Bay-Delta system. During dry and critical years, annual Delta exports could decrease by as much as 610 TAF or could increase by as much as 130 TAF. Higher Bay-Delta system demands have a relatively small impact on Delta exports during dry and critical years because the system is generally supply-limited during droughts. For most parameters of interest, existing conditions fall within the range of uncertainty associated with the alternative.	Some improvements would be realized from improved export pumping capacity. Greater benefits may be obtained if additional storage facilities are constructed. Without additional storage, annual long-term period Delta exports would increase 270-390 TAF (dry and critical year exports would increase up to 190 TAF) over the No Action Alternative. With additional storage, annual Delta exports would increase 690-800 TAF (dry and critical year exports would increase 240-640 TAF) over the No Action Alternative.	Some improvements would be realized from improved export pumping capacity. Greater benefits may be obtained if additional storage facilities are constructed. Without additional storage, annual long-term period Delta exports would increase 230-410 TAF (dry and critical year exports would increase up to 200 TAF) over the No Action Alternative. With additional storage, annual Delta exports would increase 460-800 TAF (dry and critical year exports would increase 130-650 TAF) over the No Action Alternative.	Some improvements would be realized from improved export pumping capacity. Greater benefits may be obtained if additional storage facilities are constructed. The alternative was evaluated with both a 5,000- and 15,000-cfs isolated facility. Without additional storage, annual long-term period Delta exports would increase 140-590 TAF (dry and critical year exports could decrease 90 TAF or increase 440 TAF) over the No Action Alternative. With additional storage, annual Delta exports would increase 410-1,300 TAF (dry and critical year exports would increase 90-1,200 TAF) over the No Action Alternative.	Actions under the Water Use Efficiency and Water Transfer Programs would lead to more efficient allocation of existing supplies. The degree to which beneficial redistribution of water resources would occur is uncertain. Ecosystem Restoration Program actions could use more water than current agricultural land uses. The Levee System Integrity, Water Use Efficiency, and Water Transfer Programs would contribute to improved supply reliability. Actions under the Water Quality Program could increase the amount of water available for some beneficial uses and provide improved operational flexibility.	Some improvements would be realized from improved export pumping capacity. Greater benefits may be obtained if additional storage facilities are constructed. The alternative was evaluated with and without a new screened diversion (2,000-4,000 cfs) from the Sacramento River near Hood to the Mokelumne River system. Without a new diversion, consequences are similar to those under Alternative 1. With a new diversion and no additional storage, annual long-term period Delta exports would increase 250-380 TAF (dry and critical year exports would increase 50-180 TAF) over the No Action Alternative. With a new diversion and additional storage, annual Delta exports would increase 490-900 TAF (dry and critical year exports would increase 180-670 TAF) over the No Action Alternative. Changes in operations could affect water supply and management.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
BAY-DELTA HYDRODYNAMICS AND RIVERINE HYDRAULICS					
Changes in Bay-Delta hydrodynamics and riverine hydraulics could result either from more protective Delta water management criteria or higher demands on the Bay-Delta system. For most parameters of interest, existing conditions fall within the range of uncertainty associated with the alternative.	Small increases in reverse QWEST flow would occur with or without new storage. Circulation patterns and water levels would improve in south Delta channels through the operation of flow control structures. Bay-Delta X2 position may increase or decrease. Minor changes to riverine flows and existing reservoir operations would occur through implementation of new storage.	Substantial decreases in reverse QWEST flow would occur with or without new storage through the operation of a Hood diversion. Circulation patterns and water levels would improve in south Delta channels through the operation of flow control structures. Bay-Delta X2 position may increase or decrease. Minor changes to riverine flows and existing reservoir operations would occur through implementation of new storage.	The alternative was evaluated with both a 5,000- and 15,000-cfs isolated facility. Substantial decreases in Sacramento River flow at Rio Vista and reverse QWEST flow would occur with or without new storage through the operation of an isolated facility. Circulation patterns and water levels would improve in south Delta channels through the operation of flow control structures. Bay-Delta X2 position may increase or decrease. Minor changes to riverine flows and existing reservoir operations would occur through implementation of new storage.	The Ecosystem Restoration Program pulse flows and Delta outflow targets result in potentially substantial short-term increases in Sacramento River and San Joaquin River flows during selected periods from March to May. The Levee System Integrity Program could alter channel geometry and slightly increase channel depth, which could alter flow patterns. The Water Use Efficiency Program could reduce or eliminate the need for increased diversions as populations increase or demand grows. These changes would benefit streamflows overall, but detrimental in-stream flow reductions could occur in cases where streams are partially or entirely fed by return flows. Water Transfer Program actions could modify the timing and magnitude of streamflows. Effects of the Watershed Program could range from very limited changes in flows in localized stream reaches to large-scale changes in flow regimes. Program actions may increase retention of surface water in the watershed, resulting in less variable runoff patterns.	The alternative was evaluated with and without a new screened diversion (2,000-4,000 cfs) from the Sacramento River near Hood to the Mokelumne River system. Without a new diversion, consequences are similar to those under Alternative 1. With a new diversion, substantial decreases in reverse QWEST flow would occur with or without new storage. Circulation patterns and water levels would improve in south Delta channels through the operation of flow control structures. Bay-Delta X2 position may increase or decrease. Minor changes to riverine flows and existing reservoir operations would occur through implementation of new storage. Changes in operations could cause changes in Bay-Delta circulation patterns and reservoir releases.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
WATER QUALITY					
Delta water quality would gradually deteriorate.	Shift in timing of Delta inflow results in some improvements in Delta water quality in alternative with storage, but is offset by increased south Delta pumping. Salinity would increase in Delta in alternative without storage. With or without storage, average monthly salinities would be increased in parts of central and west Delta, Old River, CCFB, and San Joaquin River. Bromide concentrations would increase in Old and Middle Rivers.	Reduction in salinity and bromide concentrations due to improved circulation pattern and shift in timing of Delta inflow in alternative with storage. Salinity in lower Sacramento and San Joaquin Rivers in west Delta would increase due to diversion of water into central and south Delta. With and without storage there are reductions in peak salinity levels in the central Delta, Old River, Middle River, DMC, and CCFB. Corresponding decreases in bromide levels are expected with lower salinity. Moderate increases in salinity in the west Delta under high water use with storage scenarios.	Quality of water exported to South-of-Delta SWP and CVP Service Areas improves substantially with isolated facility because water is taken from Sacramento River instead of Delta. Salinity increases at Rock Slough, and in south and central Delta. With and without storage very good reductions in salinity are projected in CCFB and good reductions during peak salinity periods are projected for Old River and the DMC. Mixed changes in the interior Delta are expected. West Delta areas would experience some salinity increases during high water use scenarios.	All regions would experience substantial potential benefits from source control measures of the Water Quality Program. The Ecosystem Restoration and Levee System Integrity Programs increase sediment loading and turbidity during construction and initial operation. Western Suisun Marsh levee rehabilitation could protect water quality. Ecosystem Restoration Program would re-establish more natural flows, lowering water temperature and salinity, and increase dissolved oxygen at certain times of the year.	Similar impacts as Aternative 1 without a Hood area diversion and similar impacts on Alternative 2, but less water quality impacts with a Hood area diversion facility. Changes in operations may significantly affect water quality in the Delta Region and quality dependent beneficial uses. Reductions in export pumping rates could temporarily reduce the intrusion of ocean-derived salinity and bromides into the vicinity of the export pumps. Water quality benefits could result from beneficial increases in net Delta outflows, and overall improvements in circulation patterns. Increases in reverse flows in Old River, during selected periods, could temporarily degrade central and south Delta water quality. Operational changes could cause increases in fresh-water inflows to the Bay and significant changes to the salinity gradient. Changes in pumping operations could move the position of X2 upstream or downstream by as much as 2 km, and about 1 km further upstream during selected periods. Significant improvements are expected in water quality exported to the San Joaquin River Region and the Other SWP and CVP Service Areas.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
GROUNDWATER RESOURCES					
Increased groundwater use with potential adverse impacts related to overdraft, subsidence, and water quality.	Alternative with surface water and groundwater storage could potentially reduce the potentially significant adverse impacts on groundwater resources throughout all regions.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	The Ecosystem Restoration, Water Quality, and Levee System Integrity Programs would increase groundwater recharge. The Water Use Efficiency and Water Transfer Programs can result in greater reliance on groundwater resources during dry periods and potential reductions in groundwater recharge. These changes can adversely affect groundwater resources for third-party users.	Impacts similar to Alternative 1. Changes in operations could significantly affect groundwater resources, depending on the change of recharge rates and pumping due to the changes in operation in export water in the San Joaquin River Region and service areas. Changes in groundwater use could change subsidence rates, which could affect land use and water demands in the San Joaquin River Region and the Other SWP and CVP Service Areas.
GEOLOGY AND SOILS					
Conditions similar in type, but of greater magnitude than, existing conditions due to continued soil erosion, sediment contamination, subsidence, and channel degradation.	Reduced potential for erosion of channel, levee, and interior island soils through levee setbacks. Applied salt loads would be reduced in the Delta, Sacramento River, and San Joaquin River Regions. With new storage, increased ground disturbance, inundation, and shoreline wind and wave erosion.	Impacts similar to Alternative 1, but a larger area of land would be affected by additional conveyance facilities.	Impacts similar to Alternative 1, but a larger area of land would be affected by the isolated facility.	The Ecosystem Restoration Program would result in beneficial long-term effects in all geographic regions except the Other SWP and CVP Service Areas with respect to soil erosion, geomorphology, and sediment transport. The Water Use Efficiency Program would reduce erosion from agricultural lands. Watershed efforts could result in adverse short-term impacts on surface soil and channel erosion in the Sacramento River and San Joaquin River watersheds, but would result in beneficial long-term impacts on stream geomorphology by reducing sediment inputs from hillslope, bank, and channel erosion. The Levee System Integrity component could cause sediment loading and increased channel	Impacts similar to Alternative 1 without a Hood area diversion. Impacts similar to Alternative 2 with a Hood area diversion.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
GEOLOGY AND SOILS (continued)					
				depth. Beneficial impacts of the Suisun Marsh levee component include decreased soil salinity and increased protection of managed wetlands and tidally influenced lands due to increased flood protection.	
NOISE					
Conditions similar to existing conditions.	Construction of facilities would cause noise impacts that can be mitigated.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
TRANSPORTATION					
Conditions similar to existing conditions, but traffic demands and traffic volume on existing roadways are expected to increase.	Potentially significant short- and long-term impacts where construction of levee, storage, and conveyance improvements may cause rerouting or temporary closure of traffic routes.	Impacts similar to Alternative 1. Additional short-term impacts would occur from construction of conveyance facilities.	Impacts similar to Alternative 2.	Construction activities associated with the Ecosystem Restoration and Levee System Integrity Program improvements may cause potentially significant short-term impacts on roadways and traffic routes if detours or road closures occur.	Impacts similar to Alternative 1 without a Hood area diversion. Impacts similar to Alternative 2 with a Hood area diversion.
AIR QUALITY					
Conditions similar to existing conditions.	Short-term construction air quality impacts that can be mitigated would occur in the Delta, Sacramento River, and San Joaquin River Regions.	Impacts similar to Alternative 1. Additional short-term impacts would occur from construction of conveyance facilities.	Impacts similar to Alternative 2. Some additional impacts would be related to construction of an isolated facility.	Direct, short-term air quality impacts during construction. Increased emissions associated with fugitive dust; prescribed burning; equipment use and cultivation, agricultural chemical use, and crop shifting; and land use changes leading to higher residential, commercial, or recreational uses. Increased use of fossil fuels or other energy resources.	Impacts similar to Alternative 1 without a Hood area diversion. Impacts similar to Alternative 2 with a Hood area diversion.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
FISHERIES AND AQUATIC ECOSYSTEMS					
Conditions similar to existing conditions, although increased input of contaminants and increased Delta exports would adversely affect some aquatic organisms and potentially limit opportunities for recovery of special-status species.	Adverse impacts, including increased entrainment loss, reduced productivity, and delayed migration of fish species would result from diversion to new storage and increased exports in alternative with storage. Without storage, change in flow conditions would be less, and impacts described above would be less.	Impacts related to increased diversion and subsequent effects on flow conditions would be similar to those under Alternative 1. Additional impacts on Delta channel flows would result from the Hood diversion, including increased entrainment, reduced Delta productivity, negative impacts on upstream migration of adult anadromous fish, reduced survival of aquatic outmigrants, and habitat loss or degradation. Beneficial impacts could result from Delta flow conditions in the Lower San Joaquin River that improve fish migration to the Bay. Impacts from dredging operations and disposal of spoils could cause temporary degradation of water quality, structural characteristics, water flow variations, and habitat for fish and aquatic ecosystems, as well as the delayed migration of fish species.	Impacts related to diversion and subsequent effects on flow conditions would be improved compared to those under Alternative 1. Impacts associated with a Hood diversion would be reduced compared to Alternative 2. An isolated facility could result in beneficial impacts in the east, central, and south Delta due to restored ecological processes related to Delta hydraulics, reduced entrainment losses, increased productivity, and improved aquatic outmigration. Dredging impacts would be less than those described for Alternative 2. If the isolated facility is sized adequately, the south Delta barriers may not be needed, and the impacts associated with those barriers avoided.	The Ecosystem Restoration and Water Quality Program actions would improve and increase aquatic habitats and increase species abundance under all alternatives in all regions except the Other SWP and CVP Service Areas. The Water Use Efficiency Program is expected to create ecosystem benefits through reduced diversion entrainment impacts, modifications in flow timing, and improved instream water quality. The Water Transfer Program may provide water for ecosystem purposes. The Levee System Integrity Program, including the Suisun Marsh levee component, could adversely affect fish and aquatic ecosystems through decreased water quality for fish and aquatic ecosystems, and loss of seasonal wetlands during levee rehabilitation; beneficial impacts could include decreased soil salinity and increased protection of managed wetlands and tidally influenced lands due to increased flood protection.	Impacts similar to Alternative 1 with or without a Hood area diversion. The Hood area diversion would not be constructed until it is determined that it would not significantly affect fishery resources. Changes in operation could benefit fish and aquatic resources by reducing entrainment at the pumps and providing improved flow conditions in Delta channels. Make-up pumping could adversely affect fish and aquatic species through increased entrainment and flow changes in Delta channels. Changes in operations could reduce entrainment at the pumping facilities in the south Delta. Reoperation of reservoirs could potentially degrade water temperature conditions, and increase spawning and rearing mortality. Reduced flow could adversely affect transport of eggs and larvae.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
VEGETATION AND WILDLIFE					
Conditions similar to existing conditions.	Construction of alternative with storage would affect vegetation and wildlife communities by disruption and reduction of habitats, fragmentation and loss of habitat, and permanent loss of wetland and riparian habitat. Similar but reduced impacts in alternative without storage.	Greater adverse impacts on vegetation and wildlife than under Alternative 1, and benefits to some species from the creation of aquatic habitats. Dredging for increased conveyance could reduce the amount of terrestrial habitat that setback levees would affect but would not provide opportunities for the habitat creation that setback levees may offer.	Greater adverse impacts than Alternative 2 resulting from extensive facility construction.	The Ecosystem Restoration and Water Quality Programs would lead to improved habitats under all alternatives. The Water Use Efficiency Program may result in adverse impacts on some habitats by reducing or eliminating surface water runoff. Changes in crop mix as a result of increased efficiencies and water transfers may reduce the amount of wildlife-friendly crops. Beneficial impacts of the Levee System Integrity Suisun Marsh levee component include decreased soil salinity, and increased protection of managed wetlands, tidally influenced lands, and critical waterfowl and terrestrial species habitats from increased flood protection. The Suisun Marsh levee component may result in temporary loss of habitat and displacement of wildlife during levee rehabilitation.	Impacts similar to Alternative 1 without a Hood area diversion. Impacts similar to Alternative 2 with a Hood area diversion.
AGRICULTURAL LAND AND WATER USE					
Shifts in production from field crops and grains to fruits and vegetables are expected.	Agricultural lands, including up to approximately 15,000 acres of prime, statewide important and unique farmlands, would be converted; and potential conflicts between proposed actions and regional land use plans and policies could occur. Some of these effects cannot be avoided. Storage facilities could increase the amount of water available for agricultural production.	Agricultural lands, including up to approximately 19,500 acres of prime, statewide important and unique farmlands would be converted, and potential conflicts between proposed actions and regional land use plans and policies could occur. Some of these effects cannot be avoided. Storage facilities could increase the amount of	Agricultural lands, including up to approximately 21,000 acres of prime, statewide important and unique farmlands, would be converted, and potential conflicts between proposed actions and regional land use plans and policies could occur. Some of these effects cannot be avoided. Storage facilities could increase the amount of	The Ecosystem Restoration Program would convert up to approximately 152,000 acres of prime, statewide important and unique agricultural lands to other uses in the Delta, Sacramento River, and San Joaquin River Regions. These impacts cannot be fully mitigated. Habitat could use additional water supplies. The Water Quality Program would result in improved water quality of irrigation water, higher crop yields, and greater crop selection flexibility. Retirement of lands in the San	Agricultural lands, including prime, statewide important and unique farmlands, ranging from up to approximately 15,000 acres without a Hood area diversion facility to up to 19,500 with a facility, would be converted by storage and conveyance facilities. Storage facilities could increase the amount of water available for agricultural production. Changes in operations may affect agricultural land and water use in the San Joaquin River Region and Other SWP and CVP Service Areas.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
AGRICULTURAL LAND AND WATER USE (continued)					
		water available for agricultural production. Dredging to increase conveyance reduces the amount of land that setback levees require. Dredging spoil disposal could occur on agricultural lands.	water available for agricultural production. Dredging to increase conveyance reduces the amount of land that setback levees require. Dredging spoil disposal could occur on agricultural lands.	Joaquin River Region could affect up to approximately 37,000 acres of agricultural land. The Levee System Integrity Pro-gram would convert up to approximately 35,000 acres of Delta Region farmland but provide great-er protection to farmland from flooding and salinity intrusion.	
AGRICULTURAL ECONOMICS					
The cost of water is expected to continue to increase.	Conversion of farmland may result in adverse economic effects.	Effects similar but more pronounced than Alternative 1. Dredging to increase conveyance could reduce the amount of agricultural land setback levees require and reduce effects on agricultural production.	Effects similar but more pronounced than Alternatives 1 or 2.	The Ecosystem Restoration and Watershed Programs would convert agricultural lands from production, resulting in adverse economic effects on revenue generation, employment, and local spending, but could increase spending related to other activities like hunting and fishing. The Water Quality Program would reduce long-term production costs and generate higher crop yields. Jobs and economic income would be lost in the San Joaquin River Region as lands are retired. Levee System Integrity Program would potentially convert agricultural land from production but would provide increased protection to farmlands, resulting in short-term adverse effects but creating long-term benefits. Water transfers may result in changes to local economies as a result of the sale of water. The type of effect would depend on how revenues from the sale are spent and how local economies are affected because of the transfer of water into	Effects similar to Alternative 1 without a Hood area diversion and effects similar to Alternative 2 with a Hood area diversion. Changes in operations may affect agricultural economics in the San Joaquin River Region and Other SWP and CVP Service Areas. Reductions in water supply could reduce agricultural production and industry, and adversely affect local rural economies. Increases in water supply could benefit the agricultural economy. The Watershed Program would alter land use practices in the upper watershed, which may result in foregone economic opportunities.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
AGRICULTURAL ECONOMICS (continued)					
				or away from a region. The Watershed Program would alter land use practices in the upper watershed, which may result in foregone economic opportunities.	
AGRICULTURAL SOCIAL ISSUES					
Conditions similar to existing conditions.	Job losses could occur as agricultural land is converted to other uses.	Job losses similar to, but more pronounced than, Alternative 1.	Job losses similar to, but more pronounced than, Alternative 1.	The Ecosystem Restoration Program would result in a significant loss of jobs due to the conversion of agricultural lands for habitat restoration. The Water Quality Program could result in a loss of jobs in the San Joaquin River Region as lands are retired. The Water Use Efficiency Program would result in increased yield for farmers but may reduce on-farm jobs associated with irrigation activities. Water transfers may result in the loss of farm worker jobs and other job-related effects in the selling region. The loss of farm worker jobs in the receiving region, if the water is purchased for agricultural use, may be avoided by a transfer.	Effects similar to Alternative 1 without a Hood area diversion and effects similar to Alternative 2 with a Hood area diversion. Changes in operations may affect agricultural social issues in the San Joaquin River Region and Other SWP and CVP Service Areas. Reductions in water supply could reduce agricultural production and industry, and adversely affect local rural economies. Increases in water supply could benefit the agricultural economy by increasing jobs.
URBAN LAND USE					
Continued development trends would cause displacement of some residents, disruption of some existing communities, and local and regional land use plan inconsistencies.	Urban effects could include displaced residents, disruption of existing communities, and inconsistencies with local and regional land use plans.	Effects similar to Alternative 1 but potentially more pronounced.	Effects similar to Alternative 1 but potentially more pronounced than Alternative 1 or 2.	Other programs are expected to result in only negligible effects on urban land uses but could require relocation of major infrastructures.	Effects similar to Alternative 1 without a Hood area diversion. Effects similar to Alternative 2 with a Hood diversion.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
URBAN WATER SUPPLY ECONOMICS					
Water supply reliability would continue to decline, and supply costs would increase.	Water supply costs could increase.	Effects similar to Alternative 1.	Effects similar to Alternative 1.	Other programs are not expected to significantly affect urban economics.	Effects similar to Alternative 1. Changes in operations may affect urban water supply economics in the San Joaquin River Region and Other SWP and CVP Service Areas. Reductions in water supply could result in an adverse effect, depending on the magnitude of reduction
UTILITIES AND PUBLIC SERVICES					
Demand for utilities and public services is expected to increase significantly.	Alternative 1 could increase demand for utilities and public services, and require the relocation of some utility infrastructure components.	Alternative 2 causes effects that are similar to, but more pronounced than, Alternative 1.	Alternative 3 causes effects that are similar to, but more pronounced than, Alternative 2.	The Ecosystem Restoration Program may require the relocation of utility infrastructure components.	Effects similar to Alternative 1 without a Hood area diversion. Effects similar to Alternative 2 with a Hood area diversion.
RECREATION RESOURCES					
Increased demand for recreational opportunities.	Alternative 1 with storage facilities would create new recreational opportunities while displacing some existing opportunities. Barriers in the Delta for fish and flow control would restrict boat travel, and affect marina access and use. These impacts cannot be fully mitigated.	Impacts similar to, but more pronounced than, Alternative 1. Dredging for increased conveyance would not cause the degree of long-term impacts on recreational resources or offer the opportunities for habitat enhancement that setback levee construction may provide.	Impacts similar to Alternative 2. Isolated facility may affect additional recreational facilities.	The Ecosystem Restoration Program could convert existing open space uses in the Delta, Sacramento River, and San Joaquin River Regions. The Levee System Integrity Program improvements may result in beneficial impacts by creating beach slopes associated with new levees and reduced exposure to flooding for existing recreational facilities. Some facilities could be closed or relocated, depending on the location of the levee improvements. Some public fishing areas may be temporarily disrupted during levee rehabilitation for the Suisun Marsh levee component.	Impacts similar to Alternative 1 without a Hood area diversion. Impacts similar to Alternative 2 with a Hood area diversion.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
FLOOD CONTROL					
Property values in the Delta Region would continue to increase, but flood protection levels would slightly decline.	Small potential benefits or costs to flood control would be experienced in the Sacramento River and San Joaquin River Regions. Alternative with storage may provide additional flood control benefits.	Similar to Alternative 1, but greater benefits to flood control in the Delta, Sacramento River, and San Joaquin River Regions from channel improvements, setback levees, and dredging. Dredging for increased conveyance could provide flood control benefits by increasing channel capacity. Dredged spoil disposal over peat soils could prevent oxidation and continued subsidence.	Similar to Alternative 2.	The Ecosystem Restoration, Water Quality, and Levee System Integrity Programs are expected to substantially benefit flood control. The levee system component could protect water quality, structures, and resources in the Delta. The Suisun Marsh levee component could increase channel depth slightly as levees are standardized.	Impacts similar to Alternative 1 without a Hood area diversion. Impacts similar to Alternative 2 with a Hood area diversion.
POWER PRODUCTION AND ENERGY					
The No Action Alternative would affect power and energy resources due to changes in water demand, conveyance, and pumping strategies.	Alternative 1 with storage would increase project energy use as operations change, would decrease the amount of CVP energy available for sale, and would increase the SWP's net energy requirement.	Effects similar to Alternative 1.	Effects similar to Alternative 1.	Other Program elements may affect power production and energy, but would not significantly affect CVP and SWP hydroelectric generating capacity, power production economics, or energy generation.	Effects similar to Alternative 1. Changes in operations may affect power production and energy resources in all regions. Changes in the amount of water exported from the pumping plants in the Delta and changes in operations of storage reservoirs could reduce or increase power production and energy use.
REGIONAL ECONOMICS					
Conditions similar to existing conditions adjusted for population growth.	Adverse effects are expected from loss of agricultural production, and beneficial effects would result from increased recreation and water supply.	Effects similar to those of Alternative 1 but would provide more beneficial recreational effects and water supply.	Effects similar to Alternative 2. In addition, this alternative would provide greater water supply reliability as a result of additional conveyance flexibility.	The Ecosystem Restoration and Levee System Integrity Programs would remove agricultural lands from production, resulting in adverse economic effects.	Effects similar to Alternative 1 without a Hood area diversion, and effects similar to Alternative 2 with a Hood area diversion but with less export water quality improvement.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
CULTURAL RESOURCES					
Additional development could result in impacts on cultural resources.	Disturbance of some cultural resources in all regions is expected except in the Other SWP and CVP Service Areas.	Impacts similar to Alternative 1. Dredging to increase conveyance could reduce the amount of land that setback levees require. Disposal of dredged spoils could affect buried archeological sites.	Impacts similar to Alternative 2 but greater due to construction of isolated facility.	The Ecosystem Restoration Program could adversely affect cultural resources in all regions except the Other SWP and CVP Service Areas. The Levee System Integrity Program could adversely affect cultural resources in the Delta.	Effects similar to Alternative 1 without a Hood area diversion. Effects similar to Alternative 2 with a Hood area diversion.
PUBLIC HEALTH AND ENVIRONMENTAL HAZARDS					
Some adverse impacts on public health and beneficial impacts on environmental hazards are expected.	Construction activities may expose people to hazardous materials and waste. Alternative 1 with storage could benefit firefighting.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	The Ecosystem Restoration, Water Quality, and Levee System Integrity Programs may increase the amount of mosquito breeding habitat. Reduced surface water pollution would reduce health risks and may discourage mosquitoes.	Effects similar to Alternative 1.
VISUAL RESOURCES					
Continued development could result in some visual impacts. Flooding caused by levee failure could be considered an adverse visual impact.	Adverse visual impacts in the Delta from flow control structures. Facilities may obstruct views or be visually obtrusive. Alternative 1 with storage would cause shoreline "ring" effects.	Impacts similar to Alternative 1, additional adverse impacts could occur in the Delta from new conveyance facilities and channel enlargement.	Impacts similar to Alternative 2, with additional impacts caused by the isolated facility.	The Ecosystem Restoration Program would cause short-term construction impacts; but long-term benefits in the Delta; and beneficial and adverse impacts in the Bay, Sacramento River, and San Joaquin River Regions. The Levee System Integrity Program, including the Suisun Marsh levee component, could result in temporary construction and long-term visual impacts in the Delta.	Effects similar to Alternative 1 without a Hood area diversion. Effects similar to Alternative 2 with a Hood area diversion.

Table 3-1. Summary Comparison of Environmental Consequences (continued)

NO ACTION ALTERNATIVE	STORAGE AND CONVEYANCE			OTHER PROGRAMS	PREFERRED PROGRAM ALTERNATIVE AND CHANGES IN OPERATION
	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3		
ENVIRONMENTAL JUSTICE					
Conditions similar to existing conditions.	Some actions could disproportionately affect minority and low-income populations, including migrant workers, as agricultural land is converted to other uses.	Effects similar to Alternative 1.	Effects similar to Alternative 1.	The Ecosystem Restoration Program could disproportionately affect minority and low-income populations, including migrant workers, as agricultural land is converted to other uses. The Levee System Integrity Suisun Marsh levee component could displace some low-income houses on or near the levees during levee rehabilitation.	Effects similar to Alternative 1. Changes in operations may result in environmental justice effects in all regions. Reductions in water supply caused by changes in export water to the San Joaquin River Region or the Other SWP and CVP Service Areas could affect employment of minority and low-income populations. Increases in water supply caused by changes in export water to these regions could result in a beneficial impact.
INDIAN TRUST ASSETS					
Conditions similar to existing conditions.	Some programs could adversely affect the Sacramento River and San Joaquin River Regions.	Effects similar to Alternative 1	Effects similar to Alternative 1.	The Ecosystem Restoration Program could benefit from water or fishing rights.	Effects similar to Alternative 1.

Notes:
CCFB = Clifton Court Forebay.
DMC = Delta-Mendota Canal.
km = Kilometer.
TAF = Thousand acre-feet.

Table 3-2. Summary of Beneficial Impacts Associated with the Preferred Program Alternative

RESOURCE CATEGORY	BENEFICIAL IMPACTS
Water supply and water management	Improvements in water supply are expected through coordinated implementation of Water Use Efficiency, Water Transfer, Water Quality, and Watershed Programs; facilities reoperation and integration; and, if appropriate, additional groundwater and/or surface water storage. Without storage, implementation of water use efficiency measures and transfers would lead to more efficient allocation of existing supplies, addressing some beneficial use needs. The adequacy of these non-storage measures in meeting beneficial use needs is uncertain.
Bay-Delta hydrodynamics and riverine hydraulics	Environmental implications of changes in Bay-Delta hydrodynamics and riverine hydraulics are discussed in other sections of the report in the context of each of the resources affected by the changes.
Water quality	Improved water quality for environmental and urban or agricultural uses from reduced concentrations of many contaminants, including heavy metals, pesticide residues, salts, selenium, pathogens, suspended sediments, total organic carbon, and bromides.
Groundwater resources	In areas undertaking managed conjunctive use programs, long-term increased groundwater levels, reduced pumping-induced subsidence, improved groundwater recharge, locally reduced potential for salt-water intrusion or pumping-induced migration of existing contaminants, and reduced groundwater extraction and reduced long-term lift costs.
Geology and soils	Reduced soil and wind erosion; reduced soil salinity, selenium concentrations, and sediment contamination; decreased soil subsidence; decreased loadings of toxic metals and organic compounds; reduced sediment transport; and reduced potential for seismically induced catastrophic failure of levees.
Noise	Reduced traffic or farm machinery noise associated with land use changes and reduced noise from modifying existing filtration plants, well fields, and pump stations.
Transportation	Roadway improvements, improved traffic flow, and accessibility to newly created wildlife or recreation areas.
Air quality	Decreased emissions from preparing agricultural land, burning fossil fuels, and applying herbicides and pesticides; reduction in fugitive dust production; and reduced crop burning due to crop shifting.
Fisheries and aquatic ecosystems	Reactivated and maintained ecological processes and structures that sustain healthy fish, wildlife, and plant populations; increased abundance and distribution of desired aquatic species; improved streamflow, sediment supply, floodplain connectivity, stream temperature, and biological productivity; and reduced entrainment losses.
Vegetation and wildlife	Net increases in target habitat types, increased protection for natural habitats, reduced toxic organic and inorganic constituents in the food web; increased quality and quantity of wetland and riparian habitats; increased habitat diversity; improved vigor of target populations (including special-status species); and long-term flood protection for existing and restored wetland, riparian, upland, and agricultural habitats.
Agricultural land and water use	Increased certainty in availability of irrigation water, potential for higher value crops and higher grazing productivity because of better water quality, increased property protection and reduction of salt-water intrusion, updated aging and inefficient irrigation systems, and opportunities for water transfers that could make irrigation water available where it may not have been otherwise.

Table 3-2. Summary of Beneficial Impacts Associated with the Preferred Program Alternative (continued)

RESOURCE CATEGORY	BENEFICIAL IMPACTS
Agricultural economics	Protection, long-term savings, increased revenues, and certainty for the agricultural economy.
Agricultural social issues	Some localized increases in agriculture-related employment, protection of agricultural jobs and income from catastrophic loss due to levee failure, and reduced future social dislocations due to water reliability.
Urban land and water use	Greater flood protection for urban centers.
Urban water supply economics	Lower treatment and regulatory costs, improved water quality, relocated water supply intakes, reduced risk of export interruptions caused by levee failure, and increased water supply availability.
Utilities and public services	Reduced risk to electrical or natural gas transmission lines, utility facilities, communication infrastructure, and emergency service centers due to levee failure.
Recreation resources	Increased open space; enhanced or restored wetland or wildlife habitat; improved water quality; increased fishing, hunting, and wildlife viewing opportunities; more recreation-related jobs; increased quality of recreational experience; increased flood protection for camping facilities and boat launches; and increased or improved access to public recreation areas.
Flood control	Easier inspection, maintenance, and repair of the flood control system; improved flood flow conveyance capacities; and reduced incidences of instability and overtopping failures. Additional system-wide flood control benefits from levees improved to the Public Law 84-99 standards and restored floodplains.
Power production and energy	Some increase in hydropower generation if new storage is constructed.
Regional economics	Increases in recreation-related or construction-based economies, increased land values due to flood protection, reduced cost to some water supplies due to increased storage, and some increases in regional revenues and jobs associated with the Storage element.
Cultural resources	Protection of cultural resources that are present on a site purchased and placed under federal ownership.
Public health and environmental hazards	Better water quality, which could reduce opportunities for disease transmission and mosquito breeding habitat; reduced sediment loading in streams and rivers; reduced surface water pollution from agricultural field drainage; improved human safety from flood control and fire management capabilities; and reduced exposure to hazardous materials.
Visual resources	Restored woodland, riparian, and wetland habitats; increases in visual variety to the landscape and possible upgrade of variety class; and improvement or preservation of natural watershed landscape character.
Environmental justice	Short-term restoration-related employment, restored fishing and hunting opportunities for populations that rely on fishing or hunting for subsistence, and reduced threat of death and economic devastation from flooding.
Indian trust assets	Possible improvements in water and fishing rights.

Table 3-3. Summary of Potentially Significant Adverse Avoidable and Unavoidable Impacts Associated with the Preferred Program Alternative

RESOURCE CATEGORY	POTENTIALLY SIGNIFICANT ADVERSE IMPACTS
Water supply and water management	Temporary local water supply interruptions due to turbidity of water during construction of facilities and habitat restoration activities.
Bay-Delta hydrodynamics and riverine hydraulics	None identified; changes in this category may cause effects in other resource categories.
Water quality	Increases in concentrations of bromide, salinity, total dissolved solids, and total organic carbon in the Delta. Increased diversion of water from the Delta, reducing outflow to the Bay and changing Bay salinity. Releases of inorganic or organic suspended solids, or toxic substances into the water column in the Delta. Increased water temperatures and decreased dissolved oxygen concentrations in the Delta. Potential decreased in-stream water quality from reduced in-stream flows associated with new storage facilities.
Groundwater resources	Increased groundwater extractions in the Sacramento Valley, and, to a lesser extent, the San Joaquin Valley, resulting in land subsidence, lower groundwater levels, and higher pumping costs; degradation of groundwater quality; or losses of existing wells.
Geology and soils	Increases in agricultural land soil conversion, local subsidence, soil erosion and soil salinity, construction-related short-term soil erosion, and sediment deposition or soil compaction from heavy equipment. Changes to geomorphology downstream of surface water storage facilities. Ground disturbance, inundation, and shoreline wind and wave erosion.
Noise	Increased noise from heavy construction equipment operation, traffic along major access and haul routes, and vehicle traffic associated with the construction labor force; facility operation of spillways, pumping generating plants, and switchyards; and additional automobile or boat traffic associated with recreational use.
Transportation	Changed traffic flows around construction sites, detoured traffic as new roadways and railroad bridges are constructed, and added construction vehicles to existing traffic levels. Relocated or permanently closed roads. Impeded or blocked patrol or rescue boats in Delta sloughs where fish barriers and flow control structures are installed.
Air quality	Direct, short-term air pollutant emissions during construction activities. Increased emissions associated with fugitive dust, prescribed burning programs, equipment use and cultivation, agricultural chemical use, and crop shifting; and land use changes leading to higher residential, commercial, or recreational uses. Increased use of fossil fuels or other energy resources.
Fisheries and aquatic ecosystems	**Increased non-native species abundance distribution**; blocked access to habitat and potentially altered water quality and flow conditions from placement of barriers in the south Delta. Altered natural ecosystem structure, removal of benthic communities, and creation of conditions that may damage habitat for desired species from dredging activities. Short-term disturbance of existing biological communities and species habitat, mobilized sediments, and input contaminants from construction activities. Reduced streamflow and Delta outflow, changed seasonal flow, water temperature variability, and changes in salinity potentially resulting in reduced habitat abundance, impaired species movement, and increased loss of fish to diversions. Increased entrainment loss of chinook salmon and other species from diversions to new off-stream storage. Reduced frequency and magnitude of net natural flow conditions in the south and central Delta from Delta Cross Channel operations and south Delta barriers. With a Hood area diversion facility, impacts on individual organisms of special-status species from reduced net flow conditions in the Sacramento River downstream of Hood; increased mortality through abrasion, increased predation, and other factors from a new fish screen facility; and delayed migration and reduced spawning success for adult fish.

Bold indicates a potentially significant unavoidable impact.

Table 3-3. Summary of Potentially Significant Adverse Avoidable and Unavoidable Adverse Impacts Associated with the Preferred Program Alternative (continued)

RESOURCE CATEGORY	POTENTIALLY SIGNIFICANT ADVERSE IMPACTS
Vegetation and wildlife	**Fragmentation of existing habitat corridors on small or ephemeral tributaries as a result of inundation by storage reservoirs, potentially blocking the movement and interchange of populations of some wildlife species from upper to lower watershed locations. Loss of habitat and direct impacts on special-status species.** Loss of incidental wetlands and riparian habitats that depend on agricultural water use inefficiencies. Temporary or permanent loss or distur-bance of wetland and riparian communities, wintering waterfowl habitat, portions of rare natural communities and significant natural areas, and quantity or quality of forage for species of concern.
Agricultural land and water use	**Conversion of prime, state-wide important, and unique farmland; and conflicts with local government plans and policies; conflicts with adjacent land uses.**
Urban land and water use	Displacement of existing urban residences, physical disruption or division of established communities, and potential conflicts with local general plans.
Utilities and public services	Relocation or modification of major infrastructure components; increased risk of gas line ruptures during construction.
Recreation resources	Temporary or permanent closure of some recreation areas or facilities; reduced access to recreation facilities and decreased recreation opportunities from changes in reservoir levels. **Loss of terrestrial and on-stream recreation by inundation from reservoirs. Temporary and permanent changes to motorized boating in the Delta from speed limits, channel closures, and installation of flow and fish control barriers.** Decrease in flooded lands suitable for wildlife viewing, hunting, and fishing. Reduced water-contact recreation quality from releases of reservoir cold water.
Flood control	Reduced levee stability and reductions in a channel's flood flow conveyance from barriers in the channel. Increases in seepage, wind-fetch, and wave erosion on landside levee slopes; level of flooding downstream of diversions after removal of Sacramento River tributary diversion structures and other flow obstructions; flood stages along streams. Localized subsidence, resulting in levee slumping or cracking if occurring near levees. Adverse impacts on water quality from use of dredged materials.
Power production and energy	Decrease in amount of energy available for non-project uses, possible air quality and land use impacts from new power plants to replace lost power.
Cultural resources	Impacts on cultural resources from ground-disturbing activities; new construction, excavation, or fill; inundation; altering existing facilities; altering the historic setting of a cultural resource; and introducing elements out of character with a cultural resource site.
Public health and environmental hazards	Increases in mosquito breeding habitat. Increases in risk of groundwater contamination from naturally occurring or spilled hazardous materials and from improper handling of hazardous materials; exposure to hazardous materials and waste from construction; and water quality degradation, resuspension of contaminants, and exposure to hazardous materials from placement of contaminated dredged spoils.
Visual resources	Visual impacts from construction activities, such as vegetation removal, construction of staging areas, night-time glare from construction lights, haul routes, and dust. Presence of constructed linear and obtrusive features (such as dams and spillways), view obstructions, and a bathtub ring effect caused by fluctuating reservoir water levels; new levees and embankments that could visually dominate the surrounding flat, open landscape; and new facilities. Degraded views in visually sensitive areas from Program actions, such as creating borrow pits for gravel replacement, installing fish screens in areas with high visual sensitivity, and altered timber harvesting practices.

Bold indicates a potentially significant unavoidable impact.

Table 3-5. Summary of Potential Program-Induced Growth Impacts Associated with the Preferred Program Alternative

RESOURCE CATEGORY	RESOURCE CATEGORIES THAT MIGHT BE ADVERSELY AFFECTED BY PROGRAM-INDUCED GROWTH
Water supply and water management	Yes
Bay-Delta hydrodynamics and riverine hydraulics	No
Water quality	Yes
Groundwater resources	Yes
Geology and soils	Yes
Noise	Yes
Transportation	Yes
Air quality	Yes
Fisheries and aquatic ecosystems	Yes
Vegetation and wildlife	Yes
Agricultural land and water use	Yes
Agricultural economics	No
Agricultural social issues	No
Urban land and water use	No
Urban water supply economics	No
Utilities and public services	Yes
Recreation resources	Yes
Flood control	Yes
Power production and energy	No
Regional economics	No
Cultural resources	Yes
Public health and environmental hazards	Yes
Visual resources	Yes
Environmental justice	No
Indian trust assets	No

Table 3-6. Summary of Short- and Long-Term Associated Relationships with the Preferred Program Alternative

RESOURCE CATEGORY	RELATIONSHIPS
Water supply and water management	Short-term construction-related impacts may disrupt deliveries. Long-term improvements in supply and reliability.
Bay-Delta hydrodynamics and riverine hydraulics	No relationships identified. Changes in this category may cause impacts on other resources and are addressed in other resource categories.
Water quality	Short-term construction-related impacts. Long-term improvements in water quality.
Groundwater resources	No relationships identified.
Geology and soils	Short-term construction-related and long-term impacts, including ground disturbance, inundation, and changes to geomorphology. Long-term benefits resulting from reduced erosion, salinity, and soil subsidence.
Noise	Short-term noise from construction activities. No long-term increase in noise levels.
Transportation	Short-term construction-related impacts. Long-term adverse impacts, such as relocating or closing roads. Long-term benefits due to road improvements.
Air quality	Short-term construction-related impacts. No long-term effects.
Fisheries and aquatic ecosystems	Short-term construction-related impacts. Flow conveyance facilities and operations could result in short-term impacts. Long-term benefits to fish and aquatic ecosystems.
Vegetation and wildlife	Short-term construction-related impacts. Long-term benefits to vegetation and wildlife resources.
Agricultural land and water use	Long-term benefits from increased irrigation water quality and supply reliability, and from levee protection. Long-term loss of agricultural land used for Program purposes.
Agricultural economics	No relationships identified.
Agricultural social issues	No relationships identified.
Urban land and water use	Short-term construction-related impacts. Long-term benefits from improved water quality and supply reliability.
Urban water supply economics	No relationships identified.
Utilities and public services	Short-term construction-related impacts. Long-term effects associated with increased demand for utilities and public services.
Recreation resources	Short-term construction-related impacts. Long-term benefits from improvements in other environmental resources. Long-term impacts on motorized boating in the Delta Region and possible stream inundation.
Flood control	Short- and long-term benefits from improved flood protection.
Power production and energy	Short-term construction-related impacts. Long-term decrease in power available to other users, requiring replacement power.
Regional economics	Short-term construction-related impacts. No long-term effects.
Cultural resources	Short-term construction-related impacts. Long-term benefits if lands with cultural resources are obtained and receive federal protection.
Public health and environmental hazards	Short-term construction-related impacts. Long-term benefits from improved water quality, flood control, water use efficiency, and fire management. Long-term adverse impacts due to increased mosquito breeding habitat.
Visual resources	Short-term construction-related impacts. Long-term improvements due to improvements in other environmental resources. Long-term adverse effects from constructed linear and obtrusive features and view obstructions.
Environmental justice	Short-term impact from reduction in agricultural lands and fewer opportunities for hunting and fishing. Long-term benefits from increases in agricultural- and recreation-related employment, and from fish and hunting opportunities.
Indian trust assets	Effects appear unlikely but must be determined at a project-specific level.

Table 3-7. Summary of Irreversible and Irretrievable Commitments of Resources Associated with the Preferred Program Alternative

RESOURCE CATEGORY	IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS
Water supply and water management	Displacement of water supplies from one region or use to another region or use.
Bay-Delta hydrodynamics and riverine hydraulics	No commitments identified. Changes in this category may cause impacts to other resources as noted below.
Water quality	No commitments identified.
Groundwater resources	Long-term degradation from overdraft, subsidence, and contamination.
Geology and soils	Ground disturbance, inundation, and changes to downstream geomorphology. Commitments of construction material and land conversion.
Noise	No commitments identified.
Transportation	Displacement of roads.
Air quality	No commitments identified.
Fisheries and aquatic ecosystems	Habitat losses from construction activities, changes in aquatic habitat types.
Vegetation and wildlife	Habitat losses from construction activities, changes in habitat types.
Agricultural land and water use	Conversion of agricultural land to other uses.
Agricultural economics	No commitments identified.
Agricultural social issues	No commitments identified.
Urban land and water use	Commitments of resources, such as construction material, labor, and energy for facilities. Conversion of small amounts of land currently in urban uses to other uses.
Urban water supply economics	Costs and resources committed to a fixed water supply structure are not easily reversed.
Utilities and public services	Increased demand on energy, utility infrastructure, and transmission line capacity.
Recreation resources	Increased recreation access and facilities, changes in boating access and circulation patterns in the Delta Region, and inundation of flowing streams and rivers from enlarging existing storage reservoirs.
Flood control	Improvements in levees, channel conveyance capacity, and other flood control features.
Power production and energy	Commitments of the nonrenewable energy resources needed to construct, implement, and maintain project structures and programs. Increase in project energy use at pumping plants would cause commitments of resources if nonrenewable resources are used to generate electricity for the pumping plants.
Regional economics	No commitments identified.
Cultural resources	Loss of cultural resources. Data recovery techniques ameliorate this loss, but cultural resources cannot be replaced or reproduced once they are lost, regardless of mitigation activities.
Public health and environmental hazards	Changes in amount of mosquito breeding habitat, levels of fuels that contribute to forest fires, and water supply to help fight forest fires.
Visual resources	Changes to visual settings caused by Program actions.
Environmental justice	No commitments identified.
Indian trust assets	No commitments identified.

Table 3-8. Summary of Potentially Significant Adverse Cumulative Impacts

RESOURCE	PROGRAM REGION				
	DELTA	BAY	SACRAMENTO RIVER	SAN JOAQUIN RIVER	OTHER SWP AND CVP SERVICE AREAS
Water supply and water management	✓	✓	✓	✓	✓
Bay-Delta hydrodynamics and riverine hydraulics	✓	✓	✓	✓	
Water quality	✓	✓	✓	✓	✓
Groundwater resources	✓	✓	✓	✓	✓
Geology and soils	✓	✓	✓	✓	
Noise	✓	✓	✓	✓	
Transportation	✓		✓	✓	
Air quality	✓	✓	✓	✓	
Fisheries and aquatic ecosystems	✓	✓	✓	✓	
Vegetation and wildlife	✓	✓	✓	✓	
Agricultural land and water use	✓		✓	✓	
Urban land and water use	✓	✓			
Utilities and public services	✓		✓	✓	
Recreation resources	✓	✓	✓	✓	
Flood control	✓		✓	✓	
Power production and energy	✓	✓	✓	✓	✓
Cultural resources	✓	✓	✓	✓	
Public health and environmental hazards	✓	✓	✓	✓	
Visual resources	✓	✓	✓	✓	